University science education and deemed universities

I was happy to read the guest editorial of Lakhotia[1] and the article by Raghuram[2]. It is a good sign that the university teachers are now raising their voices for science education in universities. In my own article[3], I have dealt with the problem in detail.

Lakhotia has rightly raised the question whether the institutions recognized as 'deemed universities' really fulfilled the requirements expected of a university? The UGC Act declared by notification in the *Official Gazette* clearly states that any *institution for higher education* (emphasis mine), other than a University, shall be deemed to be a University for the purposes of this Act. How many of the deemed universities fulfil the requirements of the act?

Concern for university science education has been expressed at various places. Such as in a 20-page special issue of *Nature*[4] dealing with (i) What is to be done about the Indian universities? (ii) Will India's policy of technological self-reliance succeed? and (iii) Does the bureaucracy stifle Indian Science? *Nature*[5] again devoted 14 pages to 'Science in India', and lamented about the deplorable state of science education in universities. The weekly newsmagazine *Outlook*[6] published a special issue on 'Indian science is dead'. None had any effect.

We have a strong point that we see no evil and that makes us so complacent. Have we ever expressed any concern that the position of India as far as its publications are concerned was ranked no. 8 in the eighties, 13 in the nineties and 21 at present? When this question was raised in the parliament, the reply of the Minister for Science and Technology had been that there was nothing wrong with our science. And who would have drafted the reply for the Minister except the Secretary of the Department of Science and Technology who also happens to be a Fellow of our Indian National Science Academy? The last Chairman of the University Grants Commission never accepted the true state of affairs and held the view that science education was not bad. If I have to believe him, I will have to discover another meaning of 'bad'.

The Scientific Advisory Council to the Prime Minister[7] states, 'The application of S&T in a more intensive manner automatically generates a need for trained and skilled manpower planning. Training of such manpower is the legitimate function of universities, but the state of our universities has significantly deteriorated, with a proliferation of colleges with inferior facilities' and the recommendation suggested to correct this was that some national laboratories be given the status of deemed universities. Why should the government be blamed when the scientists recommend and the government accepts it? The Council constituted 15 subcommittees to examine important issues. None was there to look into science education. In contrast to this, in a conference of Indian physicists held in the National Physical Laboratory, New Delhi, 26–27 November 1954, to assess the issue of atomic energy, Jawaharlal Nehru had asserted that 'The issue of atomic energy had two components: a scientific one and a technological one. The former could be the domain of universities, but the latter to be restricted to the state alone – not for its national security implications as India was uninterested in military applications of nuclear power but due to the cost involved'.

The Indian National Science Academy got a document *India Science Report* prepared that had been presented to the Prime Minister recently. The document states 'Most developed countries keep a tab on the health of science and technological activities through "periodic science reports". These country reports are an important component in restructuring national S&T priorities and have played a large part in funding and monitoring S&T programmes in these countries'. Does this document serve this purpose? How can anyone better the health of any system unless one talks about the diseases that afflict the system? Under chapter 2, 'Education in Science and Engineering' it casually states that 'the science education system, as it stands today, needs a drastic makeover for the nation to really derive any competitive advantage'. It has not even devoted a page to substantiate this. The whole document deals with statistics, which would look impressive in numbers anyway since the country has a population of a billion plus.

As against this, let me cite only two examples from USA. Can we contradict that education in science and research in that country continues to be one of the best in the world? In 1957, when the then Soviet Union had sent the sputnik in space, the then President of United States was shocked at the state of science and technology education in his country and asked the scientists to go to the moon. He had said in his address at Rice University, Houston on 12 September 1962: 'We choose to go to the moon. We choose to go to the moon in this decade and do the other things, not because they are easy, but because they are hard, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one which we intend to win.' And they landed on the moon in less than a decade. Such shocks are given to the country quite regularly. One has only to look into another document brought out recently, 'A Nation at Risk', a report presented to the American Congress that stirred the soul of the nation. A knowledge economy woke up to the reality that their very basis, 'knowledge advantage' was disappearing. That set in immediate major reforms in their schools and educational institutions to prepare the young American minds in competencies that gave America their edge over other economies. Does our *India Science Report* serve any such purpose? One had only to listen to the address of Tony Blair, the new President of the European Union delivered to the Heads of the nations recently. At one stage he emphasized that if the Union had to keep pace with the world, more specially USA, China and India, we must strengthen our university education. Do any one of us, the scientists and the political leaders, ever speak like this? No, because India is any way developing at the growth rate of seven per cent or so. So let the *chalta hai* attitude continue, why bother about anything.

I am not against national laboratories *per se* but am amazed at the couldn't-care-less attitude exhibited by us towards science education in universities. The standard of science in the country will never go up by taking care of only national laboratories such as Jawaharlal Nehru Centre for Advanced Scientific Research, Indian Institute of Science, Tata Institute of Fundamental Research, Centre for Cellular and Molecular Biology, a few more such institutes, and may be at the utmost a score of universities.

We suffer from national laboratories–institutions syndrome, which is reflected in our advising the government to start two national institutes for science education at Pune and Kolkata. If this very amount of Rs 1000 crores have been allocated to ten of the better universities and asked to start undergraduate classes with conditions attached to ensure excellence, I am sure, at least 20 times better graduates would have been produced. Universities do suffer from many problems, many of which could be resolved without any extra financial inputs. I have written a lot about them elsewhere. These should be rectified by discussions and not by neglecting them.

1. Lakhotia, S. C., *Curr. Sci.*, 2005, **89**, 1304–1305.
2. Raghuram, N., *Curr. Sci.*, 2005, **89**, 21–22.
3. Srivastava, P. N., *University News*, 2005, **43**, 7–12.
4. *Nature*, 1984, **308**, 581–600.
5. *Nature*, 1993, **366**, 611–626.
6. *Outlook*, 23 October 2000.
7. *Perspectives in Science and Technology*, Har-Anad Publications, 1990.

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Water and science in India

Rajamani *et al.*[1] discussed the potential impact of interlinking major rivers on India's monsoons. Their concern is that reductions in freshwater influx caused by river-linking could disturb the near-surface salinity of the Bay of Bengal, leading to perturbation of the monsoonal pattern. Reductions in freshwater discharges to the Bay of Bengal may also arise due to the large number of tanks in watersheds. Reportedly, the number of irrigation tanks currently existing in Tamil Nadu, Karnataka and Andhra Pradesh may total several tens of thousands. Clearly, India's natural resources base comprising rainfall, the landscape, the ecosystems and the environment is being noticeably affected by India's water resources use. Available scientific knowledge unequivocally indicates an imperative for careful water resources management, failing which India may face a national catastrophe in the future. Yet, spurred by short-term economic objectives and political expediency, water resources development in India is uncontrolled. There is no coherent water policy.

India's water crisis is a matter of concern for all citizens. This concern is reflected in many articles on water that one reads in national newspapers. They often express frustration with the inability of the government at various levels to achieve any significant amelioration of the water situation. In the absence of meaningful governmental action, the common desire is that India's water woes be somehow banished through a combination of modern technology and water policies. In this atmosphere, public debate is polarized. At the moment, water debates involve two extremes. One is the concept of transporting very large quantities of water across the length and breadth of the nation by linking major rivers, and the other is the vision of local communities taking control of their water needs through rain harvesting. What is missing in the debate is an inclination, on the part of those who espouse either solution, to frame their strategies within the context of the physical–chemical nature of water, and the complex ways in which water functions in the Earth and its biological systems. The debates invariably explore policy alternatives, with scant attention to scientific issues of water availability. The perception is that technology will somehow find more water through manipulation and control of nature, or that competitive markets will lead to efficient water use.

The ongoing water debate is healthy, and must expand. However, for achieving constructive outcomes, the debates must shift from confrontation to informed discussion. Critical to informed discussion is a basic understanding of the scientific aspects of water that constrain long-term sustainable water use at various levels from a village to the nation as a whole. Based on such understanding, communities must make critical decisions on complex water issues.

How may the stage be set for informed national discourse on water? One possibility is that the nation's scientific leadership dedicates itself to influence the government and educate the public on water and natural resources.

India's strength in science is reflected in its national academies. The Indian National Science Academy, New Delhi, was born in 1935, patterned after the Royal Society of London, with the object of promoting science in India and harnessing scientific knowledge for the cause of humanity and national welfare. Its counterpart in the United States is the National Academy of Sciences. The Indian Academy of Sciences, Bangalore, was formed in 1934, with the goal of promoting progress and upholding the cause of pure and applied sciences. Both the Royal Society and the National Academy of Sciences play influential roles in national and international science policies. Their contributions may arise either in response to solicitations from their respective governments, or in response to initiatives from their own membership.

India's unique problems of water utilization stem from its physiography, geology and climate, and its long history of human habitation. It is essential that India's science academies make a concerted effort to address these problems so as to guide national policy and facilitate public education. They should be pro-active, initiating action even without governmental solicitations.

Assuming that the academies will be so inclined, it is appropriate to outline the underlying scientific issues.

At the heart of water management lies the challenge of adapting social needs and aspirations to the hydrological cycle. Deceptively simple and profoundly complex at the same time, the hydrological cycle involves four components that dynamically interact on widely varying spatial and time scales: atmosphere, surface water, groundwater and biological communities. Individually, each component is characterized by complex geometries,