

COMMENT

ATMOSPHERIC SCIENCE Regulate China's air quality for global impact **p.161**

FICTION Michael Frayn on expressing uncertainty through farce **p.163**



HISTORY Thomas Kuhn's paradigm shift **p.164**

OBITUARY Sherry Rowland's battle to save the ozone layer from CFCs **p.168**

ILLUSTRATION BY JONATHAN BURTON



Bold strategies for Indian science

For a nation of its talent and education, India deserves higher scientific standing. It needs clear and honest leadership, not more money, says **Gautam R. Desiraju**.

When an Indian prime minister publicly admits that India has fallen behind China, it is news. Manmohan Singh's statement last January at the Indian Science Congress in Bhubaneswar that this is so with respect to scientific research, and that "India's relative position in the world of science has been declining", has rung alarm bells. Singh was not springing anything new on Indian scientists; many of us will admit that things are not well¹. Recognizing the problem is the first step towards reversing this slide.

At present, India has a trickle-down strategy, in which elite institutions are

supported in the hope that good science there will energize the masses, and a bottom-up approach, in which the general public is targeted with schemes to popularize science.

These approaches have converged with the setting up in recent years of tens of new universities, institutes and centres of higher learning, even though many hundreds more are desirable for a country of India's size. Although there was, curiously, no increased allocation to science in this year's Indian budget, there is hope that, as the prime minister has declared, things would improve if government support were increased to 2% of the gross domestic product (it now stands

at 0.9%). But it is a haphazard plan, with no hint of new strategies. The assumption is that the answer to our problems lies simply in more money.

As someone who has worked in India for 34 years, I am impatient with our slow progress². At the glitzy level, we have had no Nobel prize winner since C. V. Raman in 1930, no highly Shanghai-ranked university, no miracle drug for a tropical disease and no sequencing of the rice genome. At the industrial level, there have been no breakthroughs to rival the telephone, the transistor or Teflon. At the organizational level, we do not have a postdoctoral ▶

► system worth its name, and our undergraduate teaching system is in a shambles. We figure occasionally in the best journals, yet we tolerate plagiarism, misconduct and nepotism. And yet, the innate abilities and talents of India are palpable. Why is it that this country has not been able to harness its strengths into deliverables?

Money is not the primary constraining factor in our problems, nor will an abundance of it solve them. More money is undoubtedly better, but if there are deep cultural and social problems, extra money will simply drain away. The rate of any improvement will not match the rate of increase in investment³. Big problems in big countries usually emanate from a small number of core reasons. An understanding of these reasons in the context of Indian science should stem from an appreciation of the country's historical, economic and sociological profile.

It is not enough for the prime minister to resort to platitudes by saying (as in his recent speech) that “things are changing but we cannot be satisfied with what has been achieved”, or that we should make “scientific output more relevant”. He and his advisers must ask themselves if there are underlying causes for this lack of satisfaction and relevance. Until then, no amount of bankrolling, populism, bureaucrat bashing or whistle-stop tours by prominent Western scientists will help.

A FEUDAL MINDSET

Two aspects of the Indian psyche are particularly troubling for a country seeking its rightful place in the modern world. Our cultural value system, backed by Hindu scriptural authority, has created a strongly feudal mindset among Indians. Centuries of servitude, right up until 1947, have made the average Indian docile, obedient and sycophantic. ‘Behave yourself and be rewarded’, is the pragmatic mantra. I believe this feudal-colonial mentality has had far-reaching and debilitating consequences for research.

The first is our lack of the ability to question and dissent that is so essential to science. Most of the faculty in our better institutions have done postdoctoral work in a foreign laboratory of consequence. Unlike young scientists in advanced countries, however, newly returned Indian lecturers typically relive their golden moments as postdocs throughout their research careers. The best research papers from India may be competent, but they do not inspire or excite. Very few Indian scientists are known as opinion-makers, trend-setters or leaders. They follow obediently.

Another consequence of this feudal mindset is our unquestioning acceptance — bordering on subservience — to older people. In this part of the world, age is blindly equated with wisdom, and

youth with immaturity. This facilitates the continuance of the status quo. Geriatric individuals with administrative and political clout reinforce their positions so well that we are unable to eject them. So we hail scientists in their eighties, film actors in their seventies and cricketers in their forties.

VARIANTS OF CORRUPTION

In healthy organizational hierarchies, the decision-makers are also active participants who have a stake in the future. We will have come of age only when Indian universities are allowed to appoint their own vice-chancellors, and institutes and national laboratories their own directors, rather than suffer the choices made by conclaves of old men in New Delhi.

The most important decisions in an academic system concern the appointment of faculty. This procedure is flawed in India. For a start, selection committees consist mostly of outsiders, and representation from within is often restricted to institutional and departmental heads. In the smaller state universities, all sorts of irregularities occur in the name of caste-based reservations. In the more influential central institutions, appointments are often made incestuously, with students of a few senior researchers filling a disproportionate

“More money is better, but if there are deep cultural and social problems, it will simply drain away.”

number of vacancies, or with plain academic ‘inbreeding’. A good dose of regional parochialism completes the picture. Corruption need not take a monetary form; in a national laboratory it can mean acquiescing to the notion that one's administrative head is also one's scientific superior. By that logic, and given our civilian-based system of administration, the secretaries in the science ministries in Delhi should be our most creative scientists.

These variants of corruption — along with general indifference, absence of incisive introspection, old-boys' networks, administrative vindictiveness, vagaries in research funding and studied silences — conspire to create an atmosphere that lacks innovation and creativity. Impact factors and *h*-indices become the sole arbiters of scientific excellence in such an environment. If policy-makers are ignoring cultural parameters, scientists are looking only at numerical parameters.

The true measures of a country's scientific strength are found in the numbers of competent teachers and lively students in schools and undergraduate colleges, because these translate into real gains in the future. Fluffy factors, such as the numbers of

articles in *Nature* and *Science*, do not tell the real story. As a chemist, I would say that it is better to move deliberately and confidently towards the thermodynamic minimum (a system's most stable state, which has the lowest energy but is not always the easiest to achieve) rather than flit anxiously between any number of metastable kinetic states (which are easy and fast to access but have higher energies).

A large country with a well developing economy can afford this long-term strategy and vision. China need not be a comparison point⁴ — India is endowed enough to seek its own solutions for its problems⁵.

THE WAY FORWARD

I suggest that our policy-makers consider the following. First, provide modest funding to a very large number of small, single-investigator, blue-sky projects — including those in state universities — to achieve a critical density of ideas and a feeling of mass participation and enthusiasm.

Second, provide heavy and directed funding into a few specific projects of national importance — such as energy, water and public health — with high levels of accountability and proper exit options. Third, reduce or abolish the present system of awards, prizes and recognitions in higher-level science. This would dissuade younger scientists from chasing awards rather than doing good science, and it would reduce the influence of the cliques who allocate prizes.

To reach a stable solution, we can employ longer-term measures that include modification or removal of caste-based quotas and reservations in the educational and research sectors; improvement of undergraduate teaching institutions and teaching laboratories with respect to greater uniformity and transparency; and clear identification of paths towards scientific and administrative growth for individuals.

Money is neither the cause nor the solution to our problems, although it can facilitate progress in an otherwise healthy climate. What is lacking in India is the quality of leadership and the level of honesty that are required for a breakthrough. When will this country see another C. V. Raman? ■

Gautam R. Desiraju is a professor of chemistry in the Indian Institute of Science, Bangalore 560 012, India. He is president of the International Union of Crystallography. e-mail: desiraju@sscu.iisc.ernet.in

1. Jayaraman, K. S. *Nature* <http://nature.com/doi/10.1038/nature.2012.9750> (2012).
2. Desiraju, G. R. *Econ. Polit. Weekly* **43**, 37–43 (2008).
3. Shi, Y. & Rao, Y. *Science* **329**, 1128 (2010).
4. Kostoff, R. N., Bhattacharya, S. & Pecht, M. *Technol. Forecast. Soc.* **74**, 1519–1538 (2007).
5. Desiraju, G. R. *Angew. Chem.* **123**, 5704–5705 (2011).