

It is imperative that early education be made inclusive

I read with great interest the absorbing, comprehensive and well written Guest Editorial by Narasimha¹ in *Current Science*. I do have a couple of comments to make. First, it is not just enough to say that the two camps which hold opposite opinions, one that assigns all manner of ‘achievements’ to the ‘ancients’ and other that dismisses any achievement at all on the part of the same ‘ancients’, have both gone too far. Both opinions are based on ignorance flowing from the sort of education imparted early that seems never to inculcate a sense of what, for want of a better description, I can only call ‘a sense of identity’. That brings me to ask what we can do about it though, pessimistically, I do think it is too late.

Second, in a longish piece I wrote nearly two decades ago, I had included the following paragraph: ‘I now wish to end on a “low” key, by merely entering a plea symbolic of the burden of this article. If proper priority is to be accorded, what is known as the Pythagoras Theorem must really also be called a “Sulva Theorem” since it occurs in the Sulva Sutras and saw practical use in the construction of yagna kundas, clearly predating Pythagoras (at least as a theorem though not as “proof”). This and other mathematical discoveries (e.g. those of Aryabhata who knew the incommensurability of π and gave it a value more accurate than that of the Greeks, those of the early mathematicians who arrived at the now well-known formula for the solution of quadratic equations before anybody else did) and ancient knowledge with scientific import must be part and parcel, at the appropriate places, of information given in school books instead of being doomed to languish in “knowledge books” good only for quiz competitions. By this I mean that Indic achievements in early science must be mentioned in the same breath as those of the early South-west Asian (Babylonian/Assyrian) or ancient Greek civilizations. Text-books written in India, in imitation of those produced in the West, omit even a mere mention of Indic achievements. That cannot continue. Such small beginnings, linking our ancient science to modern understanding, would give the cultural confidence much needed by our young Educated Sensitive Indian (ESI) as India “globalizes”’.

I have given above the full text of the paragraph because a version condensed from my article, titled ‘Science in India. Reintegrating a forgotten heritage’, published on the edit page of the *Times of India*² did not have the paragraph in its entirety.

I mentioned in the article several other instances of past insights and happenings that have met with a similar fate. I cannot resist quoting one: ‘In many news items outsourced from Western news agencies Indian newspapers miss the Indian angle. A case in point is an item on the small-pox vaccine. The preventive aspects of rubbing the scrapings off an infected calf on a minor cut was known to Indian medicine over a long time even though “immunisation” and the biomolecular intricacies the process involves, were beyond the ken of the practitioners who were pure empiricists. But then, the words “vaccine” and “vaccination”, etymologically directly connected to “vatsa”, “a calf” in Sanskrit, have entered the general vocabulary!’ One wonders who brought the words into English.

Narasimha’s editorial clearly shows that the information about ancient Indian achievements is available only to certain specialists with scientific training and achievement, who may yet have access to the original sources and their commentators – Prof. Narasimha has no reason to suffer from an identity crisis! I think the only way to make such access available is to include the information, in ways appropriate, even at the beginning, as the courses are taught.

A couple of examples from medicine: ‘gynecology’ from the Greek ‘gyne’ – woman – possibly cognate with ‘kanyaa’ in Sanskrit; ‘geriatrics’ from the Greek ‘jara’ – old man – cognate with ‘jaraha’ – old man; ‘dental’ from the Latin ‘dentes’ – tooth – cognate with ‘danta’ in Sanskrit, making the young medicos aware of the Indo-European stream. Besides dealing with questions in psychology, India has made singular contributions to linguistics, a near-hard science that began to be studied only after the discovery of the connection between Sanskrit and European languages but, sadly, the young are left quite uninformed about it in India. Two other examples of increasing accessibility for the young are to embed how one or the other

of the Pythagorean triads was used in building construction in ancient India (not mentioning anything about yagna kunda-s, of course!) while teaching the properties of right-angled triangles. Another, to be embedded while teaching metallurgy, could be some possible speculation or result of a true, deep-going research on how ancient sculptors could have learned to prepare tools with tempered tips to fashion their beautiful, intricately carved sculptures. And, so on. The ‘chauvinists’ need sympathetic understanding because of the near total neglect of teaching about India’s ancient past. They want to be proud of that past, but go about it in a quite unscientific way. The ‘dismissive camp’ is not worth worrying about even though it derives its strength from what is now current, and that is ignorant impudence. There is a chance to correct that; one way is to provide evidence in a proper manner.

In the end let me raise a question: What would have happened had ancient Indian science continued uninterrupted and moved to a modern-type understanding? I can only rue the outcome with a joke: Husband to wife (on their honeymoon): Last night I dreamt I was rocketed to the Moon. Wife (eagerly): What was it like? Husband: What do you think? It was just like another d**n, b***dy airport.

1. Narasimha, R., *Curr. Sci.*, 2015, **108**(4), 471–472.
2. Balasubrahmanyam, S. N., *The Times of India*, Bangalore edition, 10 February 1996.

S. N. BALASUBRAHMANYAM

‘Saras Kshetra’,
Machohalli, Bapagram PO,
Bengaluru 560 091, India
e-mail: snobchem@hotmail.com

Response:

I am grateful to Balasubrahmanyam for his generous comments about the Guest Editorial. I agree with him that a major part of the solution lies with the educational system. Most Indian texts for schools and colleges not only fail to mention anything about historical

matters, but are also written in a way that provides no Indian context at all. Surely this will always make science seem like an alien enterprise to young students, and has an adverse effect on acquiring a proper appreciation of the nature of science and engineering. However, my point was this: while it takes a great deal of time and effort to reform our educational system, it should be possible for scientists with much less effort to write attractive but reliable and credible accounts of the history of science and technology in this country. Such books can change the way that students as well as teachers think about the subject of study. Even in India, however, changes do occur (although far too slowly); so I am less pessimistic about the issue than Balasubrahmanyam is.

The question that Balasubrahmanyam raises in his last paragraph is hard to answer, in part because the strength of Indian methods (for example) may lie precisely in the fact that they pursued a path very different from that of Greece and Europe. In the 16th century Francis Bacon realized that the old Greek methods had ceased to be effective, and there is much evidence to indicate (as the quote from Hemann Weyl in the Guest Editorial shows) that it was new ideas from the East that were in part responsible for the emergence and rise of modern mathematics. So if East and West had thought alike, the extraordinary revolution that occurred in Europe some four centuries ago might not have happened at all. Attempts at understanding this sort of question could help in triggering the

revolution that India needs but has not yet quite experienced.

I would like to take this opportunity to correct an error in the Guest Editorial. Towards the bottom of p. 471 in the right column, the words '1815 by a British surgeon . . . press reports' should be replaced by '1814 by a British surgeon who had studied the technique for the best part of 20 years, following the excitement triggered by press reports from India in 1794'.

RODDAM NARASIMHA

*Jawaharlal Nehru Centre for Advanced Scientific Research,
Jakkur PO,
Bengaluru 560 064, India
e-mail: roddam@jncasr.ac.in*

Spreading knowledge of classical India mathematics

Lord Russell wrote that science attempts to establish a causal relation between results and antecedent conditions, while religion promises miraculous results no matter what the antecedent conditions! Indians in the 21st century are afflicted by this latter malaise, i.e. inability to separate the contributions of our ancestors from the myth that surrounds them.

Narasimha envisages a conscious effort by his colleagues to spread this gospel globally. At the risk of beating a dead horse, let me briefly restate the obvious. The industrial revolution skipped India entirely – no steam engine, no printing press, no cotton gin (the three accepted mile-posts of the Industrial Revolution). This circumstance did not prevent India from building the Taj Mahal, Hoysala Temple, Ajanta and Ellora, etc. Can we imagine designing and completing such structures without the aid of laser, e-mail, blueprint or sms today?

Our grade school books should inform children at an impressionable age about the 'real' scientific contributions of our ancestors in a simple way, to neither glorify nor trumpet our greatness – and without launching into a national debate

on the language employed. All Indian languages support constructs rich enough to depict the real contribution of our ancestors.

At all high schools in the US and other countries, award an Aryabhata medal for excellence in mathematics, and computer science doctoral thesis with a Panini Medal. They are of Indic contributions to science.

Make students plot planetary positions by placing stones of various heights and thus defining a vector converging on a planet – a procedure devised by Madhava near the Karnataka–Kerala border. (At IIT-Ropar I had my freshmen plot planetary positions using this method and verify the ancient method by a modern telescope.) Plan a field trip to the place.

Indic mathematicians looked upon differential equations as algebra of rates.

Regarding reckoning elapsed time, if a train leaves Jammu on Monday at 6 p.m. and arrives at Kanyakumari on Thursday at 5 a.m., to avoid wrap-around IBM chose arbitrarily 1 January 1960 as the starting point of time, making elapsed time a simple difference without the cumbersome wrap-around. Indic mathe-

micians chose the occurrence of solar eclipse as the starting point. Incidentally, several fierce debates ensued between the Connecticut Indic School and the Chennai Indic School as to what constitutes a valid eclipse observation (M. D. Srinivasan, IIT-Madras, Chennai, pvt commun.).

Robert Kanigel's book '*The Man Who Knew Infinity*' should be translated into all Indian languages and should be widely circulated. The book has been translated into 21 languages worldwide. And Meera Nair is making a movie on the life of Ramanujan.

This is a movement I propose to make our Indic mathematics a household word globally.

1. Narasimha, R., *Curr. Sci.*, 2015, **108**(5), 471–472.

KRISHNAMACHAR SREENIVASAN

*Department of Information Technology,
Central Institute of Technology,
Kokrajhar 783 370, India
e-mail: sreenivasan@cit.ac.in*