

Nalanda and the Pursuit of Science

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The subject of this talk is Nalanda and the pursuit of science, but before I go into that rather complex issue, I must say something about Nalanda itself, since it is still an obscure entity for most people in the world. Since the university is being, right now, re-established under a joint Asian initiative, the fact that Nalanda was a very ancient university is becoming better known. But how does it compare with other old universities in the world?

Well, what is the oldest university in the world? In answering this question, one's mind turns to Bologna, initiated in 1088, to Paris in 1091, and to other old citadels of learning, including of course Oxford University which was established in 1167, and Cambridge in 1209. Where does Nalanda fit into this picture? "Nowhere" is the short answer if we are looking for a university in continuous existence.

Nalanda was violently destroyed in an Afghan attack, led by the ruthless conqueror, Bakhtiyar Khilji, in 1193, shortly after the beginning of Oxford University and shortly before the initiation of Cambridge. Nalanda university, an internationally renowned centre of higher education in India, which was established in the early fifth century, was ending its continuous existence of more than seven hundred years as Oxford and Cambridge were being founded, and even compared with the oldest European university, Bologna, Nalanda was more than six hundred years old, when Bologna was born. Had it not been destroyed and had it managed to survive to our time, Nalanda would be, by a long margin, the oldest university in the world. Another distinguished university, which did not stay in existence continuously either, viz. Al-Azhar

University in Cairo, with which Nalanda is often compared, was established at a time, 970 AD, when Nalanda was already more than five hundred years old.

That is enough vaunting of age (as you know, in India we take age quite seriously), and I hope you have got the point: we are talking about the oldest university in the world by a long margin, that is, if we do not insist on continuous existence. The university is being re-started right now, and since I happen to have the difficult task of chairing its interim governing body, I am finding out how hard it is to re-establish a university after a 800 year hiatus. But we are getting there. This meeting here gives me an opportunity to recollect the pursuit of science in old Nalanda which will inspire and guide our long-run efforts in new Nalanda. I say long run, because mainly for cost reasons - indeed entirely for cost reasons - we cannot start the science faculties immediately (physical and biological sciences cost much more money than the humanities and the social sciences do). The recollection - and more challengingly, assessment - of the scientific tradition in old Nalanda are important right now, partly because we have to start thinking about the long run (even as we try to raise money for initiation and expansion), but also because a scientific attitude and disciplined thought are important for the entire conception of new Nalanda, including the teaching of - and research in - humanities (such as history, languages and linguistics, and comparative religion), as well as the social sciences and the world of practice (such as international relations, management and development, and information technology).

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Let me identify a few questions about the pursuit of science in Nalanda. First, was the old Nalanda sufficiently large to be a factor in whatever pursuit it might have been championing? Was it not merely a drop in an ocean of superstition and ignorance that some people see as the characteristic feature of the Indian old world: you only have to read James Mill's "History of

India," which was obligatory reading for all British civil servants sent off to run the Raj, to see how firm and politically important this conception of the past was in keeping modern India in check.

Well, Nalanda was an old centre of learning that attracted students from many countries in the world, particularly China and Tibet, Korea and Japan, and the rest of Asia, but a few also from as far in the west as Turkey. Nalanda, a residential university, had at its peak 10,000 students, studying various subjects. Chinese students in particular, such as Xuanzang and Yi Jing in the seventh century, wrote extensively on what they saw and what they particularly admired about the educational standards in Nalanda. Incidentally, Nalanda is the only non-Chinese institution in which any Chinese scholar was educated in the history of ancient China.

It is also important to recognise that while Nalanda was very special, it was still a part of a larger tradition of organized higher education that developed in that period in India - in Bihar in particular. In addition to Nalanda, there were in the vicinity other such institutions, such as Vikramshila and Odantapuri. Indeed, Xuanzang wrote about them too, even though he himself studied in Nalanda. There was a larger social culture to which Nalanda belonged, and this is important to recollect in thinking about the tradition of Nalanda.

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The second question to ask is the difficult one about the room for science in what was after all a religious institution. Nalanda was a Buddhist foundation, as were Vikramshila and Odantapuri, and surely the central focus of these institutions were studies of Buddhist philosophy and practice. The point to remember here is that by the nature of the philosophy of Buddha, whose focus of preaching was on enlightenment (the name given to Gautama, viz Buddha, itself means "enlightened"), there was a basic epistemic and ethical curiosity in the tradition of intellectual Buddhism that sought ~~to~~ knowledge in many different fields. Some of the fields were directly related to Buddhist commitments, such as medicine and healthcare; others went

with the development and dissemination of Buddhist culture, such as architecture and sculpture; and still others linked Buddhist intellectual queries with interest in analytical discipline.

Let me comment briefly on the last - not specifically with reference to Nalanda, but as a way of understanding better the Buddhist intellectual impact. One of the connections on which evidence of intellectual connections between China and India is plentiful is the impact of Buddhists in general, and of adherents of Tantric Buddhism in particular, on Chinese mathematics and astronomy in the seventh and eighth centuries, in the Tang period. Yi Jing, who was a student of Nalanda, and to whom I referred earlier, was one of many translators of Tantric texts from Sanskrit into Chinese. Tantrism became a major force in China in the seventh and eighth centuries, and had followers among Chinese intellectuals of the highest standing. Since many Tantric scholars had a deep interest in mathematics (perhaps connected, at least initially, with Tantric fascination with numbers), Tantric mathematicians had a significant influence on Chinese mathematics as well.

Indeed, as Joseph Needham notes, "the most important Tantrist was I-Hsing (+672 to +717), the greatest Chinese astronomer and mathematician of his time." Needham goes on to remark that "this fact alone should give us pause, since it offers a clue to the possible significance of this form of Buddhism for all kinds of observational and experimental sciences." Yi Xing (or I-Hsing, to use Needham's spelling), who was in fact never a student of Nalanda, but belonged to a tradition of which Nalanda was one of the results, was fluent in Sanskrit. (I request the audience to be careful of the distinction between Yi Xing, the mathematician, and Yi Jing, the intellectual trained in Nalanda, who was, among other things, interested in medicine.) As a Buddhist monk, Yi Xing was familiar with the Indian religious literature, but he had acquired a great expertise also on Indian writings on mathematics and astronomy. Despite his own religious connection, it would be a mistake to assume that Yi Xing's mathematical or scientific work was somehow motivated by religious concerns. As a general mathematician who happened to be also a

Tantrist, Yi Xing dealt with a variety of analytical and computational problems, many of which had no particular connection with Tantrism or Buddhism at all. The combinatorial problems tackled by Yi Xing included such classic ones as "calculating the total number of possible situations in chess." Yi Xing was particularly concerned with calendrical calculations, and even constructed, on imperial order, a new calendar for China.

Calendrical studies in which Indian astronomers located in China in the eighth century, along with Yi Xing, were particularly involved, made good use of the progress of trigonometry that had already occurred in India by then (going much beyond the original Greek roots of Indian trigonometry). The movement east of Indian trigonometry to China was a part of a global exchange of ideas that also went West around that time. Indeed, this was also about the time when Indian trigonometry was having a major impact on the Arab world (with widely used Arabic translations of the works of Aryabhata, Varahamihira, Brahmagupta and others), which would later influence European mathematics as well, through the Arabs.

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It is this general intellectual animation, including animation in analytical and scientific questions, that we have to appreciate in interpreting what was going on in old Nalanda. I take the liberty of mentioning here that it is not, of course, unique to Nalanda that as a religious foundation, it nevertheless pursued general intellectual and scientific studies the products of which were of great interest also to people who were not religious, or did not share the religion of the foundations involved. Isaac Newton was religious - indeed very mystically oriented - and while he revolutionized the nature of physics, mathematics and optics, he had no problem with his (and, as it happens, mine and Venky Ramakrishnan's) college¹ (that is Trinity's) the-then religiosity, and did not raise the kind of questions about compatibility that some later Trinity-men, like Henry Sidgwick, would with powerful arguments. The mixture of religion and science

was by no means unique to Nalanda, and to illustrate with another example, it was the Christian university of Padua - one of the earliest of the extant universities in the world - that produced Galileo Galilei. (I was, incidentally, amused when, while receiving an honorary doctorate at Padua, I heard Paul Ricoeur, another recipient, chastising the University of Padua for not standing up sufficiently for Galileo. Ricoeur's arguments were impeccable, though it seemed a little unfair to blame the current Rector of Padua for ^{Padua's} ~~the~~ lack of support for Galileo.) To ^{what} extent such conflict arose in Nalanda, I do not know, but as more documents come to light, we may well find out whether there were tensions in the relation between science and religion in Nalanda. What is, however, absolutely clear is that this Buddhist foundation made much room for the pursuit of analytical and scientific subjects within the campus of Nalanda university.

A third question concerns the subjects that were actually taught in Nalanda. Here we do have a problem, since the documents in Nalanda were indiscriminately burnt by Bakhtiyar and his conquering army. We have to rely therefore of the accounts of students of Nalanda who wrote about what they had seen, and given the reticence of Indians to write about history (a subject of interest in itself), we have to rely mostly on the accounts of outsiders who did not share that reticence, such as Xuangzang and Yi Jing. We do know that among the subjects taught, and on which there was on-going research, were medicine, public health, architecture and sculpture, in addition to religion, history, law and linguistics.

What about mathematics? As it happens the Chinese chroniclers from Nalanda, such as Yi Jing and Xuangzang, were not involved in mathematical studies. Those in China who were deeply involved in Indian mathematics, such as Yi Xing, did not train in Nalanda. There may have been others, in India or China or elsewhere, from Nalanda who were involved in mathematics (a subject that was flourishing ^{in India} in this period) and whose documents have been lost. However, we do know, from Indian accounts, that logic was a subject that was taught in Nalanda, and my guess is that eventually evidence would emerge on this part of the curriculum in Nalanda as well.

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I end with two final remarks. The first one concerns an aspect of the intellectual life of Nalanda that emerges powerfully from the accounts we do actually have about Nalanda from Chinese as well as Indian scholars. The faculty and the students in Nalanda loved to argue, and very often held argumentative encounters. I have discussed elsewhere how deep this argumentativeness is in Indian intellectual history, but I want to add here that it is a part of the scientific tradition as well to seek arguments and defences, refusing to accept positions and claims on grounds of faith. There were plenty of organized argumentative matches going on in Nalanda, and this too fits, in a very general way, into the scientific connections of Nalanda.

The final remark concerns the passion for propagating knowledge and understanding that Nalanda stood for. This was one reason for its keenness to accept students from abroad. Xuangzang as well as Yi Jing mentions the warm welcome they received as they arrived in Nalanda from China. Indeed, Xuangzang used this commitment in an argument with the faculty in Nalanda when he was asked - and pressed - to stay on as a faculty member in Nalanda, after he had completed his studies. He mentioned his commitment, and here he invoked Buddha himself, to spread enlightenment "to all lands." He asked the rhetorical question: "Who would wish to enjoy it alone, and to forget those who are not yet enlightened?" If the seeking of evidence and vindication by critical arguments is part of the tradition of science, so is the commitment to move knowledge and understanding beyond locality. Science has to fight parochialism, and Nalanda was firmly committed to just that.