A Transnarrative for the Colony

Astronomy Education and Religion in 19th Century India

Early in the colonial period, the orientalist presence in the administration ensured that traditional subjects and knowledge retained their earlier predominance in the educational sphere. However, by the mid-19th century, as colonialism witnessed its own growing assertion and power, it was the anglicists, and their belief in the superiority of western knowledge, who came to play a more dominant role. This article analyses how the debate between orientalists and aglicists was played out in the sphere of science education. With the evangelical influence too coming to play a key role, this debate took on a more complex note. The colonial transnarrative now equated Christianity with western astronomy and Hinduism with puranic lore. Thus philosophy and pedagogy ably assisted the formulation of colonial education policy, that soon saw a neglect of traditional institutions and subjects.

RAJIVE TIWARI

> When we consider the efforts made to carry out the cultural estrangement so characteristic of the colonial epoch, we realise that nothing has been left to chance and that the total result looked for by colonial domination was indeed to convince the natives that colonialism came to lighten their darkness.
>
> – Frantz Fanon, *The Wretched of the Earth*
>
> The true cure of darkness is the introduction of light. The Hindoos err, because they are ignorant; and their errors have never fairly been laid before them. The communication of our light and knowledge to them, would prove the best remedy for their disorders; and this remedy is proposed, from a full conviction that if judiciously and patiently applied, it would have great and happy effects upon them, effects honourable and advantageous for us.
>
> – Charles Grant[1]

Grant's words [Mahmood 1895: 11] quite eloquently capture the essential motivations behind the British sponsored education in India – a pathological view of Indians combined with a paternalistic concern for their enlightenment and an underlying instinct of self-preservation and enrichment. Grant's statement, which forms a natural starting point for the present work, also illustrates the glorious, almost divine, self-perception that was constructed for the sake of legitimising various colonial projects including the educational one. This paper explores the evolution of astronomy (and more generally, science) education in the 19th century and the important role of religious discourse in this evolution. It looks at the intellectual locations of British administrators and educators relative to the orientalist and anglicist positions in colonial pedagogy and identifies a class of narratives that synthesise the western and eastern modes of knowledge into a single body of work that serves a hegemonic function. I will also touch upon the impact of religion-neutral education that the British policies purported to encourage.

British officials working in India were aware of the significant eroding of the precolonial network of indigenous schools whose curriculum included traditional medicine, mathematics and astronomy. These schools had been financially supported by the local rulers and other elite. In 1765, the British started collecting taxes and this set into motion a series of policy decisions that had a negative impact on the Indian education system. In effect, these policies resulted in a redirecting of funds that were being spent on education, towards ensuring the strengthening of the British rule [Baber 1996:187-190].

Educating Indians

Even as the indigenous education system was being squeezed out of existence, the colonial administrators were grappling with the question, as posed by Grant – would it be easier to rule the Indians if they were left in their "ignorant state"? Grant and some others argued in favour of setting up an educational system not only because "spreading the right knowledge" was a matter of "moral duty" but also because this would help attain the colonialists' primary goal of material progress. According to Grant, British goods didn't find ample demand in the subcontinent due to its economic and cultural backwardness. He believed that both of these deficiencies will be favourably affected by a spread of European knowledge [Mahmood ibid: 16]. The evangelical tone of Grant signifies a religious motif that was to be constantly present in the subsequent discourse on colonial science education.

The plea for educating Indians, however, could not attract enough converts among policy-makers and the decision was made to stay out of the educational sphere. This characterised the first phase of the colonial education policy [Sangwan 1990]. The second phase (1814-1835) identified by Sangwan witnessed an ascendancy of the teaching of traditional Indian texts accompanied by sporadic movements towards initiating medical and surveying education. The dominant sentiment was that European science should be introduced gradually while the primary focus should continue to be on oriental learning [Sharp 1920: 60][2]. The stage for Macaulay's grand entrance on the educational scene had been set by the likes of Bentinck and Raja Rammohan Ray [Spear 1990:125-26] and it marked the beginning of the third phase which witnessed a marked expansion of science, engineering and medical teaching.

Macaulay's famed push for encouraging European modes of thought over indigenous ones in the educational sphere had its critics within the colonial establishment. Informed by hindsight,

Arthur Mayhew, director of public instruction for the Central Provinces, chastised Macaulay (and by association Bentinck) for being oblivious of the historical context that had shaped the students in India [Mayhew 1926:57-61].

According to Mayhew, Macaulay treated everyone without the benefit of a western education as being identically "empty and receptive" towards English education and was not aware of the "Hindu character". He goes on to describe this character as being "…deficient in conative force, almost abnormally developed on the emotional side and intellectually alert to follow a line of thought to its logical conclusion, but strangely unable to criticise the product of its thought or to bring it into line with facts".

Claiming a disinclination towards positivist epistemology among Indians, Mayhew added that had the educators looked, "[T]hey would have detected indifference to the inter-relation of material events, a love of nature combined with apathetic ignorance of its laws, preoccupation with an unseen but very real world, a capacity for finding God everywhere and a reluctance to identify Him essentially with morality, and a catholicity that fails rather attractively to distinguish what is socially useful from what is socially obstructive, or what is intellectually true from what is false".

It's not just the study of nature that Mayhew found Indians unsuited for, he also found Macaulay to be imperceptive in not realising that in order to internalise western ideas of philosophy and politics a western sensibility was necessary which was lacking in Indians. Therefore, the study of European literature was of little use in the Indian intellectual milieu. Mayhew suggested that in order to overcome the extant weakness of the Indian mind the curriculum should have been chosen for its "formative value". It should have consisted of western science and also oriental literature and philosophy.

Anglicists vs Orientalists

Mayhew's position was located somewhere between the anglicist stance which advocated an exclusive teaching of English literature and European sciences with English as the medium of instruction and the orientalist position which favoured a promotion of oriental culture and learning in the educational institutes.[3] With Mayhew's two-pronged approach science could have taught Indians that nature was not to be worshipped but could be understood and overpowered. Exploration of the traditional literature, on the other hand, would have shown the way to social and religious reform. The latter, presumably, strengthening the former.

Mayhew also had political objections to the chosen educational path. He held the view that Macaulay's educational ideas weakened the colonial project. His system of education had produced students who did not look at the west as being a font of superior culture. The students had learned that the process of transplanting western notions of democracy in India would be protracted and painful. They had realised that ideas of equality and liberty had failed to rid colonial India of economic and political racism. Various wars of the recent past, according to Mayhew, had convinced Indian intelligentsia of the material and spiritual vulnerability of the west.

Coming more than 125 years later, Mayhew's criticism of Macaulay is essentially an echo of Grant's views. It is hardly a radical critique as it does not question Macaulay's objectives or his perceptions of India but merely proposes an alternative pedagogical approach. Mayhew is situated well within the tradition of colonial ambivalence towards oriental learning and the perceived monolithic mass theology in India. This tradition provides the context in which curricular transitions in astronomy teaching unfolded. As discussed below many significant pedagogical innovations in the sciences that Mayhew curiously did not discuss in fact used traditional sources of knowledge in the cause of spreading western learning.

There was a broad consensus among education administrators that indigenous learning was devoid of any inherent value. There was little doubt that it needed to be supplanted by western sciences. It was found expedient, however, to continue the teaching of traditional texts in various disciplines. The case of Poona Sanskrit College [Richey:155-56][4] illustrates the advantages that were sought.

Pandit Raghucharya, a locally well-respected figure, was appointed as the first principal of the college. The curriculum consisted of Jyotish (astronomy), Nyay, Dharm Shastra, Vyakaran, Alankar, Ayurveda, Vedant, Yajurveda and Rigveda. According to the education commissioner most of the branches of traditional learning were included to ensure the goodwill and legitimacy of Poona Sanskrit College among the Hindus even though he thought that many of these were perhaps "worse than useless".

Specifically for science education, similar sentiments were expressed in 1824 in a Despatch from Bengal, referring to the education in Calcutta's Sanskrit College and Madarsa:[5] "With respect to the sciences it is worse than a waste of time to employ persons either to teach or to learn them in the state in which they are found in the oriental books" [Sharp 1920: 92].[6]

This statement is a reformulation of Grant's vision for propagating western science, expressed more than 30 years earlier. He believed that "true knowledge of nature", if expressed in simple language, could bring rationality to the Indians. The spread of the European understanding of the universe would uproot the prevailing "absurdity" which is based on religious mythology. European explanations of eclipses would shatter the lore of "Rahu and Ketu". This should lead to a weakening of the whole "fabrick of falsehood". Grant was hopeful that gradually all of the branches of natural philosophy could be introduced and the native "minds informed" and their "error[s] dispelled" [Mahmood 1895:13].

At the time when Poona Sanskrit College was established the commissioner had not brought up the introduction of European science directly but thought it prudent to initiate the shift by stressing in the curriculum those parts of the Sanskrit texts that will "prepare their minds for the gradual reception of more valuable instructions at a future time".

In a similar vein of tactical accommodation the students were required to study mathematics through Indian classical texts at Calcutta's Sanskrit College. The mathematics contained in these texts was deemed to be "very ingenious" albeit inferior to European mathematics. The Sanskrit translation of Hutton's *Mathematics* was also being used in the classroom simultaneously. Thus the students, the argument was, will be exposed to their own science and also to the more advanced western one [Sharp 1920:42].[7] Knowledge of Sanskrit was seen as potentially useful in a formal learning of regional languages which were thought to be the best media for a future teaching and learning of the western sciences on a large scale (ibid).

In the mid-1830s the government was concerned that by focusing on traditional knowledge Poona Sanskrit College was not fulfilling any useful purpose but only "perpetuating prejudices and

false systems of opinions". To improve the situation a path of reform was chosen over a complete shut down of the college on the grounds that it was important to preserve the Sanskrit language. As part of the reform, the teaching of the four Vedas was judged to be without merit and discontinued. Later the governor, Robert Grant, revived the study of "useful" portions of Ayurveda along with Marathi translations of European medical works [Richey 1922:157].[8] This was not exactly the bringing together of two diverse traditions of medicine and synthesising them to create a more complete body of knowledge. The superiority of western medicine was never in question. The function of Ayurveda was simply to provide a sweet coating to make the real medicine palatable for the Indian students.

Experiments in Concurrent Teaching

Despite the various experiments in concurrent teaching of eastern and western sciences, the underlying objective was never lost sight of. The goal of education remained the spread of "the improved arts, science, philosophy and literature of Europe". Science and Philosophy of the east were perceived to be full of serious shortcomings and their content only "valuable for historical and antiquarian purposes". In general, educators who were trying to "ingraft upon portions of Hindu philosophy the germs of …more advanced science" were only granted tentative importance and their work was not seen to be fit for use in mass education. They were considered as being the useful only to the extent of winning confidence of the Indian intellectual elite. This in itself had a pragmatic value since these elite could provide significant help in legitimising British education [Richey 1922: 366].[9]

Driven by the idea of its own intellectual superiority and with a strategic nod to its colonial subject's intellectual tradition the diffusion of western learning was carried forward. Around the middle of the 19th century the instructor of Nyay (law) at Benaras Sanskrit College also taught western logic. Another instructor, Pandit Bapu Deva[10] taught astronomy, mathematics, and mechanics. A report on public instruction in the North-Western Provinces [Richey 1922: 257-58][11] very lyrically captures the initial moments of interaction between the Jyotish scholars of Benaras and European observational astronomy:

> A tolerable telescope has been procured, the Pundit has been able to show to his pupils some of the celestial phenomena which they knew previously by description. …It was interesting to observe the surprise depicted on the faces of a large party of astronomers, congregated on the lofty roof of the Pundit's house in the city, as each one saw the star developed into its crescent form. The moon happened to be close by, presenting an exact repetition of the form upon a large scale, and leaving no room for doubt as to the real cause of the phenomenon. Bapu Deva's pupils appeared in high spirits on the occasion, and quite delighted at being able to give this ocular demonstration of the correctness of their college class books to their less enlightened and not a little astonished friends among the astrologers of the city. We shall, I hope, be able to employ the telescope frequently to demonstrate the accuracy of the astronomical predictions of Europe, by referring to the table of the relative positions of Jupiter's moons, and letting the doubter select, a month or two in advance, the arrangement of any given evening to be tested. I am sorry that the want of appliances prevents at present our bringing the experimental divisions of physical science more prominently forward in the Sanskrit department.

This dramatic event symbolises the embodiment of aspirations of some administrators earlier in the century, namely, a winning over of the native elite to European positivism and thereby admitting the shortcomings in their traditional knowledge. Nonetheless, it was realised that there were works in Sanskrit dealing with medicine which might be helpful to a European physician. Similarly, there were works of astronomy and mathematics which while "may not add new lights to European science" could serve as a starting point for communication between Indians and British officers working in the observatory and eventually lead the 'natives…to adopt the modern improvements in those and other sciences' [Sharp 1920: 24][12]

Social manifestations of religion have played a significant role in the history of scientific development. In one opinion, the stagnation of Indian science after the downfall of Buddhism has been linked to the rise of brahmanism [Prashad 1938: xii]. The British saw the utility of maintaining the caste-divided status quo in the sociology of education. Thus, teaching brahmin students was seen as the best way of diffusing desirable knowledge since by their "birth, as well as by their learning, [they] exercise a powerful influence on the minds of every order of the community". It was hoped that the students would be impressed by the experimental apparatus that demonstrated European science and this would lead to a *union* of European and native learning resulting in "the improved cultivation of science" [Sharp 1920: 87].[13]

This suggestion, made in 1823, was contrary to the dominant attitude of outright pedagogical neglect or derision of Indian scientific sources. A note written in 1839 by J R Colvin, the private secretary to the governor general describes an attempt towards such a union as described above in the teaching of astronomy [Sharp 1920: 174].[14]

Lancelot Wilkinson,[15] the political agent at Bhopal, was a Sanskrit scholar and student of science who had translated Bhaskar's *Siddhant Shiromani*.[16] He started two schools and a Sanskrit college in Sehore in which the medium of instruction was not English but oriental languages, both classical and modern. He had 24 Sanskrit-medium students who were studying higher mathematics and grammar. Their education began with a study of *Siddhant Shiromani*. And then,

> From the Sidhants, which are wholly free from the fables of the Pooranas (Puranas[17]) and which carry the students just to that point to which the Science of Astronomy had been carried in Europe when Copernicus, Newton and Galileo, appeared to point out and to establish that the sun and not the earth was the centre of our system he [Wilkinson] unfolded and explained to the pupils all the principal facts of astronomy, proving and illustrating the further truths of the science upon the basis afforded [by] those works (Siddhants).

Wilkinson, thus, prepared a cadre of pundits who were well versed in the Siddhant and Copernican astronomies. This astronomy curriculum does not ignore or negate the contribution of classical Indian scholars to the field of astronomy but acknowledges its legitimate role in an ever-evolving understanding of the universe. Thus, what was being taught was not eastern or western astronomy but simply an astronomy that had evolved from a siddhantic to a Copernican vision. Students could then locate themselves in an intellectual space defined by a reference frame in which their collective cultural memory was situated and not an exclusively alien referrent made alienating by the hegemonic power equations of the colony. The spirit contained in

Wilkinson's pedagogy, however, was not at odds with colonial self-perceptions. He believed that the popularisation of the Siddhants was the most effective way of spreading "education, civilisation, and truth" in India. Wilkinson believed that "the popular absurdities of the puranic cosmogony will never be abandoned" unless they are shown to be contradicted by the siddhantic astronomy. The use of Siddhants also had more practical benefits for the colonial administration. Wilkinson reported a widespread suspicion and resistance among the populace towards trigonometric surveys conducted by the East India Company. Such resistance in Kota was overcome when Wilkinson cited the importance of terrestrial measurements from the Siddhants to Vaijnath, the royal astronomer, and the "joshi" at the court of Raj Rana Madhu Singh of Kota [Wilkinson 834].

In moving from Bhaskar to Copernicus the curriculum does establish the arrow of progression in astronomical understanding and by association affirms the socio-political progress represented by colonial rule. As Dodson (2002) puts it, "A developmental hierarchy of civilisation is…constructed, in which 'truth' is possessed by those at the top: the possession of this 'truth'…is the mark of modernity and for those civilisations which lack it, the mark of subordination".

Wilkinson's pedagogical experiment was deemed a success, at least by some accounts. Rameshwar Guruji and his three students from the Sanskrit College visited the Scottish missionary schools in Bombay. A teacher at the school commented on the group's scientific disposition and knowledge. He described them as being "both inquisitive and discerning" and "remarkably well instructed in astronomy" and that their example showed how much could be accomplished through the medium of the "native languages" and the help of native knowledge, he might have added [Sharp 1920: 174-175][18]

Despite some favourable reception, Wilkinson's attempts of synthesising knowledge traditions and their mutual enrichment did not engender a broader trend in the education establishment. Instead, a gradual bifurcation of knowledge set in. Traditional scientific literature was safely entombed in the syllabi of Sanskrit and Persian departments whereas the living and growing sciences remained exclusively western.

The situation of English language furnishes a notable contrast. There seemed to be a greater willingness (for reasons of job prospects and prestige, as has often been pointed out) among the students, at least in the larger urban centres like Calcutta, for studying English and forcing it into the curriculum as a compulsory subject was not considered necessary or even desirable for fear of engendering resentment among general population [Sharp 1920:43].[19] Ironically, the teaching of astronomy itself attracted criticism from some orthodox puranic ideologues, if not the general population.

Debates on European Astronomy

Interestingly, it was not the teaching of European astronomy, but Wilkinson's use of Siddhant that invited widespread condemnation from some quarters. Scholars trained at Sehore used the ideas of Siddhant to counter puranic lore. The reaction against this teaching was especially directed at students of Wilkinson, like Bapu Dev Shastri whose widely circulated Shiromani Prakash summarised the ideas of Siddhants. The pundits of Ujjain spoke against the distortion of the "truths" of the Puranas. They opposed the idea of a spherical earth and accused Bapu of heterodoxy. The Mathura pundits took a more sweeping stance and declared the entire field of Jyotish[20] to be a sacrilege. Pundits from Poona and Benaras took a more nuanced stand and admitted the validity of both the Puranas and Siddhant and expressed the belief that their contradictions could be reconciled. A pundit from Satara accepted the truth of Siddhant and rejected the Puranas. He was, however, unhappy about "arresting the sun in his course to make him the centre of the system".

The object of contempt here was not western astronomy but, irrespective of its source, a view of the universe which contradicted the narrative of the Puranas. The protest from the Hindu orthodoxy was not directly anti-colonial in character but was directed against a home-grown body of knowledge in the tradition of what Young describes as "an ongoing dialogue from deep antiquity within India itself between the empirical science of the Siddhants and the transempirical cosmology of the Puranas" [Young…forthcoming]. The rituals that constituted the priestly functions of the pundits were for most part derived from the Puranas and a challenge to the Puranas had the potential of jeopardising the economic and social standing of the pundits. Both the rejection of puranic astronomy and attempts to reconcile puranic and siddhantic theories in Sanskrit scholarship have long and rich histories. As far back as mid-19th century Lalla had argued against a series of puranic assertions and Surya had proposed ways of resolving the contradictions between Puranas and Siddhants in the 16th century [Minkowski 2001]. The socio-political reality of the 19th century India, however, had added a new dimension to the entire debate.

In 1841 the debate between the supporters and detractors of European astronomy was joined by Onkar Bhatt, a jyotish scholar and a teacher in Sehore [Prakash 1999: 64; Young forthcoming].[21] Bhatt published the text, *Bhugolsar*, in which he described western astronomy as being developed on the basis of astronomies of Arabs, Greeks and Indians and the empirical data collected during European global ventures. For Bhatt, this breadth of sources had resulted in a more accurate description of the universe than provided by the Puranas. Bhatt's arguments establish an association between advances in astronomy and colonial expansions. As Prakash puts it, "western knowledge needed western power to achieve mastery over indigenous traditions" [Prakash 1999: 68-69].

Indigenous traditions, however, do not form a monolith but have an ontological texture composed of a variety of strands which do not necessarily form a self-consistent system. In the context of astronomy both the Puranas and the Siddhants have equal claim to be a part of such a tradition. Both these claims are valid despite an undoubted broader influence of the Puranas on the popular Hindu culture and despite an easier fit of the Siddhants into the narrative of western astronomy. While one could talk about western astronomy achieving "mastery" over the Puranas it would be more accurate to characterise Wilkinson's curricular use of the Siddhants as an acknowledgement of the place that one "indigenous tradition" had in the field of astronomy. Wilkinson included the Siddhants in his teaching and this was seen as an attempted coup d'état against the puranic cultural hegemony – an ironic clash between the colonial ambitions and the native power structure.

Another important pedagogical experiment in the use of indigenous scientific sources was carried out by J R Ballantyne, the principal of Benaras Sanskrit College from 1846 to 1862.[22] In his own writings he had expressed his educational objective

to be ultimately the conversion of Hindus to Christianity. Ballantyne considered Wilkinson's pedagogy, which focused on astronomy, to be inadequate in eradicating "Hindu prejudice" and projecting Christianity in a favourable light. Ballantyne favoured a broader use of Indian scholarly tradition towards this end. This perspective led to his writing of the book *Lectures on the Sub-Divisions of Knowledge* or *Vidyachakra* as its Sanskrit version was called. In this work the different areas of human knowledge are presented as being interconnected and at the core of all learning is situated the biblical revelation [Dodson 2002].

Ballantyne's Experiments

In a similar vein, Ballantyne wrote the textbook *Synopsis of Science.* In the dedication he calls the book an "attempt to win the learned Hindus, and through them, the entire people, to a unanimity with modern Europe" [Ballantyne 1856]. Each of the eight parts of the book deals with a specific field of study that range from logic, grammar and physics to biology, world history and theology. According to his introductory remarks, the text of Ballantyne's *Synopsis* is divided into aphorisms similar to Gautam's sutras which describe the different elements of nyaya. In the portions dealing with astronomy and geography Ballantyne evokes the works of Bhaskar and Aryabhatta to get his point regarding western astronomy across but is careful to stay away from discussing their limitations or contradicting them. This is consistent with Ballantyne's intent as laid out in the advertisement for the book – "When the Hindus have only halted at a stage short of that which we ourselves have reached, we should rejoice in being able to present to them our superior knowledge as the legitimate development of what is true in their views, and not in the shape of a contradiction to anything that is erroneous".

In the scientific realm Ballantyne's pedagogical goal was to ultimately point out the errors in Puranas and convince the Indian intelligentsia of the superiority of western science in a manner familiar to his audience. His methodology consisted of using the form of logical proofs found in the Sanskrit text of *Nyaya* and relying on the traditional debating format of *Shastrartha* [Bayly 1996: 224-25]

Ballantyne's approach, thus, consisted of using the *forms* of traditional epistemology and discourse for the purpose of inculcating European learning. In contrast, Wilkinson made use of traditional knowledge itself for the same purpose. Ballantyne's focus on the structural aspects of indigenous learning would explain, for instance, his pedagogical neglect of the 18th century astronomical observatory constructed by Jai Singh in Benaras.[23] And yet, as noted above, Mayhew and many other British observers commonly cited the lack of any tradition of empirical work as a proof of Indians' lack of scientific aptitude.

Ballantyne had critics who did not see the point in his inclusion of indigenous texts and subsequently refuting them with the help of European knowledge. Ballantyne responded by saying that Hindu texts and their philosophy as conveyed to the common people by the pundits play an important role in their beliefs and conduct. Even if these texts were physically destroyed, people's ideas and practices would not change. He believed Hinduism had been ingrained deeply into the minds of the people although most of them had not directly studied the scriptures. Ballantyne held that the pundits had not had a chance to compare their philosophy with any other competing philosophy. Those who are serious students of Sanskrit, he writes, refuse to study English. Ballantyne claimed that his teaching methods had presented and compared both systems in an objective fashion. He acknowledged that there was validity to some parts of the traditional knowledge and in his teaching tried to show the commonalities between eastern and western learning. Ballantyne's discussions were directed to the shortcomings in the Hindu thought which were juxtaposed with the achievements of European science arising out of the same truths that although held by Hindus too had not led to anything fruitful in India [CRED 1859: 322].

The hierarchical relationship between eastern and western bodies of knowledge that was manifested in Ballantyne's teaching was similar to that in Wilkinson's case. The works of both Wilkinson and Ballantyne are reminiscent of the works of some missionaries like Wylie and Martin and other western scholars like Pfizmaier who wrote in the late 19th and early 20th century on Chinese science. These writings also aimed to highlight the "rational" components of Chinese traditional knowledge upon which western modes of thought and religion could be implanted [Blue 1999].

On a theoretical plane the pedagogies and scholarships of Ballantyne and Wilkinson along with the writings on Chinese science mentioned above seem to belong to a broader, a more universal category, a transnarrative. This can be characterised as a narrative which emerges dialectically when a system of knowledge crosses its cultural boundaries and aims to subdue and displace another pre-existing system. A transnarrative upholds selected elements of the latter as being in harmony with the former. It co-opts these elements and strategically deploys them as catalysts in its transformative project and to underscore differences between the two systems. One of the ways in which the effect of a transnarrative differs from a Kuhnian paradigm shift is that the former is part of a larger historical exercise of domination, for instance empire-building in the present case.

Reflecting on the universal nature of science, Michel Paty (1999) makes the case for recognising multiple sources of modern science. The contributions from these sources crystallise into an ever-evolving ontological whole through various modes of transmission across cultural boundaries. The "universality" of science is not to be mistaken for homogeneity, Paty cautions, and the differences among the varied sources ought to be discerned with "empathy" and not chauvinism. By its very nature, the construct of transnarrative cannot afford to adopt Paty's perspective which is antithetical to any imperial reading of science.

The evangelical utility of Ballantyne's work did not go unnoticed in Christian circles. The bishop of Calcutta had visited Benaras and observed students of Ballantyne recite Sanskrit poetry and read and explain Arnott's *Physics* in English. In a letter written after his return to Calcutta the bishop recorded his appreciation for the principal's "condescending scheme of meeting the learned natives in what is true of their scientific studies and carrying them on to the full truths which European scholars have developed". The bishop continues, "I trust it will lead on many of the students to a calm examination of the historical and internal evidences of Christianity, and a reception of its divine doctrine". The bishop hoped that these students would carry the learnt message far and wide once they took up the teaching vocation. He thus saw the Benaras College as being a "seed plot of light and truth in coming ages" [CRED 1859: 296].[24]

The projection of Christianity as a rational, self-consistent and generally superior religion would have been helpful in legitimising the colonial rule as a civilising endeavour. What better way of

achieving this than through the rational legitimacy provided by science, and especially astronomy, education? Due to the primal relationship between astronomy and religion an assault on a traditional astronomy easily becomes an assault on a whole religion and even the broader culture. Different cultural systems start out with a quasi-religious understanding of nature and then generate their own cosmologies and descriptions of the physical universe. The beginnings of evolution of science can be viewed as an increasing divergence, wrought by mutual conflict, between the "religious" and the "scientific" within these traditions. This is not to claim that at any stage the two categories can be neatly characterised by binaries such as subjective/objective or a-rational/rational but simply to acknowledge the existence of an epistemological tension. The Puranas-Siddhants debates and the Galileo-Church conflict are instances of this tension. The transnarrative of scientific progress that was constructed for the colonies by the metropolis highlighted the conflict between the indigenous traditional beliefs and science but suppressed the history of conflict between Christianity and science.[25] This added an ironic twist to missionary work. Fuller (1999) has observed that "While the Jesuits were persecuting Galileo for Copernicanism in Rome, they were also promulgating Copernican doctrine as part of their missionary work in China".

H Stewart Reid, the director of public instruction for the North-Western Provinces, described Ballantyne's class consisting of future village schoolmasters as the most interesting at Benaras College. The curriculum for these students was designed with much care and with an eye on both the ultimate aim of spreading western knowledge and the socio-psychological reality of rural India. Students, who were all brahmins, were taught Sanskrit and English. Their caste along with their knowledge of Sanskrit was to provide these future teachers credibility and a power to influence the community where they would work. The knowledge of English was to introduce these scholars to liberal ideas and make them appreciate the knowledge contained in English books which was not available in Sanskrit ones. The class also studied Ballantyne's works on European science "clothed in the garb which best attracts the attention of the young pundit" and the Hindi texts used in village and tehsil schools [CRED 1859: 387].[26]

Shifts in Education

These handfuls of exceptions notwithstanding, the 19th century saw the exclusive teaching of western astronomy gradually become the norm in most institutions. Agra College was established in 1822. In 1827 the study of geography, astronomy and mathematics from a European perspective was introduced [Sharp 1920: 186].[27]

Even those institutions that were established or endowed by Indians were not untouched by the trend. In 1818, the Benaras Charity School was established with a donation from Jai Narain Ghosal. The reverend D Corrie was appointed to the management. The school received Rs 3,003 per annum from the government. The subjects of study included arithmetic, geography and astronomy (ibid). In 1827, the western teaching of astronomy and mathematics were introduced in Delhi College after the nawab, Islamaid-ud-Dowla, a minister of the king of Awadh, donated Rs 1,70,000 (ibid).

In 1830 an endowed position, the Elphinstone professorship, in mathematics, astronomy and natural philosophy was established at Elphinstone College, Mumbai. The professor was in charge of the observatory and was provided free housing. The monthly salary was Rs 800. A second Elphinstone professor was hired at Rs 600 per month, who taught practical applications of the sciences such as architecture, hydraulics and mechanics. The Hindu College of Pune was established in 1821 by the government; subjects of study included medicine, mathematics and astronomy (ibid).

Towards the second half of the 19th century[28] along with the other sciences, technology and medicine, the teaching of astronomy using exclusively European sources became ubiquitous and deeply entrenched. This trend in the sciences seems to have surpassed the use of western sources in other fields. In a report from 1882-83 the principal of Benaras College, Thibaut lamented that the pundits no longer had the opportunity to learn about western thought and culture in areas other than mathematics and astronomy. The teachers were so convinced of the superiority of western science that they had long been learning and then teaching Euclid, trigonometry and calculus. Many volumes on western mathematics and astronomy had been recently written in Hindi and Sanskrit, several of these by Benaras pundits [Croft 1888: 39].

At the Oriental College of Lahore, a renowned centre of indigenous learning, western science and mathematics were also being taught in the medium of Indian languages. The college had published a large number of translations of European works in Hindi and Urdu. These included works in physics and astronomy [Croft 1888: 40].

According to the director of public instructor's report the Oriental College had made some improvements. As an example the report states that the Ptolemaic system of astronomy had been removed from the curriculum (ibid, p 158). It is curious, however, that Ptolemy had managed to even find a place in a western astronomy curriculum 300 years after the death of Copernicus. Moreover, as noted below, Oriental College, that later evolved into Punjab University, was one of the last major institutions where Bhaskar's *Siddhant Shiromani* was taught. The astronomy of Ptolemy was comparable to that of Bhaskar [Dodson 2002] and the two could have served as starting points of historical interest in a late 19th century astronomy class but it is not clear whether the two sources constituted merely the points of entry or the entire course of study.

Senior English medium students in Benaras studied Whewell's *History of the Physical Sciences* and Faraday's *Lecture on the Non-Metallic Elements* with students doing experiments themselves. Students also helped the maulvi Jalaluddin in translating Ballantyne's Synopsis of Science into Urdu [CRED 1859: 296][29]

The funding for the transition to European astronomy was lagging behind the demands from educators. Reid complained that no new scientific equipment was purchased at Sagar College in the previous year. He felt that a good phantasmagoria lantern fitted with a microscope, astronomical and other slides, and a telescope were needed. The rationale for this was phrased in terms compatible with a quest for winning a religious debate. As Reid put it, "Five minutes spent in looking at the full moon and at Saturn through a good telescope will do more to convince the Hindoo that our solar system is the true one than any mere perusal of treatises on the subject" (ibid, p 396).[30]

Similarly a request was made for procuring a magic lantern and telescope for Sagar School. It was noted that a model electric

telegraph had already been gifted to the school by one Wiggons (ibid, p 509).[31]

In some regions the fascination towards western science had spread beyond the educational institutions and into the local communities. J Garrett of the Wesleyan Mission Society, which established and still managed the government-funded school in Bangalore, reported that the teaching of science and English literature was highly appreciated in the community. People frequently visited the institution. On special occasions "when astronomical diagrams and instructive dissolving views are exhibited, or lectures on natural philosophy delivered, the attendance from the pettah is often greater than can be accommodated" (ibid, p 653).[32]

As the teaching of European astronomy became firmly established across universities and colleges in all parts of the subcontinent, a push for introducing astronomy in school curricula was also taking shape. A committee set up by the University of Calcutta to look into effective ways of teaching the sciences published its report in 1871. J W Blochmann, headmaster of the Calcutta Madarsa, responding to the committee's preliminary suggestions for schools recommended teaching astronomy instead of electricity and magnetism. Blochmann stated that the teaching of astronomy was crucial because "the superstitions to which the natives…still cling [were]…connected with their astrology, horoscopes, influence of stars and comets on the fate of nations, individuals, and c…" and that the eradication of these beliefs should be the fundamental goal of education in India. Introducing astronomy in schools, he added, will enable students to do better in the astronomy courses at the college level [UCRSS 1871: 47].

Similar sentiments were expressed by C A R Browning, the director of public instruction for Awadh. Browning supported the committee's suggestion of expanding the teaching of physical science. He viewed empirical investigation as being instrumental in developing the judgment to distinguish the true from the false. This judgment will be especially helpful for Hindus "at this time, when their semi-religious physical beliefs have received so many shocks", presumably by the spread of the western education (ibid, p 53).

Traditional institutions of Islamic and Hindu education, like Bengal's 'tols' and 'chatushpathis' that were supported by royal families and/or the British government were slow to adopt the western sciences. The Indian Universities Commission described these institutions as being not very sound. There was minimal interaction between the traditional educational centres and the universities. The commission concluded that the English language was the major factor behind the isolation of these schools. Many of the teachers were unable to study or work in the universities since they were not sufficiently proficient in the English language. According to the commission these teachers were indifferent towards the progress of western science although it did report signs of a move away from indifference and towards "cooperation" [RIUC 1902: 2].

As the 19th century drew to an end the use of indigenous sources for teaching astronomy in major institutions had been confined to departments of oriental studies. In 1878 *Siddhant Shiromani* was being used only in Punjab University, which excelled in oriental studies, but not in Calcutta, Bombay or Madras [RCTB 1878: 120]. One of the last attempts to develop a synthesis of traditional and modern epistemologies of astronomy was undertaken at Benaras Hindu university. When the university was established in 1917 the curriculum for the College of Oriental Study's programme for pure Sanskrit learning in the traditional vein prescribed an education along "the most rational lines". For instance, the course in astronomy was to include discussions of the discoveries of western astronomy and use of telescopes and other astronomical equipment [Dar and Somaskandan 1966:413].

The rise in the teaching of astronomy did not necessarily lead to a pedagogy that would cultivate future practising astronomers. Even at a premier institution like university of Calcutta the astronomy curriculum had left much to be desired. In his testimony to the Calcutta University Commission, P Neogi, speaking from his experience as a past student of astronomy there, lamented the lack of an experimental component in the astronomy classes. The students only saw the objects of study like Venus and Jupiter on the blackboard. He noted that India had a rich tradition of astronomical studies which included the extant observatories from "Hindu and Moghul" periods at Benaras, Jaipur, Ujjain and other places "but the present system of teaching astronomy has made the birth of Aryabhatta or a Bhaskara a moral and material impossibility" [RCC 1919: 37].

The influence of the Anglicists trickled down from general committee of public instruction in Calcutta and broadened in the 1820s and 1830s. A proposal to establish a madarsa for Persian and Arabic based-education and an English seminary in Benaras was received by the general committee. The establishing of the seminary was sanctioned but the idea of the madarsa was rejected. In 1835 Bentinck's resolution put an end to stipends for students at the Benaras Sanskrit College on the grounds that the stipends artificially promoted an education of no utility at the expense of "more useful studies". In addition, restrictions were placed on hiring of instructors for the college and printing of oriental texts. By the late 1830s the attendance at the College had significantly reduced [Dodson 2002].

In Calcutta some local elites, led by Raja Rammohan Ray, established the Vidyalaya or the Anglo-Indian College in 1816 [Chaudhuri 1999: 200]. In return for operational control the college received generous support from the general committee including stipends for the students. Natural and experimental philosophy, chemistry and mathematics were among the subjects in the curriculum [Sharp 1920: 183].[33]

The Christian missionaries working in India were displeased with the policy which excluded religious instructions from government institutions. The testimony of the reverend Alexander Duff before the House of Lords in 1853 captured the prevailing sentiment among the missionaries. Duff lauded Bentinck's Anglicist educational vision for "…true literature and true science should henceforth be substituted in place of false literature, false science, and false religion." What remained missing for Duff, however, was that "the only true religion – Christianity" will not take the place of "the false religion which our literature and science will inevitably demolish". In view of the administration's insistence against "*directly* communicating a knowledge of Christianity to its native subjects" the missionary schools were "convey[ing]…European literature, philosophy, and science" and a "thorough knowledge of Christianity" (emphasis in the original). In Duff's view the secular and the religious instructions complemented each other perfectly. The former "would shelter (sic; an ironically misprinted 'shatter', it seems) the huge fabric of popular Hindooism" and the latter would help fill the void that is left behind. The institutions were thus "…striv[ing] to supply the noblest substitute in place of that which has been

demolished, in the form of sound general knowledge and pure evangelical truth" [Mahmood 1895: 71-73].

Religious Ramifications

Duff's displeasure with the colonial policies notwithstanding, these policies, though religion-neutral in their language, did have religious ramifications. The administration's policies regarding the financial support of educational institutions played a significant role in the decline of the study of indigenous sources in science classrooms and helped in a westernisation of the science curriculum. In order to qualify for financial assistance from the administration a school was required to provide a "sound secular instruction" irrespective of any other religious training that students might receive. A report [CRED 1859:197] by H S Reid, director of public instruction of North-Western Provinces, characterises the policy as imposing "perfect neutrality in the matter of religious education". But its impact was very different for schools of different religious affiliations.

Missionary institutions were already teaching, besides the biblical scriptures, subjects that qualified as secular. Thus these institutions could continue with the curriculum already in place and still qualify for the aid. The institutions that would have to modify their curricula were Islamic and Hindu. The report states the anticipated impact of these changes – "In encouraging the teacher of the…(Koran) to impart instruction in arithmetic, history and geography, which will in time exclude the Koran, or at least allow the student less leisure to read it…" The policy thus had the effect of forcing Hindu and Islamic institutions to choose between financial security and curricular autonomy. In contrast, consider the case of missionary schools in Burma which illustrates the relatively favourable treatment that such schools received. The governor general received a request for financial aid for missionary schools in Burma. According to the letter the first objective of the education was "to bring the truths of the Bible to bear upon the conscience of the pupils". The letter goes on to explain how the schools also provide a thorough secular education, including astronomy (with lectures and a good telescope) and natural philosophy (with the largest available air pump and other illustrating apparatus).[34] In response the secretary to the government of India informed the commissioner of Pegu that Rs 2,000 had been sanctioned for the mission[35] [CRED 1859: 617].

On the other hand, Reid's report continues, "…the Sanscrit pundit, who at present teachers (sic) in his shasters (*Shastras*, classical Hindu texts), a false system of astronomy, must, in order to qualify his school for the acceptance of a government grant, satisfy the government inspector that he teaches in the secular department of his school (so to speak) a true system of astronomy, which coming in contact with the *false*, will, in the end *overthrow* it (emphasis added)." Thus the traditional astronomy was allowed to be taught in the hope of its eventual fading away. The rhetoric and diction used here is very similar to more general claims of moral superiority which were used to justify the colonial project.

Conclusion

Situated at a major intersection of science and religion, astronomy offered an attractive site for claiming cultural superiority in the service of colonialism. In 19th century south Asia this was achieved by a clever intermixing of the rational and the a-rational. In the twofold quest for advancing astronomy derived from European sources and promoting Christianity the colonial transnarrative equated Hinduism with the puranic lore and western astronomy with Christianity. If western astronomy could be proved to be more scientific than puranic cosmology then Christianity could claim superiority over Hinduism and Jyotish would be demolished by western astronomy. Innovative strategies were deployed in education that made a calculated use of traditional modes of knowledge to push the public discourse towards this goal.

These philosophical and pedagogical efforts constitute a transnarrative of western science which was ably complemented by educational policies of the colonial administration that claimed to be free of religious bias but in fact helped missionary education at the expense of institutions of oriental learning. The path traversed by astronomy education in 19th century India could thus be viewed as a realisation of Grant's vision for colonialism and an affirmation of its characterisation by Fanon. EPW

Email: Rajivetiwari@bac.edu

Notes

[A version of this paper was presented at the International Congress of History of Science in Beijing, China (July 2005). The author is grateful to Deepak Kumar, Richard Young, Irfan Habib and Dhruv Raina for their time and assistance. The reserch for this work was supported by grants from Belmont Abbey College, North Carolina, US.]

1 Grant's first stay in India was in the military service from 1767 to 1770. He returned to India as a factor in 1773 and stayed until 1790. During the second tenure he made a vast fortune. He became a Member of Parliament in 1802 and was made the chairman of the East India Company in 1805. He was an active member of the Evangelical party, *Clapham Sect and his Observations* were considered the best reply to the arguments of the anti-missionary party.

2 Note, dated July 17, 1823, by Holt Mackenzie.

3 See the cited works by Sharp (1920, chapters 5 and 7) and Mahmood (1895, chapters 10 and 11) for excerpts from contemporary debates on oriental and anglicist perspectives; the cited work by Vasantha (1992) describes the significance of these debates for contemporary science.

4 Extract from the Report on the Poona Sanskrit College (undated, but likely from the late 1830s).

5 The two institutions were established for the teaching of classical oriental texts. Calcutta, Madarsa, the older of the two, was established in 1781 for encouragement of the study of Arabic and Persian and of the Muslim law to prepare officers for the courts. The curriculum included the study of Islamic texts on natural philosophy, astronomy, geometry and arithmetic [Sharp 1920: 30].
Sanskrit College was established in 1824. In 1834 the enrolment at the college was 181, of which 12 attended the Jyotish classes and 13 Ayurveda (report on the Sanskrit College, Calcutta, January 31, 1835, in Sharp p 40).

6 Despatch, dated February 18, 1824, to the governor general in council, Bengal.

7 Report on the Sanskrit College, Calcutta, January 31, 1835.

8 Captain Candy's Report on the Poona Sanskrit College, for the Board of Education, Bombay, 1840.

9 Despatch from the Court of Directors of the East India Company, to the Governor General of India in Council, – (No 49, July 19, 1854).

10 Bapu Deva was a student of Wilkinson whose work is discussed in the following sections.

11 Report on Public Instruction in the North-Western Provinces, 1850-51.

12 Extract of letter, in the Public Department, from the Court of Directors to the Governor-General in Council of Bengal, June 3, 1814 (*Evidence of 1832, App I*, No 5 [329/486]).

13 Letter, dated October 6, 1823, from the general committee of public instruction, Calcutta.

14 Note by J R Colvin, private secretary to the governor general.
15 For details on the life and work of Wilkinson see the cited works by Bayly and Young.
16 A 12th century text in the Siddhant tradition of scholarship by Bhaskar II which is made up of four parts: *Lilavati* (on arithmetic), *Bijaganita* (on algebra) and *Ganitadhyaya* and *Goladhyaya* (on astronomy) [Bose et al 1971: 51].
17 One of the foundational texts of Hinduism compiled between 500 B C E and 500 C E.
18 Note by J R Colvin, private secretary to the governor general.
19 Report on the Sanskrit College, Calcutta, January 31, 1835.
20 Siddhant based astronomy.
21 Prakash and Young have interpreted the significance of this and other similar texts in very different ways. Young's work compares and contrasts Prakash's (1999) postmodern reading with his own emphasis on the objective universality of science.
22 See the cited work by Dodson for a description of Ballantyne's work and, more generally, the intellectual milieu of 19th century Benaras.
23 This and other similar observatories had been extensively described by British officers as early as 1777 [Dharampal 1983: 61-140]
24 Extract from General Supplementary Narrative, No 1, January 4, 1856.
25 Renowned Indian scientist, J C Bose has contrasted the relationship between theology and science in the west with that in India. To support his assertion Bose mentioned the persecutions of Galileo and Bruno for their scientific ideas which contradicted the prevailing religious dogmas of their times. In India, Bose argued, religion based beliefs which had the sanction of the power elite coexisted with unorthodox ideas grounded in rationality and "demonstrable truth". Bose claimed that there was no attempt by the religious authorities to suppress world views which accepted the primacy of logic and observation over faith. This claim is of course rendered untenable by the above cited reactions of puranic scholars to the Siddhant shiromani. Bose praised the spirit of intellectual quest which had spread over the length and breadth of the subcontinent in the past centuries. He, however, warned Indians against resting on the laurels of the past and encouraged building upon the inheritance. He cautioned Indians against accepting the false assertions which proclaim that their ancestors had discovered everything there was to be discovered. Bose praised the scientific honesty of the ancestors who had declared that even the Vedas should be rejected if they are contradicted by the ever unfolding knowledge about physical reality. Bose criticised the gradual decay of this scientific spirit and urged for its revival [Sundaram 1936: 420]. For a discussion of some related issues and how India's scientific past was used to counter-pose an indigenous modernity by the nationalist movement see Prakash (1999: 228-230)
26 Letter from director of public instruction, North-Western Provinces, to secretary to government, North-Western Provinces (1855-56).
27 Analysis of Fisher's Memoir and Supplement.
28 Roughly, the third phase in Sangwan's aforementioned periodisation.
29 Extract from General Supplementary Narrative, No 1, January 4, 1856.
30 As in fn 26.
31 Letter from W Muir, secretary to the government of the North-Western Provinces, to the director of public instruction, 1856.
32 Letter from G Haines, officiating judicial commisioner in Mysore to F Cunningham, secretary to the commissioner for the government of the territories of the Raja of Mysore, July 1856.
33 Supplement to the Memoir of Thomas Fisher.
34 Letter from D L Brayton, secretary, Rangoon Karen Mission to Marquis of Dalhousie, governor general of India, November 1855.
35 Letter from G F Edmonstone, secretary to government of India, to Phayre, commissioner of Pegu, 1856.

References

Baber, Zaheer (1996): *The Science of Empire: Scientific Knowledge, Civilisation, and Colonial Rule in India*, State University of New York Press, Albany.

Ballantyne, James R (1856): *Synopsis of Science, in Sanskrit and English, Reconciled with the Truths to be Found in the Nyaya Philosophy*, Orphan School Press, Mirzapur.

Bayly, C A (1996): *Empire and Information: Intelligence Gathering and Social Communication in India, 1780-1870*, Cambridge University Press, Cambridge.

Blue, Gregory (1999): 'Science(s), Civilisation(s), Historie(s): A Continuing Dialogue with Joseph Needham' in S Irfan Habib and Dhruv Raina (eds), *Situating the History of Science, Dialogues with Joseph Needham*, Oxford University Press, New Delhi.

Bose, D M, S N Sen, B V Subbarayappa (eds) (1971): *A Concise History of Science in India*, Indian National Science Academy, New Delhi.

Chaudhuri, Sukanta (ed) (1999): *Calcutta: The Living City, Volume I*, Oxford University Press (First Published 1990), New Delhi.

CRED (1859): *Correspondence Relating to the Education Despatch of July 19, 1854* in *Papers Relating to Education*, Bengal and North-Western Provinces.

Croft, Alfred (1888): *Review of Education in India in 1886*, Calcutta.

Dar, S L and S Somaskandan (1966): *History of the Benaras Hindu University*, Benaras Hindu University Press, Varanasi.

Dharampal (1983): *Indian Science and Technology in the Eighteenth Century*, Academy of Gandhian Studies, Hyderabad.

Dodson, Michael S (2002): 'Represented for the Pandits: James Ballantyne, 'Useful Knowledge', and Sanskrit Scholarship in Benares College during the Mid-Nineteenth Century', *Modern Asian Studies*, 36, 2, pp 257-98.

Fuller, Steve (1999): 'Prolegomena to a World History of Science' in S Irfan Habib and Dhruv Raina (eds), *Situating the History of Science, Dialogues with Joseph Needham*, Oxford University Press, New Delhi.

Mahmood, Syed (1895): *A History of English Education in India (1781-1893)*, reprinted, 1981, Idarah-I Adabiyat-I Delli, Delhi.

Mayhew, Arthur (1926): *The Education of India*, Faber and Gwyer, London.

Minkowski, Christopher Z (2001): 'The Pandit as Public Intellectual: The Controversy over *virodha* or Inconsistency in the Astronomical Sciences' in Axel Michaels (ed), *The Pandit, Traditional Scholarship in India*, Manohar, New Delhi.

Paty, Michel (1999): 'Universality of Science' in S Irfan Habib and Dhruv Raina (eds), *Situating the History of Science, Dialogues with Joseph Needham*, Oxford University Press, New Delhi.

Prakash, Gyan (1999): *Another Reason: Science and the Imagination of Modern India*, Princeton University Press, Princeton.

Prashad, B (ed) (1938): *The Progress of Science in India during The Past Twenty-five Years*, Indian Science Congress Association, Calcutta.

RCC (1919): *Report of Calcutta University Commission, 1917-1919*, Vol XI, Calcutta.

RCTB (1878): *Report of the Committee Appointed to Examine the Text Books in Use in Indian Schools*, Calcutta.

RIUC (1902): *Report of the Indian Universities Commission*, Simla.

Richey, J A (1922): *Selections from Educational Records, Part II, 1840-1859*, Calcutta.

Sangwan, Satpal (1990): 'Science Education in India under Colonial Constraints, 1792-1857', *Oxford Review of Education*, Vol 16, No 1, pp 81-95.

Sharp, H (1920): *Selections from Educational Records*, Part I, 1781-1839, Calcutta.

Spear, Percival (1990): *A History of India: Volume Two*, Penguin Books, Middlesex.

Sundaram, V A (ed) (1936): *Benares Hindu University 1905 to 1935*, Benares.

UCRSS (1871): *University of Calcutta: Report of the Committee Appointed to Consider the Best Mode of Introducing the Study of Natural and Physical Science into Schools and Colleges in India*, Calcutta.

Vasantha, A (1992): 'Oriental-Occidental Controversy of 1839 and its Impact on Indian Science' in Patrick Petitjean et al (eds), *Science and Empires*, Kluwer Academic Publishers, Dordrecht.

Wilkinson, Lancelot (1834): 'On the Use of the Siddhantas in the Work of Native Education', *The Journal of the Asiatic Society of Bengal*, Vol 3, January-December, pp 504-19.

Young, Richard (forthcoming): 'Receding from Antiquity (II)', (follow-up essay on the 'Receding from Antiquity: Hindu Responses to Science and Christianity on the Margins of Empire, 1800-1850' in Robert E Frykenberg (ed), (2003), Christians and Missionaries in India: Cross-Cultural Communication since 1500, Grand Rapids, MI: Eerdmans and London, Curzon, Routledge, pp 183-222).