National priorities and the quest for scientific excellence

India has a hoary tradition in science going back to ancient and medieval times. The tradition is particularly strong in areas like mathematics, astronomy, medicine and metallurgy. However, the recent scientific enterprise in the country has no direct relation to this tradition. The springs of the old Indian scientific genius began to dry up well before the British gained ascendancy in India. Modern science, as we understand it today, is essentially a product of European renaissance and it was brought to India by the British. The primary motivation of the British rulers does not appear to have been the enlightenment of Indians. The main purpose was to survey the natural resources of India with a view to exploiting them. The Survey of India was established in 1767, within a decade of the battle of Plassey in 1757, which marked the ascendancy of the British in India, to consolidate the territories of the British East India Company. The Geological, Archeological and Botanical Surveys of India were established in 1851, 1861 and 1890 respectively. The India Meteorological Department started functioning in 1875.

The early Indian initiatives in modern science arose, almost inevitably, in Bengal, particularly Kolkata (then Calcutta), which is often described as the springboard of Indian renaissance inspired by a combination of Western liberal ideas and traditional Indian values. The first scientific organization to be established on an Indian initiative was the Indian Association for the Cultivation of Science founded in Kolkata in 1876 by Mahendralal Sircar. The organization became a centre of vibrant scientific research only when C. V. Raman entered its portals in the early years of the 20th century. The early giants of Indian science like J. C. Bose and P. C. Ray, both friends of Rabindranath Tagore, were driven to a substantial degree by nationalism. The instance of Raman refusing to comply with the condition of foreign training associated with the Palit Professorship of the Calcutta University is well known. The nationalistic spirit was evident in the next generation of science leaders like M. N. Saha, S. N. Bose and K. S. Krishnan as well.

It is the nationalistic urges of J. N. Tata that led to the founding of the Indian Institute of Science at Bangalore in 1909 on land provided by the then Maharaja of Mysore. The Indian Science Congress Association was established in 1914. The three national science academies of India started functioning in the thirties of the 20th century. Thus the first few decades of that century witnessed the emergence of an indigenous scientific community in the country in addition to that of significant specific scientific contributions from India. This resurgence of Indian science during that period paralleled, and to an extent derived inspiration from, the growth of the national movement in the country.

The way science is done underwent a major change with the Second World War. Scientific research became increasingly dependent on large instrumental facilities and substantial financial support from the government. Involvement of industry has also been important, particularly in the West. Compared to the pre-war period, scientific research became a highly organized, facility-based effort. Newly independent India, under the enlightened leadership of Jawaharlal Nehru, was sensitive to the requirements of modern science. Nehru and great institution-builders like Homi Bhabha, Shanti Swarup Bhatnagar and many others laid great emphasis on developing infrastructure for research and science education at the highest level. This was indeed perceived as very much part of national reconstruction.

Young scientists in independent India adopted different paths in their personal career. Most had some training in the West, in a majority of cases as postdoctoral fellows and in many cases as doctoral students. A substantial section of them remained abroad for a variety of reasons. Some did so as they did not find career opportunities in India. Some others perceived working in the West as an easier option and as an escape route from the harsh Indian reality, especially in the early decades of independent India. There were also youngsters who wanted to do cutting-edge science, which they thought was impossible to do in India. Those who returned to India or remained in India were also motivated by a spectrum of considerations: family ties, inability to secure positions abroad and genuine urge to work in the country. The fact that India used to be often considered as a basket case in the fifties and the sixties fuelled in some the urge to return to India. One realized the full impact of our underdog status when staying abroad. Different people reacted differently to the situation. Some of us retuned to India with fire in our belly, determined to build up or strengthen our own areas of science in the country against heavy odds. Scientific research is exciting, but the commitment to India is equally compelling.

Science is truly international, but its pursuit is strongly influenced by the social and the national context. Science is intimately related to technology and development, and involves heavy investment. It is not accidental that developed countries are also global leaders in science. The utilization of science for development and national reconstruction is particularly important in developing countries. To an extent, nationalism could be a positive force for the less endowed. In any case, the national and international identities need not be mutually contradictory. They could well be complementary.

Science involves a celebration of excellence and each scientist is expected to strive for excellence in the given circumstances. Science is also a community activity and an instrument for development and societal well-being. Therefore, the responsibility of scientists, especially in developing or emerging countries, includes establishment of research schools, institution-building and mentoring of the younger generation. The solution of a fundamental scientific problem is space and time-independent, but the choice of the problem need not be. For instance, many of the molecular mechanisms of life processes have been elucidated using the bacterium, *Escherichia coli*. In the Indian context, however, it is just as well if one used an organism like *Mycobacterium tuberculosis*, the causative agent of TB, for this purpose, as that would also contribute to the understanding of the pathogen. No two organisms are exactly the same. Therefore, it might be sometimes necessary to explore fundamental processes in the pathogen, even if they have already been addressed in *E. coli* or in some other organism. An understanding of pathogen-specific funda-

mental processes would certainly aid rational development of drugs and vaccines. It is often good fundamental research and a prepared mind that would lead to applications. Furthermore, fundamental research is necessary to thoroughly understand the pathogens in order to combat them on a long-term basis. In countries like India where infectious diseases are endemic, such research becomes a national priority.

Fundamental research on microbial pathogens has been dealt with above only as an example. As R. Chidambaram, the Principal Scientific Advisor to the Cabinet, has indicated in his enunciation of what he describes as directed basic research, similar opportunities can be found in every sector of our developmental agenda[1].

It is often rhetorically asked as to when an Indian working in India would get a Nobel Prize. As Venki Ramakrishnan, a Nobelist of Indian origin, has mentioned, getting Nobel prizes is not the objective. The objective should be to raise the overall standard of Indian science. When the overall level is high, peaks are more likely to emerge. As I had argued earlier, reforms in the structure of Indian science and the educational system are a pre-condition for substantial progress[2–5]. But they are not enough. It is important that we develop more self-confidence and become less dependent on the approval of colleagues in the West for doing our own thing. Undoubtedly, the centre of gravity of modern science is still in the West and we have much to learn from the pursuit of science in developed countries. However, after careful consideration, we have to choose our problems and approaches ourselves and stick to them on a long term basis. Indian scientists who have made a global impact are those who have done so. As a corollary, we have much to learn from non-resident Indians and we need their help. However, Indian science, as it exists today, has been built up by scientists who remained resident, often braving difficult circumstances. What is required is to improve the conditions for the pursuit of science in India so that residents become more productive and non-residents are encouraged to return.

Science derives its strength from plurality in its practice. Ramanujam, the mathematician, was an all-time genius. It is futile to search for a national relevance to his activities. We can only rejoice that India produced a colossus like him. C. V. Raman was among the founders of modern physics. He was also a great mentor. J. C. Bose consciously remained an academic scientist. His contemporary P. C. Ray, on the other hand, made pioneering contributions to Indian industry. All these and many more different strands went into making the vibrant fabric of Indian science in the pre-independent era. The same kind of plurality continued to be the hall mark of Indian science after independence. Some, like G. N. Ramachandran, concentrated exclusively on excellent research. On the other hand, leaders like Bhabha and Bhatnagar were great institution builders. Bhabha, a distinguished theoretical physicist, stopped his personal research to devote himself fully to institution building and national science leadership. There are many who combine excellent personal research and an effective leadership role. Some consciously orient their research to cater to the national requirements. Such an orientation of effort need not necessarily involve a compromise in quality. If it is perceived by some as a compromise, it is a price worth paying for contributing to the advancement of an emerging country like India.

1. Chidambaram, R., *Curr. Sci.*, 2007, **92**, 1229–1233.
2. Vijayan, M., *Frontline*, 4 December 2009, p. 96–99.
3. Vijayan, M., *Curr. Sci.*, 2009, **96**, 451.
4. Vijayan, M., *Curr. Sci.*, 2011, **100**, 815–816.
5. Vijayan, M., *Curr. Sci.*, 2011, **101**, 605–606.

M. VIJAYAN

Molecular Biophysics Unit,
Indian Institute of Science,
Bangalore 560 012, India
e-mail: mv@mbu.iisc.ernet.in

Headhunters needed

While commending Gowrishankar's[1] suggestion to consider performance-based funding, I would like to state that a panel of scientists may be set up to spot talent, especially among the youth. This should be done by constant screening of journals, Indian and foreign, to see who is publishing what from various institutions in India. And if found worthy, encourage them to further develop their research through funding and advice. Many a times, just a letter of encouragement may be sufficient to give the initial push. In my period of stay in a private medical institution in India, I met a young pharmacologist who almost synthesized 'artemisinin' by an alternate route, but gave up due to lack of encouragement from his peers (B. K. Rao, pers. commun.). A young biochemist who found evidence of cyanide-resistant electron transport in amphibian endothelium (and published a couple of papers[2]) gave up research to take up a bank job because she could not get a teaching job. I think it is time to set things right.

1. Gowrishankar, J., *Curr. Sci.*, 2011, **101**(7), 823.
2. Rao, R., Nalini, K. and Rao, J. P., *J. Biosci.*, 2009, **34**, 849–852; Rao, R. and Rao, J. P., *J. Biosci.*, 2010, **35**, 519–525.

J. PRAKASA RAO

Department of Physiology,
College of Medicine,
American University of Antigua,
Antigua, West Indies
e-mail: jprao2001@gmail.com