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EDITORIAL

Scientific Research: Stupidity and Success

Lectures and committee meetings are often occasions to learn a new phrase. At the annual meeting of the Indian Academy of Sciences, C. N. R. Rao, one of India's most productive and celebrated scientists, spoke about scientific research and the joys and pains of academic pursuits. He observed in passing, that the results of scientific research must be taken to the logical conclusion with investigators publishing their findings in a respectable scientific journal. This 'last mile', a phrase used by Nandan Nilekani in his public lecture on the unique identification number, is sometimes difficult to traverse. Rao noted that many scientists succumb to 'referee fatigue', a wonderfully evocative phrase that immediately conjures up the image of tired and defeated authors, who crumble under the combined onslaught of disagreeable and unkind reviewers and unsympathetic editors. The task of acquiring a formidable list of publications in the best of scientific journals is not an easy one; patience, commitment, resilience and enthusiasm are among the key ingredients for success. The pressures to publish in the best of journals are growing in India and fresh entrants to academia are thrown into a competitive arena, where the obstacles to success loom large at every step. The worldwide competition for journal space in the highest impact publications is intense; referees and editors are often driven by the pressures of current fashion, with the result that careful, scholarly work can often be easily dismissed. The front offices of some journals are sometimes manned by editorial staff, who carry out preliminary review to assess 'importance' of the findings. In such situations current fashion ('nanostructures', 'stem cells' or 'climate change' among others) may score over academic depth and scholarship. Writing styles are important; the best introductory paragraphs often promise a 'paradigm shift' – a term more misused than understood. Editors are under great pressure to drive up impact factors, while university administrators try to drive up institutional rankings. The young (and sometimes the even not so young) academic scientist can thus be subjected to a considerable degree of pressure. In the Indian academic scene the proliferation of awards, academies and incentives add a local flavour to the competitive stress imposed. Stresses must necessarily be transmitted and indeed they are; often influencing

even students who are on the verge of beginning a research career. For authors who seek to publish their work the hurdles of the anonymous peer review system must be crossed; rejection letters must be received with the level of equanimity that is necessary to allow the author to take a deep breath and try again. Most often, the visibly successful scientists are those who plough on undeterred by local criticism or difficult referees. The tendency to succumb to 'referee fatigue' must be resisted; cheerful enthusiasm is always an effective antidote.

How does one embark on a career in science? Ambition may be a necessary condition but can, in isolation, never be a sufficient condition for success in science. Even as I wondered whether there could be a recipe for success in research, a young and enthusiastic student sent me an essay, with an eye-catching title: 'The importance of stupidity in scientific research' (Schwartz, M. A., *J. Cell Sci.*, 2008, **121**, 1771). Two helpful colleagues also drew my attention to this piece, although unlike the innocent student, they may have had less than honourable intentions. In Schwartz's words: 'Science makes me feel stupid too. It's just that I've gotten used to it. So used to it, in fact, that I actively seek out new opportunities to feel stupid'. Feeling stupid is a term that Schwartz uses to describe a state of mind that I (and, hopefully, other researchers) often encounter—an inability to understand or solve a problem that appears distressingly simple. At times, subjects and concepts that one has repeatedly encountered in courses and examinations years ago seem incomprehensible and not easily applied to the research problems at hand. Often, research and the background acquired over years of courses and examinations seem strangely disconnected. Problems, even minor ones, encountered in everyday research appear more difficult to solve than those encountered in examinations for which solutions undoubtedly already exist. Schwartz suggests that Ph D programs do not always make students 'understand how hard it is to do research'. He adds: 'We don't do a good enough job of teaching our students to be productively stupid—that is, if we don't feel stupid it means we are not really trying . . . Productive stupidity means being ignorant by choice. Focusing on important questions puts us in the awkward position of being ignorant.'

One of the beautiful things about science is that it allows us to bumble along, getting it wrong time after time and feel perfectly fine as long as we learn something each time'. On reading this I could not help feeling that the 'bumbling' approach to science, that I must confess I love and which Schwartz describes so simply, is fast disappearing. Science today is a highly organized and professional activity; projects must be perfectly conceived, approaches to research must be planned to the last detail and the results are almost always anticipated. The organized, managerial scientist found in academia today has little time for 'bumbling' and certainly no appreciation for 'stupidity'. Ignorance, wide-eyed enthusiasm and wonder, which can be useful attributes in research, are rare qualities, even as research laboratories abound with 'specialists', all of whom seem to have answers to every problem that is posed. Most often, neat hypotheses only need to be proved by experiment; any questions raised by laboratory work are dismissively attributed to poor experimental skills of graduate students, who are often sacrificed on the hard road to scientific success.

How does one become a scientist? Bruce Alberts, a former President of the US National Academy of Sciences and Editor of *Science*, suggests that 'one normally becomes a scientist through a series of apprenticeships, pursuing research in laboratories directed by established scientists' (*Science*, 2009, **326**, 916). It is during these 'apprenticeships' that students learn how to do research. It is in this phase of a career that students must learn to be, in Schwartz's words, 'productively stupid'. Schwartz also notes that 'scientific education might do more to ease what is a very big transition: from learning what other people once discovered to making our own discoveries'. Alberts wisely points out: 'Because so much of one's scientific future is shaped by early experiences, it is critical that beginning scientists select their mentors wisely. Unfortunately, what constitutes a 'good' choice is not always obvious... The best research advisers... provide their graduate students with enough guidance to prevent them from wasting time on nonproductive pursuits, while giving them freedom to innovate and learn from their own mistakes'. Here there is an echo of the need to be 'stupid' and the importance of mistakes. In research, as indeed in life, the most useful lessons are learnt from mistakes. The launch of an independent scientific career generally requires 'two apprenticeships'. The first, of course, is the period spent as a student acquiring a Ph D degree, while the second is the stint as a postdoctoral fellow in a different laboratory. Alberts advises pro-

spective scientists to choose their areas well so that the 'skills acquired are complementary'. He does, however, sound a cautionary note: 'But success as an independent scientist will require much more than technical skills'.

India has embarked on an ambitious phase of expansion of its institutions of higher education and research. There has never been as much interest in rejuvenating the science and technology enterprise as in the last few years. There are many oft repeated slogans: 'more Ph Ds', 'more laboratories', 'more publications', 'more innovations', 'more patents'; indeed 'more' of everything connected with science and research. A critical problem in this phase of expansion is the need to recruit new faculty and students in large numbers. Existing institutions must also enter a phase of adjustment as the countrywide expansion plans begin to gather momentum. This may be an opportune moment to ask whether the system of graduate (Ph D) training in India can be critically examined and if fledgling post-doctoral programs need strengthening and expansion. The needs of young faculty members, both material and somewhat less tangibly, intellectual, require understanding. I suspect that there is a pervasive feeling in our institutions that financial resources, 'infrastructure' and 'efficient administration' are the only limiting factors in determining research success.

There seems to be little discussion within institutions and departments on the need to promote a collective approach towards building up an intellectual climate that promotes scholarship. An environment which appreciates the 'importance of stupidity' (especially 'productive stupidity') would be wonderfully energizing. Unfortunately, we have gone overboard in 'incentivizing' research, with the result that most young researchers in major laboratories appear to believe that they must achieve recognition milestones (awards and fellowships) at regular intervals. The pressures to publish in the best journals, with the attendant side-effect of referee fatigue, are quickly transmitted from mentors to apprentices leaving little time for being 'stupid'. It is clear that we cannot return to more leisurely times. How does a beginning scientist cope with the pressures of today? Alberts suggests that 'senior scientists have the responsibility of maintaining a system that provides talented young scientists with the opportunity to succeed in whatever career they choose'. Mentoring young faculty is always more difficult than influencing fresh students. As a beginning, we might do well to recognize the importance of 'stupidity'.

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