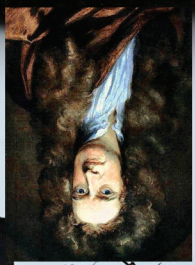
Dissenting Knowledges Pamphlet Series (no. 8)

Is Science Western in Origin?

C K Raju



Multiversity

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Vinay Lal, Founding Editor

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Foreword to the
Dissenting Knowledges Pamphlet Series

Vinay Lal
Founding Editor

This pamphlet series was commenced a little over five years ago as one of several initiatives of a new undertaking known as Multiversity. One of the principal buzz words of our times is 'globalization', and there has been much discussion, in the popular media and equally among academics, of the effects of increasingly porous borders, the massive expansion in the flow of goods, the inter-connectedness of national economies, and the opening up of hitherto closed economies to the principles of 'free trade'. Neither the recent economic recession nor the attention lavished on (Islamic) terrorism can obscure the fact that the dominant story throughout the 1990s was the crumbling of all resistance to the onward march of the market. The mounting literature on globalization has generated numerous clichés, among them the aphorism that 'the world is a global village', and some —albeit few—genuine insights, among them the awareness that the slave trade, which encompassed large parts of the globe, involved numerous middlemen, vastly enriched some slave-owners and entrepreneurs, and respected few borders, can also be construed as a form of globalization. How far one can speak of a globalized world in the age of European imperialism or earlier still when the Indian Ocean trading

system accounted for large chunks of the world's trade is an interesting question. But, for the present, it suffices to say that 'globalization' appears to have captured and even monopolized our imagination, and thus it behooves us to probe further the politics of globalization.

In the contemporary world, as globalization's most ardent advocates are inclined to argue, the exchange of goods and services takes place at a highly accelerated, indeed unprecedented, rate. The internet appears, in some respects, to embody the principles of globalization, particularly if one is hospitable to the argument that the internet democratizes the public sphere and ensures that flows of information are not unidirectional. To many, the promise (and perhaps perils) of globalization are best comprehended by an awareness of the global iconicity of such corporate enterprises as McDonald's and Coca Cola, rock stars such as Madonna and Michael Jackson, and even tee-shirts sporting the numbers of legendary sporting figures such as Michael Jordan. That the United States does not exercise a complete hegemony in such spheres of globalization is amply clear, as globalization's enthusiasts proclaim, from the rapid and widespread proliferation of Japanese pop culture, characterized by animation, Nintendo games, and manga. However, aside from the consideration of how far goods flow freely across borders, there are many more substantive questions to be posed to the proponents of globalization. Why is it that, even if goods flow freely, or relatively more so under present conditions of 'globalization' than at any previous stage in history, nation states appear ever more so determined to police their borders and place restrictions on the mobility of people? Why have walls come up between nation states and why are immigration authorities the world over monitoring and restricting the entry of those deemed 'aliens'? What, to raise

another set of questions, might be the new forms of inequality being generated by globalization? If outsourcing is a palpable instantiation of globalization at work, is it not instructive that it permits the wealthier nations to avail of relatively cheap labor without the presumed hazards of immigrant growth? Have the indentured laborers of the nineteenth century paved the way for the cyber-coolies of the twenty-first century, and do the Harminders and Satinders of our times, masquerading as Harry and Sam, signal the advent of new opportunities or are they only a new class of mediators between the 'developed' and 'developing' worlds?

To understand just what are the ramifications of globalization, we would do well to recall that the principal determinant of modern history has been the regimes of colonialism under which most people lived for a few hundred years. The world as we know it today is understood almost entirely through categories that are largely the product of Western knowledge systems and the academic disciplines that have been charged with codifying, disciplining, organizing, institutionalizing and transmitting knowledge not only about the physical and material world, but about the various social, political, cultural, religious, and legal institutions and practices found among diverse human communities. There is today no more urgent task than understanding the political and epistemological consequences of the imposition of the West upon the entire world, and at the same time endeavoring to work, in myriad ways, towards the decolonization of academic disciplines. The age of exploration and navigation, which commenced in Europe a little over 500 years ago, eventually paved the way for the colonization of the Americas, South and Southeast Asia, the Near East, Polynesia, Africa, and other parts of the world over the course of the next 200-300 years. Historians have drawn

distinctions between plantation colonies, settler colonies, and other colonies with varying degrees of direct and indirect rule. In the Americas and Australia, the indigenous populations were wiped out; in South Africa, black and colored people were confronted with stern subjugation under the Boers; and in the Congo, the same results, that is the extreme brutalization of the native people by the Europeans, were achieved in European-owned rubber plantations. The British in India out-Brahmined the Brahmins, refusing after the late eighteenth century to consort with local populations.

One of the many idioms in which the great game of colonialism survives today is in those numerous discussions that seek to distinguish between "good" and "bad" colonialisms. British imperial historians, such as P. J. Marshall, Denis Judd, and Niall Ferguson, still engage with unbridled enthusiasm in this puerile exercise. It is an indisputable fact, except to those who live in absolute awe of the Enlightenment's categories and have decided that all of our universalisms are to be derived from European thought, that Europe's colonization of the world, when it did not lead to the outright decimation or extermination of native peoples, resulted in the extinction of lifestyles, cultural life forms, and the biological, cultural, and social inheritance of colonized societies. It is imperative to recognize that everywhere the colonizers sought to impose upon the colonized their worldview. Nothing should thus be allowed to obscure the fundamental fact of colonialism and the post-colonial era: every conquest is, in the first instance, a conquest of knowledge. The epistemological imperatives of the colonial state have only in the last few decades begun to receive the critical scrutiny of scholars and commentators. The British in India, to take one well-known example, devoted themselves to an exhaustive study of India's social and intellectual traditions: grammars of

Indian languages were created, translations of scriptural texts were authorized, the legal texts of Hindus and Muslims were codified, the land was mapped and its inhabitants counted, measured, and classified; "communities" were enumerated, marked, and named.

In the present conditions of globalization, Western knowledge systems have sought, largely with success, to gain complete dominance across the globe in nearly all spheres of life. The economists' conceptions of growth, poverty, scarcity, and development, marketed by all the social sciences, have come to predominate everywhere, and the sum total of Western social science has not only been to mire the so-called developing world in ever more acute levels of poverty, but to forestall the possibility of worldviews and lifestyles that do not synchronize with the conception of the "good life" that prevails in the "developed" West. The entire theory of development is predicated on a time-lag: countries that are under-developed or part of the developing world seek to emulate the developed countries, but by the time they have seemingly caught up, the developed countries have gone well beyond to another plane of development. The native, to speak in a different tongue, always arrives late at the destination; indeed, the theory of development condemns the underdeveloped to live not their own lives, but rather to fulfill someone else's conception of life. Colonialism sought to compel the conquered to jettison their past; globalization seeks to hijack their futures. If the native's present is the European's past, the native's future is the European's present.

In all of the voluminous literature on globalization that has emerged in recent years, there is scarcely the recognition that what has been most effectively globalized are the knowledge

systems of the West. And this, as C. K. Raju cogently argues in the present pamphlet, is by no means the only aspect of the problem, since there is a prior question to be asked about how, with respect to what is today termed science, this body of knowledge came to be viewed as having its origins in the West. Raju, a mathematician, philosopher, and historian of science, puts on offer a narrative of "Western science" that, even if it is known in parts, is strikingly at odds with the received version that has become enshrined as the unquestionable truth. On the standard view, as it is encountered in textbooks and scholarly views alike, science first originated among the Greeks, and, many centuries later, developed in Europe in the wake of the Renaissance. Among the "enlightened", if one may put it this way, the most that has been conceded is that the Arabs facilitated the acquisition of Greek knowledge by putting it back into circulation after the Christian Dark Ages had succeeded in obscuring if not obliterating the spirit of inquiry. Indeed, in the aftermath of the terrorist attacks of 11 September 2001 on the US, many liberals have sought to counter the aggressively hostile representations of Muslims and Islamic history with the suggestion that attentiveness to intellectual history would heighten our appreciation of the role played by Arabs in reminding the West of its own intellectual heritage. Where one strand of contemporary Western discourse has turned Muslims into terrorists, another strand tolerates them as handmaidens to Europe's intellectuals.

In his densely argued essay, Raju makes mincemeat of the received view of the Greek origins of science. He speaks of three different phases through which the received narrative was constructed, though his argument is peppered with a great many other critical observations. The story of the Greek origins of science, Raju argues, can nowhere be found 'from

the beginning of the Christian Dark Age to the beginning of the Crusades'. The Greeks had a primitive system of numeration; similarly, since much has been made of the great library of Alexandria, it is imperative to recognize that people other than Greeks produced its books. Raju has elsewhere, in a forthcoming work on Euclid, detailed what exactly it is that we know about Euclid, and what might be the sources of our knowledge about Euclid; and he surprises us with the observation that the sum total of any credible knowledge about someone called 'Euclid' is zero. This is the same 'Euclid' who had become such a globalized and universal figure that even someone like Mohandas Gandhi could effortlessly allude to him in his own quest for truth and precision: as he was to explain to the passengers on board a ship on 25 December 1931, 'It is a self-evident axiom, like the axioms of Euclid, that one cannot have peace unless there is in one an intense longing for peace all round.' Speaking of zero, however, it is well known that the idea of zero (sunya) came to the West from India, mediated by the Arabs; but astronomy and trigonometry also traveled in that direction, even if the West has long persisted in the fiction that these sciences were transmitted to India from the West.

Having established that the story of the transmission of astronomy and geometry from the Greeks to, in effect, the rest of the world during the Crusades cannot be given any credence, Raju argues that, in the period of the Inquisition, a concerted attempt was made to suggest that Europeans independently rediscovered the scientific knowledge. Raju sees in the much-celebrated account of the supposed Copernican revolution, which takes us from a geocentric view of the universe to a heliocentric view, evidence only of a sustained and pernicious hellenocentrism. Though Copernicus used Islamic sources

to reach his conclusions, he failed to acknowledge them. In the final phase of the Western appropriation of scientific knowledge, which continues down to the present day, the entire apparatus of imperialist power was marshaled to press forth the case that accurate scientific knowledge had always been the monopoly of the Europe. Indeed, though Raju does not go so far, this view was bound to prevail in Europe considering that most 'natives' were held to be altogether devoid of the faculty of reasoning. Raju's intent here is also to question the supposition that knowledge in the West has a secular cast. 'Note how theology has crept in', he avers: 'we are asked to believe that science is about deducing the consequences of some "laws" instituted by a god who created the cosmos, as has been made out in the West since Newton.'

Raju's pamphlet, then, takes its place along others in this series that have probed the assumptions underlying the disciplines of economics and anthropology. This pamphlet series, as I noted at the outset, is one of many enterprises to have emerged out of the desire of some scholars, academics, activists, and public intellectuals, who first convened together in Penang, Malaysia in early 2002, to create a new forum, which has been termed "Multiversity", that will at once enable a wholesale but rigorous and searching critique of the frameworks of modern knowledge as well as more ecumenical political and cultural futures. Multiversity's members are committed to the proposition that there needs to be less conversation with the West and more conversation between peoples of the South. Long before India, China, Southeast Asia, and Africa interacted with Europe, they interacted with each other; indeed, the Indian Ocean was a global world, a crossroads, but part of the effect of colonialism has been to obscure these earlier histories. The conception of what constitutes the "world" has

narrowed so considerably that everywhere outside Europe it means knowledge only of one's own country and of the Euro-American world. These, apparently, are the borders of our supposed cosmopolitanism.

There can be no intercultural dialogue or genuine exchange of ideas so long as the terms of the conversation are set exclusively by the West. It is necessary to add that the "multi" in multiversity and multiworld ought to be distinguished from the "multi" in multiculturalism. Having ruthlessly homogenized itself, the United States, the leader of the West, has now had to embrace "multiculturalism" and relentlessly peddles its multiculturalism to the world as a sign of its openness and tolerance. Multiculturalism of the American variety, which is synonymous with consumer choice and white domination (sometimes appearing in the relatively more "benign" form of primus inter pares), is now ironically poised to become a template for societies where the ground reality has always been plural. Multiversity aims at resisting such insidious forms of resurgent colonialism and creating the conditions that would permit dissenting knowledges to flourish. This pamphlet series is, I hope, a step in that direction.

Pamphlets have long had an association with revolutions, movements for social change, and popular demands for reform of government. Many of the most famous works of political dissent in the West originated as pamphlets, among them Tom Paine's Common Sense and Thoreau's On the Duty of Civil Disobedience. Pamphlets played an instrumental role in creating the conditions for change at a time when literacy rates were low and education was the privilege of the few. John Milton's Areopagitica (1644), which bears the subtitle, 'For the Liberty of Unlicensed Printing', suggests the conditions under

which a pamphlet literature germinated and flourished. The American Revolution, it would be no exaggeration to say, was fought with pamphlets as much as with canons, and pamphlets by monarchists, patriots, and rebels flew thick across the Atlantic. History's most famous pamphleteer may have been Marx, and it is striking that Engels, in his eulogy to his friend on 17 March 1883, also remembered him as the author of 'a host of militant pamphlets' – among them two of the most discerning works on the revolutions of 1848, The Class Struggles in France and the Eighteenth Brumaire of Louis Bonaparte. 'They cannot represent themselves', Marx famously wrote in the Eighteenth Brumaire, 'they must be represented'. Marx's passionate defense of the Paris commune of 1871 likewise appeared as a pamphlet, The Civil War in France.

The social history of pamphlets must allow for much else, such as their role in workers' education and the creation of a class of autodidacts. Pamphlets contributed much to the vivid expansion of the public sphere that took place in most societies in the 19th century. Demands for lifting restrictions on the franchise were commonly aired in pamphlets. It is possible to argue that the entry of masses into politics, a process that took place over decades if not a few centuries, and the gradual growth of the franchise in many countries, diminished the appeal of pamphlets. What is certain is that the art of pamphleteering suffered a precipitous decline in the twentieth century, at least in the modern West, and the advent and eventually wide dispersion of other forms of media, commencing with the radio and television and now encompassing technologies that have taken us to an altogether different threshold of what used to be called the 'information revolution', have appeared to obviate the necessity of a pamphlet culture. However, the apparent democratization of the media has also been accompanied by the

relentless concentration of ownership of media in its various forms in a few hands. Perhaps, as in Milton's time, pamphlets may well be the mode of generating new ideas and a culture of dissent in the midst of staggering conformity, untold number of platitudes about 'commitment to excellence', diminishing numbers of serious readers, and the propensity towards what is described as the 'sound bite'. The revival of the pamphlet may be one of the many necessary steps that have to be taken to generate a renewed sense of political urgency.

This pamphlet series seeks, therefore, to furnish intellectuals, scholars, activists, and serious readers, especially those who rebel at the idea that the university should be the sole site of the life of the mind, with a more public and accessible forum of informed and dissenting opinion than is customarily available through scholarly monographs and learned journals. It is hoped that this pamphlet, and others in the series of which it is a part, will be enabling to all who are committed to harvesting theories of knowledge, livelihoods, and forms of political awareness that are calculated to lead to more genuine forms of equality, justice, and plurality. Readers are invited to learn more about the pamphlet series and Multiversity by accessing http://www.multiworld.org and http://vlal.bol.ucla.edu/multiversity/.

University of California, Los Angeles
June 2009

Is Science Western in Origin?

C. K. Raju

Science is a creation of the West—or so the story goes. On this creation story, science began in Hellenic (Greek) culture, and developed in post-renaissance Europe. The rest of the world had no clue.

A typical account is in the "classic" history of mathematics by Rouse Ball:

> The history of mathematics cannot with certainty be traced back to any school or period before...the...Greeks...though all early **races**... knew something of numeration...and...the elements of land-surveying, yet the rules which they possessed were...founded only on... observation and experiment, and were neither deduced from nor did they form part of any science.[1]

He presupposes that (a) deduction is more important to science than observation or experiment (which leads to mere "rules"), and that (b) only the Greek "race" had deduction. Needham avoids the racist part of the explanation; but lapses into an otherwise similar view about Chinese "land-surveying" versus Euclidean geometry.[2]

Unlike political history, it is hard to counter or even *explain* the biases in the history of science. "Information poverty" is a consequence of industrial capitalism—even otherwise-educated people are often scientifically illiterate. Like other illiterates, they uncritically accept and repeat stories from socially "authoritative" sources. Scientists, too, may not be knowledgeable enough, for in practice they rely heavily on authority (again because industrial capitalism breeds excessive specialization). Moreover, scientists focus on technique, and carelessly propagate *any* given history. Consequently, very few can put science together with its history and philosophy and build a counter-story. India is a particularly pathetic case: it has no university department of history and philosophy of science, even 60 years after independence. No wonder, the same old story is perpetuated by current Indian school texts,[3] which mention many Greek names as the originators of mathematics and science. These Greek names are accompanied by images of Caucasian stereotypes. Children get the underlying racist message!

This history was contested during the NDA-led regime,[4] but with such extreme counter-biases that there was a storm of protest. Newspapers then highlighted the "saffronization of history", suggesting that religious fanaticism leads to concocted history as a means of glorification. Certainly this is true, and certainly this

needs to be highlighted. But doesn't this apply to *all* situations where religion is mixed with state power? The Crusades and the Inquisition were periods of marked religious fanaticism in Europe. Did that influence the Western history of science? Singularly enough, the role of religious fanaticism in shaping *this* story seems never to have been assessed. Let us do so here.

The Crusades and the story of the 'Greek' origin of science

The story of the Greek origin of science postdates the Crusades.

Before the Crusades, Christendom was in its "Dark Age". In the 4th c., state and church came together in the Roman empire. The subsequent book-burning edicts of Roman Christian emperors,[5] the burning down of the Great Library of Alexandria by a Christian mob,[6] and the closure of all philosophical schools by Justinian in 529 CE, created a vacuum of secular knowledge in Christendom. Such secular knowledge as existed, prior to the Crusades, was pitiful. The outstanding mathematician of the time was Gerbert of Aurillac (Pope Sylvester II), who wrote a learned tome on the abacus (the kindergarten toy of today). So, it would be fair to say that the abacus represented the acme of mathematical knowledge in pre-Crusade Christendom.

Ironically, this Christian Dark Age coincided with the Islamic Golden Age. In sharp contrast to the book-burning traditions of Christendom, the Abbasid Caliphate had set up the Baghdad House of Wisdom by the early 9th c. CE. This led to such an explosion in the demand for books that, along the lines of the *hadith*

to seek knowledge even from China, paper-making techniques were imported from China to set up a paper factory in Baghdad, which had a flourishing book bazaar. Libraries proliferated across the Islamic world, and the 10th c. Umayyad Caliphate in Cordoba had a library, catalogued in 44 volumes, of over 600,000 tomes.[7]

Quite naturally, prior to the Crusades, Europeans regarded the Arabs as knowledgeable. To learn mathematics, Gerbert turned to the Islamic Arabs in Cordoba, not to Greek Christian sources in Byzantium. (Hence, the numerals he imported are today known as "Arabic numerals".) So, the story of the Greek origins of all science did not exist in Europe prior to the Crusades.

The Crusades as "barbarian incursions"

How did this story emerge during the Crusades?

Apart from the contrast in knowledge, there was also the striking contrast in wealth between Christendom and Islamic Arabs. Charlemagne's emissaries were dazzled by the splendour of Haroun al Rashid's court, and the gifts they brought back were avidly imitated, and became models of Carolingian art. The magnificence of Cordoba can still be guessed from the remains. The only new point here is this. Describing the Crusades as religiously motivated is like describing the Iraq war as morally motivated: it does not allow us to make sense of the events that took place.

The Crusades were undoubtedly a time of great religious hysteria, which no doubt motivated many people to participate. But the church leaders who stoked this religious hysteria, did they have

more material motives? If so, the contrast between Arab wealth and European poverty must be regarded as a key cause of the Crusades.

An increase in church wealth and power was the direct consequence of the Crusades, which also helped to expand church influence into wealthier Islamic areas. This, then, was the real motive of the Crusades, for political acts are best judged by the consequences—and not by professed intentions. In fact, to judge from the consequences, some diabolical planning went into the Crusades, for, with each Crusade, won or lost, church wealth and power increased. Also, the church kept trying to expand its influence in Islamic areas even after the military failure of the later Crusades.

From Toynbee's historical perspective, then, the Crusades are best described as "barbarian incursions". The Arabs were the centre, and Europe was the periphery, trying to break in. The conditions for these barbarian incursions were established with the disintegration of the Caliphate of Cordoba into small *taifas* (petty kingdoms) after a disastrous battle for succession around 1010. The weakness of these *taifas* made them easy targets. Toledo was one such *taifa* which now boasted the best library in Europe. During the proto-Crusades—probes which preceded the "official" Crusades—Toledo and its magnificent library came under Christian control in 1085.

The Toledo translations and their justification

This library, instead of being burnt, was preserved. By now, the usefulness of non-Bible knowledge had been accepted at the highest levels of the church—we saw how Gerbert imported Arabic numerals. The state agreed: King Otto sent emissaries to Cordoba to gather knowledge. During the Crusades, secular knowledge was gathered with great difficulty by spies like Adelard of Bath (who travelled disguised as a Muslim student and who was perhaps the first to translate the *Elements* from Arabic to Latin). If the dark age of Christendom began with the burning down of the Great Library of Alexandria, it ended with the mass translation of the Toledo library, from Arabic to Latin, starting in 1125.[8]

The church now needed knowledge for another reason. Pagan Europe was converted to Christianity mainly by force. But force would not work with the Islamic Arabs who were stronger. For the novel strategy of conversion *without* force, the church needed knowledge. But how could the church square this sudden thirst for knowledge with its earlier calls for book-burning? At the peak of religious fanaticism how could the church publicly justify acquiring knowledge from the hated Islamic enemy?

Ever since state and church first came together, at the time of Constantine, Eusebius, a church historian, had initiated the program of distorting history to promote church interests. His successor Orosius, in his *History Against the Pagans*, made it amply clear that history was just another tool of soft power in the church's armory. This technology of falsehood was now applied to "manage" common perceptions. The story-line was simple: it was the Greeks who did it. On this story, during the 600 years of the

Christian Dark Age, all that the Arabs did was to preserve Greek works, the rightful inheritors of which were the chosen people, the Christians of Europe.

It was this fantastic justification—characterizing Arabs as mere carriers of knowledge, and Greeks as the creative fount—which made the ("Greek") knowledge in Arabic books theologically acceptable in Europe, and enabled the translated Arabic books to be used as university texts for centuries in Europe.

Arabs did not quite accept this story. In the 9th c., when the Arabs built the Bayt al Hikma (House of Wisdom) in Baghdad, they gathered knowledge from all over the world, including India, Persia and China. They certainly did *not* restrict themselves to Greek sources. The actions speak for themselves: the Arabs did not then think that science was primarily a Greek invention.

Greek and Roman difficulties with elementary arithmetic

The non-textual evidence provides a good reason for this. More than deduction, science is based on quantitative *calculation*. But the Greeks lacked basic arithmetic skills needed for calculation. The early Greek (Attic) system of representing numbers was worse even than Roman numerals. (We will use Roman numerals in the following examples, since they are better known.) Greek/Roman numerals are inefficient for two reasons. First they are clumsy: the small number 1788 requires 12 symbols, and is written as MDCCLXXXVIII.

This system is hopeless for large numbers, such as 10^{53}, which the Buddha was asked to name (by an opponent, who sought to test his knowledge). The world might come to an end before one finishes writing down this number in Roman numerals!

The unavoidable inference is this: the Greeks and Romans used this primitive system of numeration just because they never encountered large numbers, and never did the complex calculations required for astronomy and science. Conversely, when the need for such complex calculations arose in Europe, first among the Florentine merchants, and then among European navigators, Roman numerals were abandoned in favour of "Arabic numerals".

Can one get around this inefficiency by inventing names for larger numbers? No. Roman numerals are *structurally* inefficient: even the simplest sum needs an abacus. Try XIV + XVIII! To add two numbers, say 1788 + 1832, one would first represent these numbers on the Roman abacus, using counters. For 1788, one would need 3 counters for I, 1 counter for V, 1 for the L, and so on, making a total of 12 counters. Similarly, for 1832 (MDCCCXXXII) we need 10 counters. Pooling together these 22 counters, one now simplifies as follows. The 5 counters for I are replaced by 1 counter for V; the 2 counters for V are replaced by 1 counter for X; of the 7 counters for X that we now have, 5 are replaced by an L and 2 stay as they are. The two L's are now replaced by a C; 5 C's are replaced by a D; and 2 of the 3 D's are replaced by an M. We now arrange the counters, starting with the M, to get MMMDCXX which is the same thing as 3620. So this simple arithmetic problem which any child could do mentally today in a jiffy becomes a tedious task with Greek and Roman numerals.

Multiplication is more difficult. Shakespeare's clown knows that 11 sheep give 28 pounds of wool which sells for a guinea. How much would he get for the wool from 1500 sheep? He "cannot do't without counters".[9] (We leave out subtraction and division as too difficult to explain!) The Greeks obviously could not have done science without properly knowing how to add and multiply.

The Baghdad House of Wisdom and transmission TO Greek texts

Therefore, while the Arabs valued the "theology of Aristotle",[10] for arithmetic, they turned to India, not to Greece. Arabs imported various Indian arithmetic texts, notably those of Aryabhata, Brahmagupta and Mahavira. These were digested and transcreated in the Bayt al Hikma, by al Khwarizmi, and became famous as Algorismus after his Latinized name. These "Arabic numerals" use the place-value system. That makes it easy to represent large numbers. It also makes arithmetic very easy through "algorithms"—the elementary techniques of addition, subtraction, multiplication, and division that everyone today learns in school.

Although the Baghdad House of Wisdom was a landmark, it only accelerated a well-established tradition. From the very beginning of the Abbasid Caliphate, the legendary Barmakids (from barmak = *pramukh*) of Persian-Buddhist origin, who were *vazir*-s to the Abbasid Khalifa-s, had already instituted this system of importing knowledge from Persia and India.

The Barmakids, in turn, were only continuing the earlier Persian tradition of gathering knowledge, and translating it into Persian

(Pahlavi). This continuity is manifest through texts, such as the Indian *Pancatantra*, which were translated into Arabic not from Sanskrit but from Pahlavi, along with other Persian books, such as the "Arabian Nights" and the astronomy text called the *Almagest*. Noticeably, the *Almagest* came to Baghdad from Persia, not Byzantium. Had this text then existed in Byzantium, it could easily have been sourced from there, for Byzantium was then an abject tributary of Baghdad.

In contrast to the extreme literal translations at Toledo, the Baghdad scholars despised blind copying (*naql*). Indeed, the House of Wisdom aimed to promote the exact opposite (*aql*, intelligent theology). So, they digested the substance and rewrote the text. The focus was on practical benefits, and not on maintaining historical sanctity; so, such texts accretively incorporated *all* knowledge then available to the "translator". For example, the "Arabian Nights" acquired characters like Haroun al Rashid, and the Barmakids.

Further, whether or not any information flowed from Byzantium to Baghdad, we have solid evidence that information flowed *from* Baghdad *to* Byzantium. Thus, the *Pancatantra* was further translated from Arabic into Greek.[11] This is an important example, because, unlike the origin of a scientific theory, which can be obfuscated, the Indian origin of the *Pancatantra* is unquestionable. Therefore, the fact of this Arabic-to-Greek translation firmly establishes that knowledge flowed *from* Arabic *to* Greek texts. That was the natural direction of information flow, given the huge investment in knowledge that was made in Baghdad.[12]

Recognizing that *9th c. or later Greek texts are derived, not "original"*, unhinges the entire strategy of glorifying the Greeks.

The earlier story of scientific knowledge

Let us go a step further into the past. Initially, many texts in Baghdad came from Persia where the same practice of collecting world-knowledge was followed. But, even in Persia, knowledge of astronomy (translated as *Zij-i-Shahryar*) was imported from India.

This is another striking fact. The Persian king, Khusrau I, attached great significance to the enterprise of knowledge gathering. However, his Vizier went to India, not to Athens or Alexandria or Constantinople. This despite the fact that the very best Hellenic sources were directly available to Khusrau: the leading philosopher of the Roman empire, the people best acquainted with Hellenic knowledge, were physically present in his court, having sought refuge in Persia to escape the edicts of Justinian.

Had any secular knowledge remained in the Roman empire, Khusrau could have easily got it, for the Roman king, Justinian, was paying him a hefty tribute for non-aggression. If Christian historians of the time are to be believed, Khusrau even included a clause[13] regarding the treatment of philosophers, as part of the treaty with Justinian! If Khusrau nevertheless imported mathematics and astronomy from India, the available Greek tradition of mathematics and astronomy *must* have been inadequate and unsatisfactory. A later source, the 7th c. Syrian Christian, Severus Sebokht,[14] although naturally partial to Greeks, nevertheless confirms this relative assessment of Indian and Greek astronomy, and attributes the superiority of Indian astronomy to the superior Indian methods of calculation.

To recapitulate, from the beginning of the Christian Dark Age to the beginning of the Crusades, the story of the Greek origins of science was nowhere to be found. The Greeks could not have developed any science with their primitive system of numeration. They lacked the requisite quantitative skills—until Indian arithmetic through Arabic texts diffused among the Byzantine Greeks, from the 9th c.

The story of a Greek origin of Arabic books, thus, appropriated to Europe all pre-Crusade knowledge which the Arabs and Persians had gathered from *all over the world*, and developed further.

The Great Library of Alexandria and its Origin

Clearly, this story of the Hellenic origin of all worthwhile secular knowledge is contrary to commonsense: why should all knowledge have originated in one place? Myth proceeds by linking story to story, and the Hellenic story is linked to the Great Library of Alexandria—most Greek names associated with science are today traced to Alexandria (in Africa).

But what was the *source* of the Alexandrian library? Over the centuries, no one seems to have asked this question, thereby promoting the belief—as an implicit postulate—that this library was of Greek origin. This is the other big lie on which the story of a Hellenistic origin of science was concocted. For what is the evidence for such a belief?

In fact, all the available evidence points in the opposite direction. The number of volumes in the Alexandrian library reportedly ex-

ceeded half a million. The tiny Greek city states, with small populations of a few thousand citizens, could hardly have produced books on this scale. The book technology then involved papyrus: a material made in Egypt, expensive to import, and even more expensive to maintain. Just the cost of the papyrus would have been staggering. Besides, how did they support the vast leisured class needed to produce and maintain books in such numbers? The Greek city-states were constantly engaged in petty warfare, so that every able-bodied person was conscripted, and very little leisure was available.

Texts corroborate these straightforward non-textual considerations. Strabo states[15] that Aristotle was the first "man" to have a library. Setting aside Strabo's peculiar notion of "personhood", the remark does tell us that *prior to Alexander, there was no culture of books in Greece*.

Plato points out that *prior to the Great Library there was no culture of science in Greece*. At his trial, Socrates was charged with a great crime—the crime of declaring the moon to be a clod of earth.[16] A death penalty was demanded just on that ground—that he did not worship the moon as a divinity! Socrates denied he was Anaxagoras. Clearly, the Greeks customarily put to death anyone who dared to do anything remotely scientific in astronomy. This situation persisted until *after* the time of Alexander, for Aristotle too ran away from Athens for the same reason, viz., that he feared being put to death for dabbling in scientific books! How could such an intolerant and superstitious culture have produced any science?

Herodotus, like other Greeks, travelled to Egypt for higher learning. He confirms that the Greeks aped the Egyptians, and that Greek gods were mostly imitations of Egyptian gods.[17] (The Ionian Greeks, being a Persian colony, preferred to mimic Persian customs.) Alexander too paid obeisance to the Egyptian gods at Memphis. Alexandria itself was better known as the city of Serapis, a dual-purpose god originating from the Egyptian gods Osiris and Apis.

So, Greeks lacked science until the time of Alexander. On the other hand, the first catalogue of books in the Great Library was prepared by Callimachus at the beginning of Ptolemy II's reign. So, the main corpus of the library was already in place by then. Such a vast library could hardly have been produced, *in situ*, during Ptolemy I's reign. So, the unavoidable conclusion is that the Alexandrian library did *not* have a Greek origin.

Only one serious explanation fits the facts: *the books in the Alexandrian library were produced by someone else, and Alexander obtained them as part of his war booty*. This is recognizably similar to the way the Toledo library was obtained—as war booty—by the proto-Crusaders. The older civilizations, such as Egypt, Persia, and Babylon, had been around for long enough, and had ample economic surplus to have produced books on the scale required for the Alexandrian library.

The Zoroastrian Book of Nativities records that Alexander got books from Darius' treasury translated, and burnt the originals. This part of Alexander's booty, being bulky, it is natural to suppose that only a small part of it would have been transported back to Greece, to his mentor, Aristotle. But the bulk of the books were left

behind in Alexandria. There they lay neglected by Ptolemy I who was preoccupied with his petty wars. It was only at the beginning of Ptolemy II's reign that someone remembered this neglected treasure, and had it catalogued. Over time, vigorous attempts were made to expand the library by banning the export of papyrus, by forcibly acquiring all books entering the kingdom etc. Numerous books from Egypt and elsewhere were naturally added to this library. Some were presumably translated into Greek.

This explanation fits into the general theory[18] that information preferentially flows *towards* the military conqueror. The idea that military conquerors at the head of vast hordes, like Alexander or Hulegu, spread culture and science is a sorry attempt at glorification aimed at uncritical and gullible people. In both cases, these military conquerors spread destruction, but acquired culture, exactly as happened during the first Crusade. (The Greeks, too, were then on the periphery of the Persian empire, so Alexander's conquests were just another case of such "barbarian incursions".)

The textual sources of the post-Crusade story

How did people hang on for so many centuries to the absurd theory of the Hellenic origins of science? Of course, the theory suited the priests who so dominated Western society for centuries. But, historiographically speaking, a key methodology was used to establish this implanted myth as theory. The methodology was to rely *entirely* on textual evidence. This was seen as culturally correct in a scriptural culture: "if it is written it must be true"!

The textual sources for this history are very late: *at least* a thousand years after the purported fact. The Latin texts are obviously all post-Crusade texts derived from the Arabic. The Byzantine Greek texts (from Istanbul) are often from even later (as we shall see in the case of Copernicus). Even the earlier texts post-date the Baghdad library. By no stretch of imagination can these texts be construed as "original" Greek sources that they are often passed off as. Only a process of wild speculation connects these late texts to purported "originals" in Alexandria, from a thousand years earlier. Non-textual evidence is contrary to these speculations. There is no continuous tradition of intervening texts connecting the actual texts to the conjectured "originals". Most likely, the supposed "original" texts never existed, but even if they did, they cannot be reconstructed from the later-day texts which are accretive: a scientific text had to be practically useful to survive, therefore it would be constantly updated.

For example, a navigator would record the *current* pole star, which is the matter of practical concern. (Due to a phenomenon known as the precession of the equinoxes, the axis of the earth precesses, like a spinning top. Therefore, the axis points to different points in the sky at different times, so the pole star changes with the epoch.) And, indeed, the current pole star heads the list found in the "original" *Almagest* text. However, the text is attributed to a Claudius Ptolemy of the 2nd c., when this star pointed 12^{o} away from the north pole! From the 2nd through the 9th c. its companion star [Ursa Minor β], an equally bright star, better indicated north![19]

Obviously, this sort of textual evidence from late and accretive sources is evidence of very poor quality. On the other hand, the priests, who wrote history based on such texts, were masters in the art of manipulating poor-quality textual evidence, and using such manipulation to promote the most absurd beliefs contrary to elementary common sense.

Let us take a few concrete examples to show how this worked.

Euclid: Geometry and Mathematics

We saw that even Needham thought that real mathematics and science began with deduction, a tradition supposedly started by Euclid.

But what exactly do we know about Euclid? One authority, the late David Fowler, gave a succinct answer: "Nothing".[20] However, other historians insist that the right answer is "almost nothing". Let us decide between these two possibilities!

Euclid supposedly wrote a key geometry text called the *Elements*. Naturally, people suppose (on the strength of the story) that the name "Euclid" is found in front of manuscripts of the *Elements*. But that is not true. As Thomas Heath, the leading authority on "Euclid", points out, "All our Greek texts of the *Elements* up to a century ago…purport in their titles to be either 'from the edition of Theon'…or 'from the lectures of Theon' ".[21] The name "Euclides" is associated with the *Elements* only in post-Crusade Latin texts of the *Elements*. This is derived from the Arabic "uclides" which means "key to geometry"! (The Toledo translations were done by

two sets of people through an intermediate language: the Mozarabs who knew Arabic but not the subject nor any Latin, and the "official" translator who knew Latin, but not the subject nor the original language. Howlers, therefore, were common.[22])

Thus, the "almost nothing" that we supposedly know about "Euclid" is based on a passage from *another* text: the *Commentary on the Elements* by Proclus. As Heath further points out, Greek commentaries "commonly speak of the writer of the *Elements* instead of using his name".[23] This particular isolated passage[24] not only names Euclid, but also attributes to him a philosophy of mathematics that is strikingly at variance with the Neoplatonic philosophy that the rest of Proclus' book advocates. It should be recalled that Neoplatonic philosophy was declared heretical and cursed by the church. However, the new philosophy of "irrefragable demonstration" attributed to Euclid in this passage fitted remarkably well with post-Crusade Christian theology and its needs.

As a source for Euclid, the passage is not reliable, for it states that no earlier historian of geometry mentioned Euclid during the 800 years that separate Proclus from the purported date of Euclid!

The passage is an interpolation. First the manuscript of Proclus' book is on paper, and hence dates to after the 13th c., when paper became common in Europe, some eight centuries after Proclus. Second, it claims that Archimedes cites Euclid. Such a citation (of the *Elements*, not Euclid) is indeed found in a manuscript attributed to Archimedes (*Sphere and the Cylinder*), but actually coming from some 1800 years after his date. This citation has been regarded as spurious for two reasons. First, such citations were not the custom in Archimedes' time. Second, the citation is isolated, though there

are numerous opportunities in the book where similar citations could have been made.

Since the author of the "Proclus" passage knew of this late interpolation in the "Archimedes" manuscript, the "Proclus" passage must be a *later* interpolation.

People seem unaware that it is on this sort of "evidence" from late and accretive texts that the grand claims about Euclid derive. Understandably, the evidence for lesser names (or their linkages to the works they supposedly authored) is much weaker.

At about this point, many people jump up to say that they don't really care about the person Euclid, and it is the book called the *Elements* which ultimately matters. This is a facile escape route.

If Euclid is a concoction, the *Elements* might have had a non-Hellenic origin in the mystery geometry of pre-Alexandrian Egypt. In that case, it could be better understood as *contrary* to post-Crusade Christian rational theology. The same conclusion applies even if we accept seriously the Neoplatonic philosophy of geometry, as articulated by Plato or by Proclus in his *Commentary on the Elements*. So, accepting Euclid as a concoction also entails a different understanding of the *Elements*, and amounts to denying the appropriation of reason by the church.[25] Such a denial would alter the present-day philosophy of mathematics,[26] and the idea of deduction as fundamental to science.

Ptolemy: Astronomy and trigonometry

Let us now turn to astronomy. Predictably, a Hellenic origin is assigned to astronomy. This is based on a key astronomy text, the *Almagest*. Prior to the Crusades (and even for centuries after it), this text was attributed to "Ptolemy", in the loose sense that it was thought to be coming down from ancient Ptolemaic times. Such an understanding, permitting its possible Egyptian roots, would render it useless today to the agenda of Western glorification.

Therefore, today, this text is attributed to a person with another strange name, Claudius Ptolemy, who supposedly lived in Alexandria in the 2nd c. CE (but was supposedly unrelated to the Ptolemy dynasty). This date is based on four short passages from a very late (post-12th c.) text, passed off as the "original" Greek source. Nothing else is known about this Ptolemy, nor is it necessary; it is the Greek-sounding name, and the sharp date that is critical to claims of Hellenic priority!

Now, we have already seen proof that the *Almagest* is accretive: its star list is headed by the present-day pole star [27] which was *not* the pole star in the 2nd c. So, new material was added from after the 9th c. There are many other examples to show the accretive nature of the text. Islamic astronomers initially had difficulties with the Indian arithmetic algorithms. So, the Islamic Zijes of the 9th c. were typically accompanied by elaborate multiplication tables. And sure enough the *Almagest* speaks of the "difficulty with multiplication". Yet, and though it has the wrong length of the year, the *Almagest* states some parameters to the 8th sexagesimal minute (or 14 places after the decimal point)!

The very name of the text, *Almagest*, is Arabic, and shows that it passed through the Baghdad House of Wisdom. The Arabic version was translated *not* from Greek but from Pahlavi—the text starts off by addressing an unknown Cyrus—presumably since it was created in Persia, in the 6th c.

Selecting a few textual passages to date an accretive text is a faulty procedure. However, such passages in the *Almagest* are unreliable for a less obvious reason. *Every single purported observation in the Almagest is a fake, and has been obtained by back-calculation!* Newton's careful analysis[28] of the *Almagest* ruled out all possible sources of natural observational error; the only hypothesis that fitted, and fitted accurately, was that of back calculation. Since the purported "observations" in the *Almagest* are all fake, and these passages were put in later, they are absolutely useless for the purpose of dating the text. The authoritative texts[29] are unable to justify their faulty procedure, and unable to meet Newton's cogent arguments, except through adjectives—a dead give-away of a motivated and dishonest approach.

The Roman calendar provides non-textual evidence which conflicts with the date assigned to Ptolemy. Thus, the Roman calendar used the incorrect figure of 365 ¼ days for the length of the year. The Romans counted a year as the time from equinox to equinox; known as the tropical year this is actually 365.24(2199) days. The error in the second place after the decimal point was deplorable even by the standards of the 3rd c. Indian calendar. The Roman calendar lost one day in a century because of this error which remained in it until the 1582 Gregorian calendar reform (which decreed that every hundredth year would *not* be a leap year).

The erroneous round figure of 365 ¼ days was used in the Roman calendar just because the Romans had difficulties in representing fractions—there is no stock way to represent fractions with Roman numerals. Consequently, only some fractions were in common use; these had special names, and ¼ was one such fraction. Now, one of the key passages used to date our Claudius Ptolemy recognizes that the figure of 365 ¼ is erroneous. The author of this passage believed that the true length of the year is 1 day in 300 years less than 365 ¼ days. (This is erroneous; a better figure is 1 day less in 128 years.) In this passage in the *Almagest*, the (fake) "observations" of equinox are back-calculated on this erroneous belief. Since the passage was put in later, it should not be used to date Ptolemy. But *if* the passage is somehow contended to be genuine, then the Roman calendar should have adopted this length of the year since the 2nd c.

At least that should have happened in the 4th c. when the Council of Nicea met to fix the date of Easter. (Easter or Pascha is a "moveable" feast, since it depends upon the full moon, and the lunar cycle is incommensurate with the solar cycle. The Roman calendar is a simple count of civil days, and had abandoned all attempts to relate phases of the moon to months. Thus, months, on the Roman calendar, idiosyncratically have 30 or 31 days and sometimes 28 or 29 days.) Therefore, the complex task of fixing the date of Easter was referred to the learned philosophers of Alexandria, who ought to have consulted Ptolemy's book if it then existed.

The wrong length of the year would have caused the date of Easter to slip within a century, and further reform of the Roman calendar were actually initiated during the 5th and 6th c. At least

these reformers should have adopted Ptolemy's revised (but still erroneous figure) had this text been around at that time. They did not; the passage is a fake, as is the date assigned to Ptolemy and the *Almagest* text.

Theologians and fabricators of history use a stock technique to get around such insurmountable difficulties. Each new difficulty is countered by a new speculative hypothesis. This way of accumulating hypotheses can be used to defend any story, howsoever absurd. It is exactly like the process where one lie is defended by inventing a thousand more.

For example, the *Almagest* has many similarities with Indian astronomy texts. (The *Almagest* planetary models, though similar, are certainly *not* identical with Indian models. However, some general arguments in Book 1 sound like a paraphrase of controversies in Indian astronomy.) This is easily understood as due to accretion since we know that Indian astronomy texts travelled to Jundishapur and Baghdad, where this Indian knowledge got mixed with the *Almagest*.

However, this simple and pragmatic explanation by accretion would defeat the objective of the grand narrative: for Hellenic glorification demands a "pure Greek" origin of all knowledge. Therefore, to hang on to the fabricated story, two new hypotheses are invented. First, the Indian controversies are related to some Greek names dodgier than Ptolemy.[30] Second, it is claimed that Ptolemaic astronomy was transmitted *to* India. This is the stock position adopted by history texts and encyclopedias today: they also claim that trigonometry was invented by Greeks (meaning Ptolemy) and then transmitted to India. There is, of course, no

serious evidence for such transmission, as there is for the transmission in the reverse direction via accretion. But unreliable textual evidence, and infinitely many speculative hypotheses, make anything possible.[31]

Certainly a channel for information transmission existed between India and Alexandria from early times. But this could have transmitted information either way. Ashok the Great's stone edicts record how Buddhist monks, carrying texts, and medicinal plants "for men and animals", were sent to Alexandria (at the time of Ptolemy II). So, from the very beginnings of the Great Library of Alexandria, Indian knowledge did travel to Alexandria.

Over-reliance on texts also conveniently delinks history from material factors. In India a calendar was (and still is) vital to an economy driven by rain-fed agriculture. The Indian calendar correctly identifies the rainy season (the months of Sawan and Bhadon, celebrated in Indian songs). A good calendar was then also needed for (celestial) navigation,[32] for overseas trade was another key source of wealth in India. Thus, according to Pliny, goods imported from India annually drained a significant part of the wealth of the Roman empire,[33] and the heavier items, such as Indian elephants and ebony,[34] were easier to transport by the sea route. The Greeks, however, had no such material need for a calendar, beyond a simple count of civil days. *Therefore*, the Greek calendar was so hopeless, that the Greek calends were the butt of jokes even among the Romans (who themselves had such a defective calendar). The Greeks knew little navigation. Some of Alexander's soldiers, who elected to return via the sea route from India, had never been out on the open sea before, and were

frightened to see the spout of a whale![35] Therefore, unlike Indians, Greeks and Romans had little motivation to do astronomy.

Yet another way to cross-check matters is to examine the *process* of development. In India, we can see the slow and realistic progress of astronomy towards greater accuracy. The 5th c. Aryabhata's trigonometric values were accurate to the first minute. Accuracy was improved to the second minute by the time of the 9th c. Vatesvara, and to the third minute (8th decimal place) by the 14th c. Madhava. The whole process took nearly a thousand years. In contrast, Ptolemy arrives full blown, though he recognizes no predecessor other than Hipparchus, from 285 year earlier. The *Almagest*, then conveniently disappears, equally suddenly, without a trace in the Roman calendar. Such sudden appearance and disappearance, and absence of process, is characteristic of magic and fairy tales. Claudius Ptolemy was clearly fabricated after the Crusades.

While Euclid and Claudius Ptolemy did not exist, *some* Greek authors obviously did. However, given the large-scale fraud in which Western historians have engaged, the mere historical existence of some persons, such as Aristotle, should not be taken as convincing proof that they authored or initiated the texts attributed to them. Thus, Arabs attributed many Neoplatonic texts to Aristotle. These attributions (which made "Aristotle" theologically incorrect in Europe) were rejected by Western scholars.[36] However, it is equally unlikely that the texts on *Logic* and *Physics*, today attributed to Aristotle, were written by the historical Aristotle, or even by a group of translators operating under his name, in his general time period.[37] The cases of Euclid and Claudius Ptolemy were taken up only to illustrate the kind of "evidence" for the grand narrative of a Hellenic origin of science. Obviously, this entire narrative, de-

veloped over centuries, cannot be refuted on a case-by-case basis in a few thousand words, and it is not necessary to do so.

The Inquisition and religious intolerance

Let us now move on to the second phase of history-fabrication, which concerns the Inquisition and the general atmosphere of religious intolerance that then prevailed in Europe. The two key scientific developments in this time period are known as the Copernican revolution and the Newtonian revolution.

The Copernican revolution

On the stock story, Ptolemy's geocentric planetary model, which survived for 13 centuries, was displaced by Copernicus' heliocentric model. This entailed an "upheaval in astronomical thought that we call the Copernican Revolution".[38] Kuhn adds that "Copernicus...first revived the full Hellenistic tradition of mathematical astronomy".

Notice how this stock story respects the unstated postulate of Western historiography that all knowledge must have a theologically-correct origin. Except for Ptolemy (Greek) and Copernicus (European), all others are pushed to the margins.

We have already seen that the first part of this story is false: Claudius Ptolemy is just a convenient name used for Hellenistic appropriation via an accretive text. In fact, astronomy was continuously modified. Let us now look at the second part of the story.

The shift from geocentrism to heliocentrism is supposedly the revolutionary idea proposed by Copernicus in the 15th c. Strangely enough, even the 11th c. al Biruni, while describing Indian astronomical theories, discusses whether the observed motion of the stars is real or relative. He points out[39] that this is irrelevant for astronomy, since both models lead to identical conclusions. He is right, of course: mathematically speaking, one has only to add or subtract the earth-sun displacement vector to move from one model to another. Furthermore, it is always necessary to transform to a geocentric model for comparison with observations. The 13th c. Delhi poet Amir Khusrau seems more excited about heliocentrism when he asks, "Who has seen the sun moving?"

Aryabhata certainly stirred a hornet's nest when he asserted that the earth moves, and that the stars only appear to move "like the stationary objects on the river-bank as seen from a moving boat".[40] Varahamihira,[41] and then Brahmagupta, came down heavily on Aryabhata for this claim, the latter derogatorily referring to him as *bhata* (a pun on *bhatta* intended to emphasize Aryabhata's low caste, hence ignorance). Even many of Aryabhata's followers were apologetic on this point (and it made no material difference). The entire controversy is paraphrased at the beginning of the *Almagest*.

Of course, the moment these precursors of heliocentrism are mentioned, chauvinistic Western historians jump to attach to the idea a Greek name: in this case Aristarchus of Samos. They will point to a stray remark from one 14th c. Greek manuscript supported by another stray remark in another 15th c. manuscript to fix a date—but we know all that stuff by now. What is needed is a revolutionary shift away from this Helleno-centrism!

Setting aside heliocentrism, Copernicus' other contribution is his mathematical model. Surprisingly, for a revolutionary innovator, this is a carbon copy of an earlier astronomical model by Ibn-as-Shatir of Damascus (d. 1375). Ibn Shatir used a technique due to Nasiruddin Tusi (whose advice to Hulegu led to the downfall of Baghdad, and who was rewarded with the Maragha observatory). The Maragha school raised new questions, and offered novel solutions. Copernicus mimics both the questions and answers. Copernicus' "lunar model is identical to Ibn ash-Shatir's...The question therefore is not whether, but when, where, and in what form he learned of Maragha theory."[42]

It is known that a Byzantine Greek translation of Ibn Shatir's work was available in the Vatican library, and that Copernicus knew Greek. Copernicus even transliterates Tusi's notation. Many contemporaries of Copernicus were familiar with various Arabic astronomy texts; they imported them and read them directly from Arabic, as we can see from their annotations on these manuscripts.[43]

Copernicus, a priest, was naturally concerned about theological correctness; but, in those days of the Inquisition, he also feared church persecution. His close friend and fellow canon, Scultetus, was named a heretic and underwent ten years of trial, imprisonment, and torture in Rome. Understandably, Copernicus prudently waited until he was on his deathbed, before sending the book for publication. Also, he stated that his theory did not depict reality, but was only a hypothesis. That Copernicus had no revolutionary intentions is made further clear by the "grovelling" preface to his book, addressed to Pope Paul III, in which Copernicus cites in his favour various religious authorities, including two bishops, one

cardinal, and a previous pope.[44] (Of course, one can "save" the grand story of a revolutionary by introducing a new hypothesis that someone else wrote the preface, and so on.)

The key questions, however, have never been asked: *could* Copernicus have openly acknowledged his Islamic sources? Had he done that, wouldn't someone have denounced him as a heretic? Would that have helped his case for theological correctness? So, Copernicus followed the tradition: he used Islamic sources, but refused to acknowledge them.

How have Western historians reacted to this resounding crash of a fabricated revolution? How have they reacted to this crash in the sustained Western enterprise of glorification? Here is Owen Gingerich's response: "some of the al-Tusi material is known to have reached Rome in the 15th century... but there is no evidence that Copernicus ever saw it. . . . I personally believe he could have invented the method independently."[45]

That's it! Such a striking coincidence would be nothing short of a miracle, but Westerners routinely perform such miracles! They have the big magic of claiming "independent rediscovery" through quibbles!

There is precedence, obviously; the similarity is undeniable; the text was in a library which Copernicus visited, these Arabic models were known to his colleagues, Copernicus transliterates Tusi's notation, but we are required to furnish further proof that Copernicus actually saw those texts in the library. Why is further proof required? Because the standards of evidence have just been changed to preserve the crumbling story. This method of unrea-

sonably sharpening the standards of evidence is an old trick: the rainmaker knows he can't make rain, so he demands a monkey without a blemish.

Note a further, subtle way in which the rules of evidence are being juggled. The appropriate standard of evidence for history is balance of probabilities, and there is ample circumstantial evidence that Copernicus' model was entirely derived. So, the onus of proof is on Western historians to *supply* solid evidence that Copernicus did *not* see the text! Instead, they shift the onus of proof, and *demand* further evidence! So, the great Copernican revolution is better called the great Copernican Quibble!

Copernicus was not an isolated case. Mercator was arrested by the Inquisition, and in grave danger of being tortured to death in a painful way. As Needham points out,[46] the famous "Mercator projection" was already used in Chinese star maps of the 10th c. The construction of Mercator's map needed precise trigonometric values—readily available from India. But the sources of this famous map (stock "map of the world"), so critical to European navigation, could not be uncovered in all these years. Fearful of the Inquisition, Mercator hid his pagan sources. (Had his sources been theologically correct, he would not have needed to hide them.)

High officials of the church made other such "independent rediscoveries" by hiding their real sources. For example, Tycho Brahe was the Royal Astronomer to the Holy Roman Empire. His "Tychonic" model was identical with Neelkantha's (1501) planetary model. The Roman Catholic missionaries, in Cochin from 1500, had easy access to Neelkantha's work. Similar remarks apply to Tycho's

contemporary Christoph Clavius who authored the Gregorian calendar reform and published elaborate trigonometric tables.

These cases are not exhaustive. They only illustrate a general phenomenon: the systematic fabrication of history through claims of "independent rediscovery". These Europeans made "discoveries" in *exactly* the sense that Vasco da Gama or Columbus made "discoveries"—by the simple process of declaring as non-persons all those who were theologically incorrect. Although, this "Doctrine of Christian Discovery" was initiated by 15th c. papal bulls, it was fully accepted by Protestant countries, as the US Supreme Court pointed out,[47] while granting it legal sanctity. Later-day Western historians then made this into a "Doctrine of Independent Rediscovery"!

Newton and the calculus

From the great "Copernican revolution", let us move on to the greater "Newtonian revolution". It is difficult to explain everything here in a few short paragraphs, but those who follow the references (recursively) should eventually be able to understand my argument.

First, what was Newton's key achievement in physics? Earlier planetary models took uniform circular motion as the norm. In India this was done not for any metaphysical reasons, but simply because that is what one actually *sees* the vast majority of heavenly bodies doing. The norm requires no explanation. What required explanation was the *departure* from the norm. The planets, including the sun and the moon, were counted as seven (corresponding

to the days of the week) and exhibited irregularities, today known as the zodiacal anomaly and retrograde motion. Indian planetary models aimed to calculate planetary positions in agreement with empirical observations. For Arabic models, too, the key concern was agreement with empirical observation, not metaphysics.

Later-day Europeans, however, took uniform straight-line motion as the norm not requiring explanation. This idea ("Newton's first law") is purely metaphysical and geometrical, and not based on any observation. It cannot be, for it is unlikely that such uniform motion in a straight line ever takes place *anywhere* in the cosmos (or that any inertial frame actually exists). Newton explicitly admitted this at the beginning of his *Principia*. If metaphysical considerations nevertheless prevailed in Newtonian physics, it was because of his religious beliefs—he thought that God had created a mathematically-correct cosmos.[48] On this metaphysical norm of straight-line motion, circular motion *did* require explanation; and it could be explained by *postulating* an inverse-square law force.

This way of explaining circular motions, by postulating a force, was well known to Newton's contemporaries, such as Hooke. What they did not know was how to extend this explanation to the case of elliptic planetary orbits. So Newton's key achievement was his use of a new mathematical technique—the calculus—to extend the idea of the inverse-square-law force to elliptic orbits. This mathematical technique is the substance of Newton mechanics: in which every problem is reducible to the solution of ordinary differential equations. This achievement must be seen in its proper context.

Indian planetary models had used epicycles with variable radii, corresponding to elliptic planetary orbits. Calculations related to these orbits used the calculus. This process was initiated by Aryabhata in the 5th c., when he switched from clumsy geometrical methods to an elegant numerical technique to calculate trigonometric values with great facility. Aryabhata's technique is essentially equivalent to what is today called "Euler's" method of numerically solving ordinary differential equations (the content of Newtonian mechanics).

How was the calculus transmitted from India?[49] Sankara Variyar, who expounded Neelkantha's work, shared a patron, the Raja of Cochin, with the Portuguese who started the first Indian Roman Catholic mission in Cochin in 1500. The Portuguese soon set up a school to indoctrinate the local Syrian Christians, with whom they had formed a strategic alliance, in line with their "Prester John strategy" for winning the Crusades. By about 1550 this school, now a college, was taken over by the Jesuits. They made it into another Toledo, acquiring and translating a variety of Indian texts, and transmitting them back to Rome. For this purpose, they used the Syrian Christians, much as they had the Mozarabs in Toledo, but they also employed Brahmins as translators. Some texts of the "Kerala school" were also available in the local language Malayalam, the mother tongue of the Syrian Christians, and which language the Jesuits were teaching to them in their Cochin college.

There was ample motivation for Europeans to acquire the Indian calculus techniques. The European navigation problem was then the foremost scientific problem in Europe, for it held the key to the European dream of wealth through overseas trade. Many governments offered huge rewards for its solution. European navigators

depended on charts, and the construction of the Mercator chart needed a precise table of secants. Precise trigonometric values were, thus, of great concern to European navigational theorists during the 16th c. The most precise trigonometric values then (precise to 8 decimal places) were in Indian texts, and were derived using the calculus.

At first, the Jesuits did not know any mathematics. However, Christoph Clavius altered the Jesuit syllabus in Rome, inserting practical mathematics into it, a subject on which he wrote a text. Matteo Ricci was in the first batch of these Jesuit students so trained in mathematics, and he was further trained in navigation at Coimbra before being despatched to India. Visiting Cochin, just before the Gregorian calendar reform authored by Clavius, he wrote that he was looking for "an intelligent Brahmin or an honest Moor" to explain to him Indian methods of timekeeping.[50] (The precise trigonometric values etc., were found in Indian timekeeping or calendrical works.) Noticeably, although Clavius published elaborate trigonometric tables he did not know enough trigonometry to use it to determine the size of the earth, a critical parameter for longitude determination on celestial navigation.[51]

Tycho Brahe, the Royal Astronomer to the Holy Roman Empire, was the other person to whom these Indian manuscripts would logically have been sent, so it is little wonder that "Tycho's" planetary model is identical with Neelakantha's. Tycho's masonry instruments were far too inaccurate, and built far too late, for him to have arrived at his model independently. After Tycho's death (or murder), his assistant, Kepler, decamped with Tycho's secret papers, to which Tycho had earlier denied him access despite all his efforts. The nearly-blind Kepler could hardly have carried out

the observations required for the phenomenal accuracy of his orbit of Mars; Neelkantha had obtained this accuracy after 50 years of observation. Kepler's explanation for this oddity is not credible, especially since, being an astrologer by profession, he was either a very bad scientist (if he believed in astrology), or accustomed to spinning stories for the gullible (if he did not believe in astrology, but nevertheless made a living from it).

However, the calculus was not readily comprehended by Europeans because their understanding of mathematics as "perfect" differed culturally from the Indian understanding. Kepler tried but failed. Objecting to the use of the calculus by Fermat and Pascal, Descartes thought it required supertasks (an infinite series of tasks). He declared this was "beyond the capacity of the human mind".[52] Galileo concurred, and, after five years of vacillation, he left it to his student Cavalieri to take the credit or discredit. Many others reproduced the Indian infinite series (always without acknowledging the pagan sources, as was the norm in Europe). It was in this context that Newton claimed that his theory of fluxions gave a "rigorous" account of the calculus. (As Berkeley showed, Newton was mistaken in thinking thus, and today the supertasks required for formal real numbers, and limits are pushed into set theory.)

So, this, then, must be seen as Newton's primary mathematical achievement: he made (or was widely believed to have made) the calculus compatible with European metaphysics. As was done with geometry, post-Crusade, Newton theologically sanitised the calculus. In any case, he made the calculus acceptable to most Europeans.

Incidentally, this had a curious effect on Newton's physics. We have already seen that Newton's first "law" of motion is metaphysical, and, so, indeed, is the second law[53]—at best it provides a *definition* of force. This, however, is *not* a good definition, since the right hand side involves a derivative with respect to time. In his attempt to make the calculus "rigorous", Newton made time metaphysical: *hence* his *Principia* begins with a reference to "absolute, true, and *mathematical* time" which flows on "without relation to anything external".[54] In making time "mathematical", Newton took a step back,[55] from his predecessor, Barrow, who had tried to keep it physical. Remedying this critical lacuna about time in Newton's physics led to the special theory of relativity. General relativity, as is well known, abandons the concept of force.

Newton, however, was undoubtedly a great scholar. His fifty years of Biblical scholarship, uncovering a systematic process of fraud and misinterpretation, could easily have sparked a real revolution had it not been suppressed, as it remains to this day.[56]

Racism and Colonialism

To summarise, Euclid the geometer and Claudius Ptolemy the astronomer were pure fabrications, like the stories of the Copernican and Newtonian revolutions. And these are just examples of what was obviously a large-scale and systematic effort, spread over centuries.

Thus, the Western history of science during the Crusades and the Inquisition followed Orosian principles: it aimed to propagate

falsehoods to glorify the West and belittle all others. This goal admirably suited racism and colonialism which followed after this and partly because of this.

Much has already been written on how history was concocted during this period.[57] So apart from emphasizing the continuity of this third phase with the first two phases (during Crusades and Inquisition), I add only a few new points.

The first point concerns the "doctrine of independent rediscovery", used to "save the story" of Copernicus, and Newton. There are a host of other such cases. So we can either understand the history of science as a series of systematic miracles, which took place in the West, or accept systematic fraud in Western history-writing.

Second, changing the rules of the game in mid-story exposes the double standards of evidence—the hallmark of racist history. Thus, for the long-standing claim that trigonometry and Greek astronomy was transmitted to India, the conjectured precedence of Ptolemy is regarded as adequate proof of transmission (discounting the simpler explanation of accretion in the *Almagest*). However, in the cases of Copernicus or Newton actual precedence is not proof enough. The story dictates which rule will be followed. So, Western historians implicitly stipulate that the standard of evidence required to prove a claim of transmission *to* Copernicus or Newton is different from the standard of evidence they earlier used for a claim of transmission *from* Ptolemy. Racist history is the only possible outcome of such double standards.

There is another subtler trick. As we saw above, the *Elements* not only acquired a theologically-correct *origin*, it also acquired

a theologically-correct *interpretation*. Plato and Neoplatonists had linked geometry and mathematics to the soul. The revised interpretation rejected this linkage as heretical. Mathematics was reinterpreted as "a universal means of compelling argument". This reinterpretation suited the post-Crusade agenda of converting Muslims without using force or scripture. After many centuries, the interpretation became so well entrenched, that even atheists like Russell promoted it. This was given final shape by Hilbert and is taught in schools today. This is not a valid interpretation of the *Elements*, since it fails[58] to apply beyond the 35th proposition of the *Elements*. Nevertheless, it has the support of those in authority.

This modified understanding of the *Elements* is now asserted to be the essence of mathematics. This allows a Rouse-Ball or Needham to claim mathematics as unique to the West. The modified philosophy retrospectively modifies history. This is much like Henry Higgins asking in the film adaptation of Shaw's *Pygmalion*, "Why can't a woman be more like me!" It amounts to saying that anything that does not mimic the West, is, by definition, not science; ergo, science is a creation of the West!

Note how theology has crept in: we are asked to believe that science is about *deducing* the consequences of some "*laws*" instituted by a *god* who *created* the cosmos, as has been made out in the West since Newton. Science is actually about building *models* and *calculating* their empirical consequences. Nature need have no laws.

Nevertheless, the above trick of demanding mimicry continues to be applied today with regard to the calculus. It took centuries for Europe to absorb the Indian calculus after adapting it. The original is now faulted on the grounds that it does not mimic Newton's (in-

correct) understanding of the calculus, or its present-day dominant understanding the West, which requires supertasks, limits, and a proof of a "fundamental theorem of calculus" using these. Be it noted that all this ritualistic paraphernalia is perfectly useless for any practical application of the calculus, for which one still needs to *calculate*. These calculations can still be done by (appropriate improvements of) Aryabhata's numerical technique of solving ordinary differential equations.[59]

We can see more clearly the effect of applying one set of cultural filters, by applying an alternative set of cultural filters to Western thought. Formal mathematics crumbles if it is interrogated from a Buddhist perspective.[60] Present-day mathematical theorems are deduced by naively presupposing two-valued logic; the use of Buddhist logic would make them erroneous. The realist Buddhist philosophy of *sunyavada* would also declare the idealisations of Platonism (e.g. a geometrical point) as erroneous, and the "erroneous" practical "approximations" (e.g. dot on a piece of paper) to be the only real thing we have. The supertasks that set theory performs metaphysically, would, of course, have to be rejected, as in computer arithmetic,[61] together with notions such as formal real numbers, and limits. Thus, all that we are left with are the mundane practical procedures, with no bunkum claims about how science captures the laws of any particular god.

Conclusions

The Western origin of science was fabricated in three stages.

1. **History was Hellenized during the Crusades**, when a Greek origin was concocted for all worthwhile secular knowledge accumulated in Arabic books, starting from those captured at Toledo. The motive was to make the origin of knowledge seem theologically correct. Euclid and Claudius Ptolemy are two grand concoctions here.

2. **Knowledge was theologically sanitised during the Inquisition**, and the accompanying religious intolerance in the rest of Europe. "Pagan" knowledge was again appropriated by Europeans who dared not acknowledge it. The appropriated knowledge was reinterpreted to make also the contents theologically correct. The concoctions of this period include the revolutionary discoveries attributed to Copernicus and Newton.

3. **Later-day racist and colonial historians built on this legacy of glorifying themselves and belittling others.** For this purpose, they used (and continue to use) double standards of evidence to claim "independent rediscovery" in one direction, and transmission in the other direction. Another common trick here is to appeal to the theologically-correct understanding of mathematics or science as the only legitimate one, and thus demand mimicry of the West to retrospectively support false claims of Western priority.
Alternative cultural filters could just as easily be applied to prove the incorrectness of Western knowledge: formal mathematics fails with Buddhist logic.

The philosophy of science based on this Western perspective would, then, also have to be abandoned, and science would have to be judged solely on the practical value of the models it proposes.

Postscript

The late Ravinder Kumar, the much-missed Director of Delhi's Nehru Memorial Museum and Library, used to maintain that history is futuristic. History ought to provide a guide to future action. To this end, having looked at a couple of past scientific revolutions, it might be interesting to look also at a possible future scientific revolution. Such a potential paradigm shift was announced by M. Atiyah. He had all the credentials for it as a Field Medalist, Abel Laureate, and former President of the Royal Society, regarded as the leading mathematician of the century. Singularly enough, this turned out to be yet another case of "independent rediscovery", a similar paradigm shift had been announced earlier—by this author![62] Atiyah was promptly informed of this author's work, however, oddly enough, his claim was *again* widely publicised, by third parties, who had consulted Atiyah. Eventually, this author's work was belatedly acknowledged.[63]

To expose false claims of "independent rediscovery", this author has proposed an "epistemic test". The idea is that those who copy often make mistakes because they don't fully understand what they copy. When two students turn in identical answer sheets, a good way to differentiate the original from the copy is to test the understanding of the students. The one who lacks understanding has copied. Conceptual mistakes show lack of understanding.

When Gerbert of Aurillac imported Arabic numerals it was natural for him to make mistakes. Copernicus made mistakes related to the Ibn Shatir model, so did Newton about the calculus. Did Atiyah make one?[64]

Notes

1 W. W. Rouse Ball, *A Short Account of the History of Mathematics,* Dover, New York, 1960, pp. 1–2. Emphasis added.

2 Joseph Needham, *The Shorter Science & Civilisation in China* (abridgment by Colin A. Ronan), Cambridge University Press, 1981, vol. 2, p. 43.

3 E.g., *Mathematics: Textbook for Class IX*, (J. V. Narlikar, P. Sinclair, et al.), NCERT, New Delhi, 2005.

4 The National Democratic Alliance was led by the Hindu nationalist party, the Bharatiya Janata Party; it governed from 1998 to 2004, when a coalition led by the Congress swept to power.

5 Clarence A. Forbes, "Books for the burning", *Transactions of the American Philological Society* ***67*** (1936), pp. 114–25.

6 Edward Gibbon, *The Decline and Fall of the Roman Empire*, Great Books of the Western World, vols 37-38, Encyclopaedia Britannica, Chicago, 1996, vol. 1, ch. 28, p. 462. Later (vol. 2, ch. 51, p. 274) Gibbon discusses and dismisses the canard that burning down the Great Library might have been the work of Caliph Omar, or that it might have happened during a fire started at the time of Julius Caesar's attack. Furthermore, in view of the above evidence for the book burning edicts of Christian emperors, one does not need a separate hypothesis for the Great Library.

7 Gibbon, *Decline and Fall*, vol. 2, ch. 52, p. 298, and footnote 54, p. 692.

8 Anthony Pym, *Negotiating the Frontier: Translators and Intercultures in Hispanic History*, Jerome Publishing, Manchester, 2000. Also: http://www.fut.es/~apym/on-line/studies/toledo.html.

9 Shakespeare, *A Winter's Tale*, iv, 2, 'Let me see. Every 'leven wether tods; every tod yields pound and odd shilling; fifteen hundred shorn, what comes the wool to? . . . I cannot do't without counters'. [11 wether [sheep] give one tod [28 lbs] of wool, which sells for a guinea [21 shillings]. How much is the wool from 1500 sheep?]

10 This theology is today attributed to Proclus, Plotinus etc. Richard C. Taylor, "A Critical Analysis of the Kalam fi'l mahd al-khair" in: *Neoplatonism and Islamic Thought*, ed. Parvez Morewedge, New York, 1992, pp. 11–40.

11 E.g., Gibbon, *Decline and Fall*, vol. 2, note 55 to ch. 52, p. 608. Others have assigned the date of 1080 to Simon Seth's Greek translation. The Arabic translation *Kalilah va Dimnah* by Ibn al Muqaffa (d. 750), was long before the formation of the House of Wisdom, and the movement called the Brethren of Purity (Ikhwan al-Safa) derives inspiration from this text.

The Pahlavi translation was by Burzoe himself, according to the *Shahnama* of Firdausi.

12 Similarly, the subsequent translation of the *Pancatantra* from Greek to Latin, in 1250, shows that there was an active information exchange between Byzantium and Rome from long before the fall of Byzantium in 1452, which only accelerated this process.

13 The clause supposedly exempted these philosophers from Justinian's edicts. Gibbon says this "reflects the purest lustre on the character of Chosroes", and credits this "curious story" to Agathias. Gibbon, vol. 1, ch. 40, p. 671, and note 155, p. 899.

14. MS Syriac, Paris, No. 346 of 662 CE.

15 Strabo, *Geography*, 13.1.54.

16 Plato, *Apology*, 26, trans. B. Jowett, Encyclopaedia Britannica, Chicago, 1996, p. 204. "Friend Meletus, you think you are accusing Anaxagoras...."

17 Herodotus, *The History*, (Euterpe) Bk II.50, trans. G. Rawlinson, Encyclopaedia Britannica, Chicago, 1996, p. 60.

18 C. K. Raju, "Models of Information Transmission", ch. 5 in *Cultural Foundations of Mathematics*, Pearson, 2007.

19 A. T. Fomenko, V. V. Kalashnikov, and G. V. Nosovsky, *Geometrical and statistical methods of analysis of star configurations: Dating Ptolemy's Almagest*, CRC Press, 1993, p. 268.

20 http://mathforum.org/kb/thread.jspa?threadID=381990&messageID=11 75734 (accessed 1 March 2009). For more details, see C. K. Raju, "Good-Bye Euclid!", *Bharatiya Samajik Chintan* VII, No. 4 (New Series) 2009, pp. 255-264; also at http://ckraju.net/papers/MathEducation1Euclid.pdf.

21 Sir Thomas Heath, *A History of Greek Mathematics*, Dover, New York, 1981, p. 360.

22 A well known such Toledan howler is the name of the trigonometric function sine. On the OED, this derives from the Latin *sinus*, meaning fold, from the Arabic *jaib*, meaning fold in a dress, or a pocket. This was a misreading of the consonantal skeleton *jb*, which was intended to refer to *jiba*, from the vernacular *jiva*, from the Sanskrit *jya*, meaning chord. (The *Surya Siddhanta* and Aryabhata use the term *ardha-jya* for the sine.)

23 Heath, *Greek Mathematics*, cited earlier.

24 Proclus, *Commentary*, trans. Glen L. Morrow, Princeton Univ. Press, 1970, p. 56; T. L. Heath, *The Thirteen Books of Euclid's Elements*, Dover, New York, 1956, p. 1.

25 For the current political uses of this appropriation to attack Islam, see C.

K. Raju, "Benedict's Maledicts", *Indian Journal of Secularism*, 10(3) (2006) pp. 79-90; also at: http://zmag.org/znet/viewArticle/3109.

26 C. K. Raju, *Cultural Foundations of Mathematics*, cited above, ch. 1.

27 Ptolemy, *Almagest*, trans. R. Catesby Taliafero, *Encyclopaedia Britannica*, Chicago, 1996, p. 234. Ptolemy calls it "the star at the tip of the tail" in the constellation of the Little Bear. See also, trans. Toomer, cited below, p. 341.

28 R. R. Newton, *The Crime of Claudius Ptolemy*, Johns Hopkins University Press, Baltimore, 1977.

29 G. J. Toomer, *Ptolemy's Almagest*, Princeton University Press, 1998.

30 On cannot rule out the possibility that such names were introduced at a very late stage into texts. Thus, already by the 12th c., Muslim historians were complaining that Western historians attributed everything to their co-religionists.

31 For a more detailed refutation, see C. K. Raju, *Cultural Foundations of Mathematics*, Pearson Longman, 2007.

32 For the need of a calendar for latitude determination, on celestial navigation, and the linkage of the Gregorian calendar reform to the latitude problem of European navigation, see C. K. Raju, *The Eleven Pictures of Time*, Sage, 2003, pp. 327-334.

33 Pliny, *Natural History*, VI.26, "The subject is one well worthy of our notice, seeing that in no year does India drain our empire of less than five hundred and fifty millions of sesterces, giving back her own wares in exchange, which are sold among us at fully one hundred times their prime cost."

34 R. N. Saletore, *Early Indian Economic History*, Popular Prakashan, Bombay, 1993.

35 Arrian, *Anabasis Alexandrii*, Book 5.

36 See e.g. note 9.

37 C. K. Raju, "Logic", in: *Springer Encyclopedia of Non-Western Science, Technology and Medicine*, 2008.

38 Thomas Kuhn, *The Copernican Revolution*, Harvard University Press, Cambridge, [1957] 1966, p. 133.

39 Al Biruni, *Kitab al Hind*, trans. E. C. Sachau, 1.26, Munshiram Manoharlal, Delhi, 1992, p. 277.

40 *Gola*, 9. *Aryabhatiya of Aryabhata*, trans. K. S. Shukla and K. V. Sarma, INSA, New Delhi, 1976, p. 119.

41 Varahamihira's arguments are of some interest because, as I have pointed out, they are identical to the arguments underlying the celebrated

Michelson-Morley experiment. C. K. Raju, "Time: What is it that it can be Measured", *Science and Education*, ***15***(6) (2006) pp. 537–551, and C. K. Raju, "On Time-3a: The Michelson-Morley Experiment", *Physics Education* (India), ***8*** (1991) pp. 193-200.

42 N. M. Swerdlow and O. Neugebauer, *Mathematical Astronomy in Copernicus's De Revolutionibus*, Springer-Verlag, New York, 1984, part 1, p. 47.

43 George Saliba, "Arabic Astronomy and Copernicus", *A History of Arabic Astronomy*, New York, 1994, ch. 15. For a more recent update, see http://www.columbia.edu/~gas1/project/visions/case1/sci.1.html (accessed 1 March 2009).

44 Nicolaus Copernicus, *De Revolutionibus*, preface and Book 1, trans. J. F. Dobson and S. Brodetsky, Royal Astronomical Society, Occasional Notes, No. 10, 1947, pp. 3–6.

45 Owen Gingerich, "Islamic astronomy", http://faculty.kfupm.edu.sa/phys/alshukri/PHYS215/Islamic_astronomy.htm (accessed 1 March 2009).

46 Joseph Needham, *The Shorter Science and Civilization in China*, vol. 2, abridged by Colin A. Ronan, Cambridge University Press, 1981, p. 123.

47 Johnson and Graham's Lessee V McIntosh 21 U.S. (8 Wheat.) 543, 5 L.Ed. 681(1823). For an elaboration, see Steve Newcomb, "Five Hundred Years of Injustice: The Legacy of Fifteenth Century Religious Prejudice", *Shaman's Drum*, Fall 1992, pp. 18-20. http://ili.nativeweb.org/sdrm_art.html (accessed 1 March 2009).

48 Likewise, the "bodies" in Newton's "laws" are not physical bodies, but are idealised geometrical points.

49 For full details, see C. K. Raju, *Cultural Foundations of Mathematics: the Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe in the 16th c*. CE, Pearson Longman, 2007.

50 Matteo Ricci, Letter to Petri Maffei on 1 Dec 1581. Goa **38** I, ff 129r–30v, corrected and reproduced in Documenta Indica, **XII**, 472-477 (p. 474).

51 Ch. 4 in *Cultural Foundations of Mathematics*, cited above.

52 René Descartes, *The Geometry,* trans. David Eugene and Marcia L. Latham, Encyclopaedia Britannica, Chicago, 1990, Book 2, p. 544.

53 K. R. Popper, *Realism and the Aim of Science*. *Postscript to Logic of Scientific Discovery*, vol 1, Hutchinson, London, 1982. For an elaboration, see C. K. Raju, "Newton's Time", *Physics Education* (India), **8** (1991) pp. 15-25. Some physics is obtained only by putting together the "laws" of motion and the "law" of gravitation, since this leads to elliptic orbits different from Galilean parabolas.

54 Isaac Newton, *Mathematical Principles of Natural Philosophy*, trans. A.

Motte, revised by Florian Cajori, Encyclopaedia Britannica, Chicago, 1996, p. 8.

55 For an elaboration see, C. K. Raju, "Time: What is it That it Can be Measured", *Science & Education*, **15**(6) (2006) pp. 537–551. Also, "Planetary Motion, Newton and Buddhism". Workshop on Modern Astronomy, Sarnath, 6-9 Feb 2009 at http://ckraju.net/papers/Planetary-motion-Newton-and-Buddhism.pdf

56 For more details, see C. K. Raju, "Newton's Secret", ch. 4 in *The Eleven Pictures of Time*, Sage, 2003.

57 E.g., Martin Bernal, *Black Athena: The Afroasiatic Roots of Classical Civilization*, vol. 1: The Fabrication of Ancient Greece 1785-1985, Vintage, 1991.

58 C. K. Raju, *Cultural Foundations of Mathematics*, Pearson Longman, 2007, ch. 1.

59 For a comparison of Aryabhata's numerical technique with what is known as "Euler's method" of solving ordinary differential equations, see ch. 3 in *Cultural Foundations of Mathematics*, cited above.

60 See ch. 2 "Proof vs Pramana" in *Cultural Foundations of Mathematics*, cited above. For an earlier account, see C. K. Raju, "Computers, Mathematics Education, and the Alternative Epistemology of the Calculus in the Yutkibhasa", *Philosophy East and West* **51**(3) (2001) 325-62.

61 See "Number representations in calculus, algorismus and computers: sunyavada vs formalism", ch. 9 in *Cultural Foundations of Mathematics*, cited above. Also, "Zeroism and Calculus without Limits", 4th Nalanda Dialogue on Buddhism and Physical Science, Nalanda, 21-24 Oct 2008, at http://ckraju.net/papers/Zeroism-and-calculus-without-limits.pdf.

62 C. K. Raju, *Time: Towards a Consistent Theory*, Kluwer Academic, Dordrecht, 1994, ch. 5B, "Electromagnetic time".

63 M. Walker, *Notices of the AMS* **54** (4) p. 472, available at http://www.ams.org/notices/200704/commentary-web.pdf (accessed 1 March 2009).

64 For more details see, http://ckraju.net/atiyah/atiyahcase.html (accessed 1 March 2009).

Dissenting Knowledges Pamphlet Series

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Citizens International (CITIZENS) is a global peoples network based in Penang, Malaysia which works on issues of peace, anti-militarism, cultural co-operation, environmental protection, sustainable development and traditional knowledge systems.

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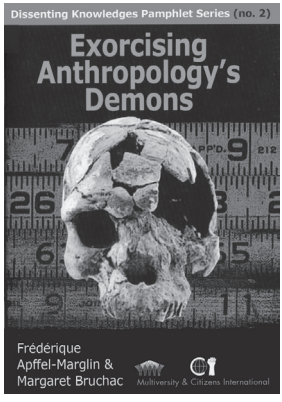
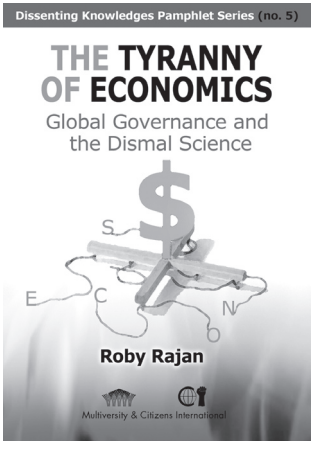
Dissenting Knowledges Pamphlet Series *No. 2*
Exorcising Anthropology's Demons
by Frédérique Apffel-Marglin & Margaret Bruchac



The discipline of anthropology originated in European and American intellectual traditions that focused principally on non-Europeans – the anthropologized – as exotic and primitive others. Anthropology's birth as the handmaiden of empire and colonialism, its involvement in eugenics, human specimen collecting, and other outrageous endeavors, has, after World War II, political decolonization, the Vietnam War, and the civil rights movement in the United States, been intensely scrutinized. This scrutiny has been done mostly by anthropologists themselves, spurred and perhaps stung by the response of the anthropologized who, on the whole, have rejected Western anthropologists' portrayals of their lives. This critical scrutiny of the discipline and its history has been and continues to be most salutary. It has allowed a much greater inclusion of multiple perspectives and might lead to a profound transformation of the discipline and perhaps even the dissolution of its classical form. Certainly, compared to some other disciplines in the social sciences, most glaringly economics, anthropology is a breath of fresh air. A growing number of anthropologists have rejected the status of a Science for their discipline, devising inventive ways of undermining the appearance of objectivity – and the authority it confers – to their texts.

One of the questions this essay poses is whether anthropology can fully exorcize its inherited demons. Are there limits to the effectiveness of its critical power? What remains to be done? Can anthropology do it? Can any modernist or post-modernist knowledge profession do it? Is criticism sufficient to bring about needed changes such as the use of non-Western concepts, theories, and practices, the decentering of the power of Western academia and publishing, the undoing of the separation of theory and praxis, the undoing of the separation between knowledge-making and everyday life behavior, for example? To say nothing of bringing about a more just, peaceful, diverse, and non-toxic world order. And what of the fact that the culture of anthropology is highly secularized in contrast with the people it has historically mostly worked with who hold sacred world-views?

Dissenting Knowledges Pamphlet Series *No. 5*
The Tyranny of Economics:
Global Governance and the Dismal Science
by Roby Rajan



We have, it is said, now arrived at a time beyond ideology.
Away therefore with everything old, in with all things new. Time to take the broom firmly by the handle and sweep out all the old remnants of irrationality, backwardness, and superstition. Time to get down to the task of economic growth post-haste by dismantling all the artificial barriers that stand in its way. Time to remove such important matters away from the hands of the uninformed and ignorant public, and entrust them to specialists armed with the expertise of economic science: the science of consumption and investment, of taxation and spending, of interest rates and inflation, of trade and exchange rates.

In this pamphlet, Roby Rajan takes a sledgehammer to these pretensions of economics, tracing its steady degeneration from being a branch of moral philosophy to the thoroughly amoral pseudo-science it has become today. Along the way, he deflates the tall claims made on behalf of its universality, punctures the bland and enervating jargon of its theorists, disrobes the vacuous pomposity of its high-priests and mandarins, and argues that nothing less than an ousting of the current regime of economic knowledge and an overcoming of the market/state/civil-society triad can restore economics to its rightful place as the field of study of the properly paradoxical aspects of human thought and action.

(The author against a decaying colonial structure —the former Viceregal palace.)

About the Author

C. K. Raju holds an honours degree in physics, a masters in mathematics, and a PhD from the Indian Statistical Institute. He helped build India's first supercomputer Param, and was an editor of the *Journal of Indian Council of Philosophical Research*. He has written books on physics (*Time: Towards a Consistent Theory*, Kluwer 1994), history and philosophy of mathematics (*Cultural Foundations of Mathematics*, Pearson 2007), and on time at the interface of science, religion and ethics (*The Eleven Pictures of Time*, Sage 2003). He argues that theology has penetrated hard science (mathematics, physics) through time beliefs adapted to inequitable politics. He advocates that science should be de-theologised in the interests of equity and harmony.

On stock Western history, science originated among the Greeks, and then developed in post-renaissance Europe. This story was fabricated in three phases.

First, during the Crusades, scientific knowledge from across the world, in captured Arabic books, was given a theologically-correct origin by claiming it was all transmitted from the Greeks. The key cases of Euclid (geometry) and Claudius Ptolemy (astronomy)—both concocted figures—are used to illustrate this process.

Second, during the Inquisition, world scientific knowledge was again assigned a theologically-correct origin by claiming it was *not* transmitted from others, but was "independently rediscovered" by Europeans. The cases of Copernicus and Newton (calculus) illustrate this process of "revolution by rediscovery".

Third, the appropriated knowledge was reinterpreted and aligned to post-Crusade theology. Colonial and racist historians exploited this, arguing that the (theologically) "correct" version of scientific knowledge (geometry, calculus, etc.) existed only in Europe. These processes of appropriation continue to this day.

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