Back to the future II

Ranganathan[1] harks back to what a great nation India was before the 19th century. Some simple calculations can give us a reality check on how dangerous the optimism behind the editorial is.

Let us first start with economics. It is tempting to argue that with the kind of economic growth India is now registering, it will soon regain its earlier glory (when together with China, it accounted for 80% of the world GDP). At present, with about 16% of the world population (demographic weight), it accounts for about 1.6% of the world GDP (economic weight). It is therefore pulling at 1/10th of the world average (think of each country as being a train being pulled by a locomotive which is under- or over-powered). When will India begin to pull just at world average, i.e. 16% of the population accounting for 16% of world GDP?

Let us assume that for the next n years, India will grow economically at 8%, while the world economy as a whole grows at 2%. Let us also assume that demographically, India grows at exactly the same rate as the world. Then, we can find that after 40 years, India will just reach the world average. This is obtained from the simple calculation:

$$(1.6\ (1 + 0.08)^n)/(100(1 + 0.02)^n) = 16/100.$$

Being average is not much to boast about. USA has 5% of the world's population, but accounts for 25% of the world GDP (pulls five times the world average.)

Let us now turn to scientometrics. It has recently become fashionable to compare India with China. The reason why these two countries fell behind economically (from 80% of the world GDP to 10% in less than two centuries) is because they neglected science and technology. Table 1 shows a recent scientometric assessment.

Let us assume that over the next m years, China does not add any more scientists to its workforce in R&D and that India adds at the rate of 4500 a year. Then, just to catch up with what China is today: 735,000 scientists to be added, at 4500 per year, it will take us 163 years.

These two simple projections give us cause for some pause to reflect upon the 'dangerous optimism' exuded in the Guest Editorial.

Table 1. Scientometric assessment

	India	China
Science funding 2002–03 (US $ billions)	3.7	15.5
Workers in R&D	115,000	850,000
Doctorates produced per year	4500	40,000
SCI-listed publications 2002–03	19,500	50,000
Percentage share of global publications	1.9	5

1. Ranganathan, S., *Curr. Sci.*, 2006, **91**, 1123–1124.

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Nypa fruticans needs more conservation efforts

Nypa fruticans is a mangrove palm found distributed in South East Asia and Australia. It was considered to be widely distributed in the east and west coasts of India several centuries ago[1]. However, presently it is found in the Sunderbans, and Andaman and Nicobar Islands along the Bay of Bengal. Although several mangrove plants have been taken up for revegetation of mangrove forests in India and elsewhere, *N. fruticans* has not been considered either for plantation in other mangrove sites or for conservation. Hence its plantation in other mangrove formations along both the east and west coasts of India may be considered and attempted.

1. Badve, R. M. and Sakurkar, C. V., *Curr. Sci.*, 2003, **85**, 1407–1409.

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Science and faith

Most of us would agree with Karanth[1] that if a belief of any kind brings relief to a person from any kind of suffering, it is most welcome. Most of our concerns in daily life (probably more than 99%) are outside the ambit of science. They depend on some value or social attitude. Belief (or faith), conscious or unconscious, is necessary for us in making day-to-day decisions.

However there are small areas which are scientific. They have a well-established scientific method to be used in exploring them. Everyone, specially the students of science, should become aware of the value and importance of this method which has been so successful in recent centuries, though restricted to a small part of our lives.

More than 30 years ago (in 1973), an interdisciplinary conference was held at

the Indian Institute of Science, Bangalore. One of the topics discussed was the production of material out of thin air by Godmen, in the context of conservation laws for mass and energy. A well-known economist was puzzled. He said, 'Why be rigid? Violation of conservation laws must be occurring all the time to some extent or the other. How does it matter?'. Many scientists rushed to explain that even small violations of this nature are way above the uncertainties in the conservation laws. Violation would be of great concern to the scientists.

What one is asking for is clear awareness of which are the areas of natural science subject to scientific method and which are not. Astrology is taught in several universities in India. At Delhi it is taught in the Department of Sanskrit. I would not like it to be studied or taught in any science department.

There is no demand in India for dismantling of beliefs, faiths or religion. There is, however, a need and demand for application of logic to remove superstitions and biases. However, science occupies a space which is quite different from that occupied by superstition and biases. Whatever one's attitude to superstitions, one can believe and practice science. This is what one is asking for. Live and let live.

1. Karanth, R. V., *Curr. Sci.*, 2006, **91**, 567.

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Conservation awareness and research to protect rare plants

The Millennium Ecosystem Assessment, a comprehensive analysis produced by 1360 scientists, determined recently that the health of the world's ecosystems has been severely damaged[1]. Ecosystems provide essential services to people around the world. Of the 24 ecosystem services examined, including provision of freshwater, food, regulation of climate and air quality, the assessment found that 15 (62.5%) of them are being degraded or used unsustainably[1]. Furthermore, another assessment from the World Conservation Union summarizes a grim statistics on the current status of global plant diversity – of 70% of the plant species assessed, 45% has been classified as endangered or critically endangered[2].

India is among the 25 hotspots of the richest and highly endangered eco-regions of the world and it harbours a diverse species of fauna and flora. The enchanting wild animals such as elephants, rhinoceros, lions and tigers have been given considerable conservation attention over the last few decades; but the less attractive plants have thus far been overlooked. Plants play a major role to give life on the planet by tapping the sun's energy. They serve as food source for many animals as well as humans. They also improve the quality of the air that we breathe. However, people tend to admire and appreciate animals more often than plants – why?

As a matter of fact, people do not see all of their surroundings by just opening their eyes. Objects that are between 0 and 15° below the eye level receive more visual attention. Researchers have calculated that each second, the eyes generate over 10 million bits of data for visual processing, but the brain extracts only about 40 bits and fully processes only 16 bits that reach our conscious attention[3]. Usually the brain searches for movements, colours/patterns, objects that are known, and other potential dangers/threats. In general, plants are stagnant and mix well with the background, and they seldom pose a threat to people; so they miss our visual attention[3]. As a result, there is a natural human tendency to ignore plants; therefore it is important to promote plant conservation to create public awareness on the role of plants in maintaining life on our planet.

India's plant endemism is estimated at 33%, with 140 endemic genera[4]. Forested areas in the northeast, Western Ghats, northwest and eastern Himalayas are considered the richest in terms of plant endemism. Besides, the Andaman and Nicobar Islands contribute at least 220 species to the endemic flora list. About 6% of the global diversity of flowering plants (15,000 species) occurs in India alone[4]. However, threats ranging from habitat destruction to biological invasion and commercial exploitation to pollution from use of nitrogen/phosphorus fertilizers continue to threaten the survival of endangered plants in India and elsewhere. Biological invasions are a major environmental concern due to their negative impacts on biodiversity and economics. There is no science to predict which in-

Figure 1. A natural pond in Tamil Nadu, South India infested with two invasive plants, *Ipomoea carnea* and *Eichhornia crassipes* (Photo: G. Agoramoorthy).