Biology in India

I was inspired to write this letter after reading M. Vidyasagar's thoughtful and provocative response[1] to the excellent articles 'Biology in India: Through the Looking Glass' by P. Balaram and 'Indian biological sciences: aiming even higher' by Mani Ramaswami[2,3]. I have been on the faculty at the University of California, Berkeley, for 27 years and have had extensive interactions with the NIH and Department of Energy, and some interactions with other agencies that support biomedical research in the UC. Thus, although I am only marginally cognizant of the current state of biological research in India, I am reasonably well informed about its practice in the US, which is relevant to points made in these highly interesting commentaries.

I found Ramaswami's article full of insight and constructive suggestions, chief among these the notion that the development of biological research in India not be overly influenced by the patterns in the US. He invited criticism of how biological research is conducted in the US, and Vidyasagar responded with a spirited account of his considerable experience with the US biological research enterprise. I have many points of agreement with the assessments of both Ramaswami and with Vidyasagar.

Ramaswami's cogent point that too much effort and money is spent on too narrow of a research focus matches my view perfectly and those of many of my colleagues. So one has to ask, why does this situation exist? Who is behind the evil force confining the breadth of funding from matching the range of scientific ambition and creativity of its practitioners? I am sad to say that in the US, to quote a famous cartoon character named Pogo, 'We have met the enemy, and it is us'. The vast majority of funding decisions in the US are driven by peer-review, and I have yet to experience a better concept of how funding priorities should be made than peer-review. Nevertheless, there is cloak of conservatism that seems to descend over peer-review committees when they meet to evaluate proposals. In some perversion of our individual values, in the context of a peer-review committee, 'ambitious' and 'risky' become pejoratives. Hence, Ramaswami's vision will be greatly aided if the review of research proposals in India can embrace risk and originality without excessive concern about whether a talented person entering a new field will suddenly be unable to develop new talents. Both the NIH and NSF have recognized this problem, and have made steps toward addressing it, but the steps so far are small and the problem is large. If you figure out a solution, please let us know.

Vidyasagar's cogent critique is certainly aptly applicable to a subset of US biomedical research labs, and has relevance to many. However, in my view, an important strength of US biomedical research is the many labs that are not of the type described in his comments. Nevertheless, his critique of elements of big science should be considered by all students before starting on a biomedical research career. In the US, it is possible in certain well-funded areas to be able to secure funding sufficient to support research teams in excess of 30 staff, which are typically some mixture of students, post-docs and technical staff. Sometimes, the head of such a lab, the CEO scientist of Vidyasagar's critique, is an exceptionally able person who can manage a group of that size, and sometimes the head is less capable. Even in the first case, let us consider whether joining that lab is a wise decision for the beginning student. The most talented scientists have the same 24 h limitation in each of their days that bind the rest of us. So, how much bandwidth can such a lab head give to mold the development of a student? There is a distinction between managing a group and leading all the individual projects in one, and students need to consider that when choosing a lab. Moreover, in labs led by scientific superstars, not everyone in that lab will be of the same level, and a promising young student may be influenced more by a rather average post-doc mentor than by the lab chief. I think an inadequate attention to choosing the right training environment is a leading cause of the long-term postdoc syndrome highlighted by Vidyasagar. Biomedical research in India will be well served if effective attention is given to this matter. A complete solution is probably impossible, but attention will diminish the impact.

To consider the generality of Vidyasagar's critique, let us now consider the fate of postdocs and students that trained in biomedical research in the one part of the US that I am most familiar with: my lab. To give this some context, UC Berkeley is among the very strong institutions for biomedical research in the US. My lab is considered a strong lab in this environment, but not one of the very top labs by the usual criteria, subjective though they may be. To date I have trained 25 post-doctoral fellows, 17 of whom presently hold academic positions in tier-one research universities that I would have been happy to accept a position in. Their present positions range from Assistant Professor to Full Professor in the US system. None did a second post-doc after leaving my lab. Only one had postdoctoral training prior to joining my lab. The median duration of their post-doctoral training was four years. Three of the remaining eight started collectively five biotech companies since leaving my lab, three of which are still in operation, the other two having been acquired. The others have a mixture of research positions in industry or government agencies, or in two cases, have retired.

With respect to graduate students, I have trained 23 to date, all of whom received their first or second choice of post-doctoral training labs. So far, seven of these hold academic positions at tier-1 research universities, and none had to do a second post-doc prior to achieving these positions. Five of my former students, all recent graduates, are still in their first postdoctoral positions, and with three exceptions, the others are all gainfully employed as scientists in industry, or in research positions in academia. The exceptions include two retirements and one senior editorship in *Nature Medicine*.

I offer these numbers not to refute the important points that Vidyasagar has made, but merely to point out that my lab is one of many in which the downside of biomedical research that he describes can be largely avoided. As consumers of training opportunities, students would be well served in considering the track record of past trainees from labs before selecting one.

Finally, in response to the comments from both Ramaswami and Vidyasagar, I agree that the calculus of influence, and hence of promotion and recognition, can be highly variable from institution to institution, and in some cases can be counterproductive. One contributor to the scientist-as-CEO syndrome in the US is the proliferation of institutions in which the faculty have no underlying salary support, and instead are free agents responsible for raising all or most of their salary from grants, whose collective grant overhead pays off the mortgage on their research institute. These institutions create a problem of major proportion for their faculty and the field, and force faculty into becoming major 'operators' as Vidyasagar has called them. I advise all my students and fellows not to commit their careers to institutions that do not make a commitment to them. India will be well served to avoid this model of soft-money support for their faculty of research institutions. The rapid growth it allows during periods of federal largess has too many negative consequences in the long run.

To close, I hope the discourse initiated by Ramaswami, Balaram and Vidyasagar stimulates continued discussion about the extent to which any model from one nation applies well to another in support of the research enterprise. The US research has benefited from the existence of several models, yet none is perfect, and all could be improved. A careful and nuanced understanding of the relative tradeoffs will certainly help maximize the impact of research on national priorities and hopefully help the careers of young scientists develop in the ways that embrace and enhance their creativity, imagination and courage, which often blossom in the earliest stages of a career.

1. Vidyasagar, M., *Curr. Sci.*, 2009, **96**, this issue.
2. Balaram, P., *Curr. Sci.*, 2009, **96**, 625–626.
3. Ramaswami, M., *Curr. Sci.*, 2009, **96**, 639–640.

JASPER RINE

Center for Computational Biology,
374A Stanley Hall,
University of California,
Berkeley, 94720, USA
e-mail: jrine@berkeley.edu

Higher education in India – aiming higher?

A recent cover story in the 9 February issue of *The Journal of Cell Biology* (*JCB*)[1] titled 'The biological sciences in India: aiming high for the future' was the subject of editorial comment by Balaram[2], and a critique by Ramaswami[3]. I am inclined to fear that the real truth may be as Balaram understates it: that the original article in the *JCB*, which had probably sardonic and skeptical overtones, was trying to point out: How can Indian biology aim 'high' or 'even higher' when the base for it is so inadequate? For example, the total number of faculty in the biological sciences in a list of 20 of India's leading institutions is less than the number holding NIH grants in a single institution, i.e. the University of California at San Francisco, and the same place has more postdoctoral fellows (~1000) than the total number in all the modern biology laboratories in India.

This is true of science in India in general. We have about 120,000 scientists in our country while the United States, which is approximately a quarter of our size demographically, has ten times as many. Anecdote has it that there are more Indian scientists working in the US (about 150,000) than in India. For any country to aspire to the highest levels of excellence in science, it must be founded on a base as broad – it has to be built like a pyramid and not as free-standing pillars.

What is true of biological research in particular, and scientific research in general, is even more symptomatic of the higher education scenario in the country. Recently, the UGC brought out two key documents on this[4,5]. India does a poor job of educating its masses. Only about 10% of those in the age group 18–23 years make it to college. There are countries which manage 80–90%! The Knowledge Commission projects that to raise the Gross Enrolment Ratio (GER) from 10 to 15%, we will need about 1500 universities, instead of the 450 or so that we have now. The UGC reports make a determined effort to lay down the basis for the approach and strategy for the higher education sector over the next plan (2007–12) and beyond. However, to the discerning mind, what is clear is that as before, our efforts are half-hearted and nowhere near enough.

To the uncritical mind, India's progress has been remarkable. According to one of the two UGC reports cited above[5], the number of universities has grown from 32 (1950–51) to 343 (2004–05) in 54 years – a compounded annual growth rate (CAGR) of 4.5%. During the same interval, the number of colleges has grown from 695 to 17,625, a CAGR of 6.2%. From 1980–81 to 2003–04, the total enrolment in degree and diploma courses has increased from 29.8 to 112.0 lakhs, a CAGR of 5.9%. According to Thorat[4], from 1950 to 2008, the number of universities has increased from 20 to 431 (CAGR = 5.4%), colleges from 500

Table 1. Enrolment of students in higher education in lakhs from three different sources. Numbers in bold are as surveyed and then interpolated linearly for graphical projection in Figure 1

Year	SES	NSS	PC
1981	**29.8**		
1982	31.56		
1983	33.32	**58.9**	
1984	35.08	61.96	
1985	36.84	65.02	
1986	**38.6**	68.08	
1987	40.66	71.14	
1988	42.72	**74.2**	
1989	44.78	76.87	
1990	46.84	79.53	
1991	**48.9**	82.20	**106.1**
1992	51.96	84.87	111.5
1993	55.02	87.53	116.9
1994	58.08	**90.2**	122.3
1995	61.14	93.67	127.7
1996	**64.2**	97.13	133.1
1997	70.58	100.60	138.5
1998	76.96	104.07	143.9
1999	83.34	107.53	149.3
2000	89.72	**111.0**	154.7
2001	**96.1**	122.03	**160.1**
2002	101.4	133.05	
2003	106.7	144.08	
2004	**112.0**	**155.1**	

SES, Selected Educational Statistics, NSS, National Sample Surveys; PC, Population Census.