Indian biological sciences: aiming even higher

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The 3 February issue of the *Journal of Cell Biology* (*JCB*) carried a cover image of the Taj Mahal and a special report with the subtitle 'Aiming high' on the biological sciences in India. For those with limited knowledge of science in India, the article by Ron Vale and Karen Dell, containing an impressive compilation of facts on Indian biological sciences, is useful and presents an American perspective that is valuable. Yet in my opinion the article was limited, portraying as it did the status, achievements and challenges faced by Indian science, through a traditional Western lens.

The US scientific and academic systems have been undeniably and deservedly the envy of the world. There is an excellent reason why students from around the world head to USA to do science. But despite their historic success, are all aspects of the US model appropriate for other countries to follow? In this day of easy information exchange, would it be equally tenable to propose that other countries should focus on scientific areas ignored in the West? And to develop systems and approaches that maximize their global competitiveness? In this context, Vale and Dell have touched, but lightly, on an issue of particular significance for Indian science and Indian scientists who are likely to be the main readers of this particular article.

Seasoned American scientists are best positioned to comment on one important but uncomfortable question. What mistakes in the American scientific and academic systems should India avoid before it becomes too heavily committed to follow specific directions? There are two reasons why this question is rarely, if ever, formally addressed by American scientists. First, from an institutional perspective, introspection could reveal uncomfortable truths about the system, which would undermine their continual quest for greater financial investment from the public and private sources. Second, from an individual perspective, public admission of one's weaknesses is considerably more difficult than a discussion of one's strengths and successes. So, are there significant problems with the American system?

Explore different areas and strategies

My late friend and colleague, Danny Brower (University of Arizona) observed, with his characteristic, uncompromising honesty, that a major problem in American science was that scientists 'did not practise birth control'. Meaning, of course, that an outstanding *Drosophila* developmental biologist for instance might 'produce' 50 postdoctoral fellows to populate their subfield and these, if successful, would produce more 'scientific progeny' of their own. While the talent of young scientists is undeniable, it is reasonable to ask, even at a difficult time for young US scientists led to expect more support, how many research laboratories must one have in any subfield?

I suggest that one failing of the US system is its huge focus on areas of biological sciences that have been deemed to be important or exciting by a subset of scientific luminaries. This, in itself, is not a problem. It is hard to be anything but enthusiastic and amazed by discoveries in genetics, cell biology and neuroscience and many distinguished Indian scientists, including some identified by Vale and Dell, operate successfully on the frontier of these areas of biology.

However, a destructive consequence of selective expansion in these focus areas is the continued neglect (or polite tolerance) of other fields. I hold that it is intensely important for Indian institutions to identify and pursue vigorous, fearless and creative scientists who propose to explore scientific areas and approaches poorly supported in the US. One such area of research may be the characterization of molecular, physiological and morphological variation in biology. For the same total investment, greater reward may be obtained if modern knowledge and technologies are used to advance relatively virgin fields.

As an approach, I suggest the articulated support of inventive rather than explorative biology as a strategy to ensure intellectual engagement of researchers who may otherwise easily slip into description of an almost limitless biological universe. There are two further arguments in support of this strategy. First, as invention is often a more direct route to biotechnology than biological discovery, such a strategy may more efficiently drive the industry. Second, as the environment for biotech start-ups changes (I have heard it said that biotech in the US cannot get venture funding these days with progress that would have been sufficient for a successful IPO in 1995), this would allow academic science to assume more of a role for the extended early stage of biotech company development.

Allow scientists to focus on excellence

A hugely important task of the scientific and academic administration is to create an environment in which learning, discovery and invention can flourish. At a 2007 conference in the Janelia Farm campus of Howard Hughes Medical Institute, I sat at a table with four 40-something colleagues. As tenured full profesors we were each, in our modest ways, productive, successful and motivated scientists in well-known US research universities. As the conversation drifted away from scientific issues, we found that none of us would recommend a career in academic science to our school-going children. None at the table was surprised at this consensus, and we did not feel the need to articulate our individual reasons. Enjoyment of science contributes hugely to creativity and success: why were we uncomfortable recommending our jobs to our children?

When asked if he was 'happy' being the President of the US, John F. Kennedy answered in the affirmative after defining the state of happiness as 'the full use of your powers along lines of excellence'. Do the funding and university governance systems in the US allow young scientists the opportunity to focus their efforts on excellence? I suggest two major ways in which they do not.

The first tragedy of training in biology in the US is the need for an extended postdoctoral period. By placing the prospect of scientific independence a

good 10 years away from an entering Ph D student, this reduces a student's expectations and so greatly devalues the period spent in graduate school. It also ensures that the most fearless and creative period of a young scientist's life is spent as an apprentice, usually to luminaries who define areas of immediate scientific importance. It is difficult for a 38-yr-old Assistant Professor with children, a mortgage, aging parents, and a list of defined expectations for continuing employment (external grant funding, x number of papers, y number of committees, good evaluations from z number of courses) to approach science with the unfettered enthusiasm of one who is 28 or younger. India should not make this mistake.

The second disappointment is intrinsic to the system of peer-reviewed funding. Though possible for the chosen few, it is difficult if not impossible for the usual excellent scientists to move into areas in which they do not have established expertise. Lateral moves into rich new fields of science that a scientist is actually excited about are strongly prevented. Thus, scientists rewarded for conservative and incremental advancement of their established areas of expertise, age with their fields. In my own case, discontent with this issue contributed to my resigning from a tenured professorship among terrific colleagues in the University of Arizona, to move to a Science Foundation of Ireland-funded position in Trinity College Dublin. An often heard fantasy in American academia is to have small but relatively stable funding for all productive scientists. This would allow wide involvement in small-scale research. In cases where the investigators are innovative, or lucky, breakthroughs may occur in unexpected areas of biology. Where investigators stick to more pedestrian research, this would, at a small cost, allow them to be part of the research enterprise and to expose students to methods of modern biology. Small science could be expanded when real breakthroughs are made via larger, but more difficult to obtain grants.

A possible limitation of the US biological sciences is its dependence on funding from the NIH, an agency charged with promoting research that leads to the advancement of human health. Historically generous funding from the NIH has led to a university system that is deeply dependent on such funds for its normal function. Thus, faculty are recruited and rewarded for their ability to attract large NIH grants. In non-NIH-funded areas, science is relatively neglected. Science at its creative best is an end in itself. Skewed focus on profitable results rather than on effort and excellence actively inhibits the expression of creative intelligence. Richard Feynman once observed 'science is like sex: sometimes something useful comes out, but that is not the reason we are doing it'. India, where the majority of funding for biological sciences comes from agencies charged with advancing science and technology, rather than human health as the NIH, may be ahead of the game here.

The dangers of gurus and the cult of personality

Status seeking and status recognition are intrinsic to primate societies. However, a major requirement for an innovative and vibrant scientific community is support and opportunity for advancement of motivated young scientists with untested ideas. This is inhibited by the cult of personality, in which the opinions of annointed gurus or 'leaders in the field' wield huge influence. Contemporary Indian science is lucky to be rich in influential, excellent scientists who retain remarkable altrusim, humility and accessibility. An unsung contribution of these scientists is to transfer the purpose of individual scientific enterprise away from personal fame to the process of academic research and teaching. From this perspective, Vale and Dells' loud selection of 14 Indian scientists as 'Leaders in Indian biology' appears poorly considered.

Vale and Dell are to be applauded for their unusual choice of a sabbatical destination and also for the interest, effort and involvement required for the compilation of data on Indian science. But their article goes beyond a review of facts. Did their 8-month sabbatical in India give the authors all the knowledge required to select 14 scientists as leaders? And was it useful to list them? While Vale and Dell are certainly entitled to their views, publication in *JCB* endows their opinions on the relative importance of Indian biologists with the appearance of authority and significance. I suggest that the list is likely to embarass many included and certain to offend several who have been overlooked.

In this context the journal cover image of the Taj Mahal, a 17th century monument commonly used to advertise package tours to the Orient, does little to convince the reader of a nuanced view of India. Well-travelled Indians are only too familiar with a trapped feeling when cornered by the Western tourists who begin their account of an Indian vacation with 'we went to the Taj Mahal and it was just fantastic'. To borrow from Albert Londres mocking the impatience of the West: 'everybody went to see the mystery and apparently saw nothing. Mystery cannot be seen my friend. It can be sensed. It is expressed without words. It is abundant in the deserted alleyways'. One is grateful for the tourist who speaks instead of the utility of a paan shop while waiting for a local bus, or of the complexity of life seen from a train window. Indeed, an image of an Indian train passing through the rural countryside may have made a more appropriate cover.

I suggest the need for more visible debate on the limitations of the US and European systems and on potentially promising paths that the Western academia has not followed. It would also be valuable to widely and actively consider novel approaches and directions in biological research possible in India, that the US might consider if it were possible for them start again. After all, to make a difference in the global scene, it helps to be different.

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