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EDITORIAL

Biology in India: Through the Looking Glass

'The time has come,' the Walrus said,
'To talk of many things:
Of shoes – and ships – and sealing wax –
Of cabbages and Kings –
And why the sea is boiling hot –
And whether pigs have wings.'

—Lewis Carroll
Through the Looking Glass

In Lewis Carroll's magical sequel to *Alice's Adventures in Wonderland*, Alice speaks to her kitten: 'Now, if you'll only attend Kitty, and not talk so much, I'll tell you all my ideas about Looking-glass House. First, there's the room you can see through the glass – that's just the same as our drawing-room, only the things go the other way. I can see all of it when I get upon a chair – all but the bit just behind the fireplace. Oh! I do so wish I could see *that* bit.' When Alice dreams her way through the looking glass she notices 'that what could be seen from the old room was quite common and uninteresting, but that all the rest was as different as possible'. It is here that Alice encounters Carroll's immortal creations, Humpty Dumpty, Tweedledum and Tweedledee and the White Knight. I was reminded of Alice when I encountered the February 9 issue of *The Journal of Cell Biology* (*JCB*). Shimmering in the background behind the Taj Mahal was double-stranded DNA, stretching infinitely into the horizon. The journal's cover welcomed readers 'Inside Indian Bioscience'. Even as I wondered about the connection between one of the most enduring symbols of India's past and DNA, I found the article to which attention was drawn by the cover designer, *The Biological Sciences in India: Aiming High for the Future* (Vale, R. D. and Dell, K., *JCB*, 2009, **184**, 342). The authors who spent an 8-month sabbatical at the National Centre for Biological Sciences (NCBS), a unit of the Tata Institute of Fundamental Research (TIFR), provide an overview of the 'past, present and future of Indian bioscience'. As I quickly leafed through the article I found photographs and two line sketches of 'leaders in Indian biology'. The selection seemed curious. I could not help wondering if, like Alice, the authors were portraying the characters they had encountered. To my dismay, despite not being sighted by the authors, I found my own photograph on the last page, conjuring up visions of Humpty Dumpty. Normally, I would have allowed the matter to rest if I had not received a submission to *Current Science* entitled 'Indian biological sciences: aiming even higher' (see Ramaswami, M., p. 639, this issue). The author characterizes 'Vale and Dell's loud selection of 14 Indian scientists as leaders in Indian biology' as 'poorly considered'. This piece is a critique of sorts, describing the Vale–Dell article as 'limited, portraying as it did the status, achievements and challenges faced by Indian science, through a traditional western lens'. The author, presumably because of his closer association with Indian institutions, views biology in India through a lens which has a different tint. Now that 'Indian biology' is being examined through various lenses, one wonders how many views will emerge if the community looks inward, in an attempt to understand the past, assess the present and plot a strategy for the future.

The Vale–Dell *JCB* article and Ramaswami's critique must be read by biological scientists (and indeed scientists in other areas), for they represent the assessment of 'outsiders', which must undoubtedly be distorted by the prism through which they view their subjects. However, they do convey a feeling of optimism that is hard to generate from observers who are embedded in the Indian system. Vale and Dell suggest that biology in India took root much later than the physical and engineering sciences. For them, and I am sure their view is shared by many, the introduction of molecular genetics at TIFR in the early 1960s marks the foundation of a 'truly modern molecular biology research unit'. As an aside, I must note that in my early years as an observer of 'molecular biology', I was always mildly puzzled by the total absence of molecules as chemical entities in any discussion. My own prejudices would have led me to point to G. N. Ramachandran's work on collagen in the early 1950s and his seminal work on protein conformations in the early 1960s, work that finds a mention in the Vale–Dell article, as a turning point in the evolution of modern molecular approaches to biological problems. This work emerged from a physics department of a conventional university and was remarkable for its anticipation of the role of interdisciplinary approaches to the problems of biology. In some ways the 1950s did see the parallel evolution of two distinct

schools of 'new biology'; the structural approaches of Linus Pauling and the Cambridge crystallographers on the one hand and the geneticists of the Delbrück school on the other. The early work in India was indeed of a high order, comparable in many ways to cutting edge research in the West. Much has changed in the intervening decades. Biological research has exploded in all directions and the Indian research landscape has altered dramatically. Science in India has emerged from an era of limited funding and poor infrastructure only in the last twenty years or so. As new institutions have been built, modern laboratories staffed by young researchers have provided a fresh thrust to biology research in India. It is this changing research ambience that Vale and Dell attempt to capture.

The Vale–Dell view of the origins of biological research in India is limited; disregarding in one stroke, much of the base of biochemistry and classical biology that did exist for many decades. They note that, 'until the 1960s biological research was largely directed towards pragmatic applications in agriculture, nutrition and public health'. Curiously it is these very areas that are still dominant in the minds of those who hope to see that biological research is indeed translated into solutions for real-life problems. Unfortunately the foundation that existed in biochemistry and 'classical biology' was swept away when the molecular genetics revolution exploded in the 1970s. Molecular biology in India often distanced itself from its classical roots in botany, zoology and systematic microbiology in this period and was hesitant in building bridges to the chemical and physical sciences. The reintegration of biology in the wake of the genomics revolution in the 1990s and the coalescence of the broad biological concepts of natural selection, mechanisms of inheritance and the chemical basis of information transfer, together with the spectacular advances in the technologies of experimental research have raised new and formidable challenges for the practice of competitive and cutting edge research in biology.

For Indian biology to aim 'high' or 'even higher' an understanding of some constraints may be valuable. Vale and Dell point to some of these. They note that the total number of faculty in the biological sciences in 20 of India's key institutions is 'less than the number of faculty holding NIH grants at the University of California, San Francisco'. The number of postdoctoral fellows in Indian laboratories is very small and they note that the 'University of California, San Francisco alone has ~1100 postdoctoral fellows', a number considerably larger than the total number in all the modern biology laboratories in India. While 'postdocs' are the major labour force in US laboratories, Indian counterparts rely on graduate (Ph D) students. Training is an important activity and it is this group that moves on to Western laboratories where they perform very well. Another component that is largely missing in Indian institutions are skilled technicians. There is little appreciation for developing and promoting technical skills which have become critical to the advance of biological research. Even as Indian biology laboratories acquire sophisticated instrumentation there is a growing awareness that the full potential of the new facilities will not be realized unless there are 'technical experts', who understand their craft. There is a common failing which results in equating maintenance and operation with an understanding of complex methodologies. It is hard to see a dramatic change in the near future, unless there is a move to encourage technical proficiency. At the level of entry to biological research the problem of preparation of undergraduates needs to be addressed. The ubiquitous 'biotechnology' courses appear to be doing considerable damage by failing to teach the requisite chemistry, physics and mathematics. Indeed, it is this poor foundation that sometimes acts as a limitation in keeping up with the latest advances in biological research. In the 1980s Arthur Kornberg once lamented, in characteristically eloquent fashion that 'molecular biology in its turbulent advance washed away the bridges to cellular chemistry'. The integration of disciplines has since been established quite firmly in the West. This is still to happen in India. Indeed the creation of many new, small institutions as 'islands of excellence' has promoted over-specialization of faculty and students. The external view of Indian biology is provocative. Viewing ourselves through the looking glass may yield some interesting insights.

I must yield to the temptation of ending, as I began, with Lewis Carroll, although this may be an unwarranted digression. Some readers may wonder: 'Did he have any link to biology?' Curiously enough in *Looking Glass*, Alice wonders aloud to her kitten: 'How would you like to live in Looking-glass House, Kitty? I wonder if they would give you milk there? Perhaps Looking-glass milk isn't good for you.' This is indeed a reference to Pasteur's spectacular work on organic stereochemistry in the 1850s. Lewis Carroll in 1872 may have anticipated the consequences of chirality in biological recognition. For readers who are historically inclined the Van't Hoff-LeBel ideas were to appear in 1874 and Emil Fischer's 'lock and key' hypothesis was over two decades away.

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