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EDITORIAL

Science: Pressures of a Changing Age

The global economy is driven by competitive pressures. A recent editorial in *Science*, that addresses the issue of 'Nurturing Young Scientists' in the United States, proclaims: 'It is imperative to grow our economy through global leadership in science'. The editorial highlights the need to nurture and mentor early career scientists and the importance of recognizing the need to 'affirm and reward cross-boundary collaborations'. The American research university system has long been envied in the developing world. It is almost impossible to attend any gathering of science policy makers in India without hearing of the role models in graduate education and research – Harvard, MIT, Caltech, Berkeley, Columbia and the list goes on. In the drive to stay ahead of the competition, the US National Academies have begun to examine 'ways to keep research universities healthy'. There is a real concern that the future demands change. In their editorial essay, J. Gentile and S. Boehlert (*Science*, 2010, **329**, 884) argue that frameworks must be created 'in which interdisciplinary research and synergistic teaching can thrive'. Even in the best of places, interdisciplinary work can sometimes be difficult for young researchers, constrained by conservative and tradition-bound mechanisms of peer assessment. The *Science* editorial recognizes the need to redefine 'what constitutes original and independent contributions to a research agenda that involves multiple partners and rewarding those who forge robust interactions among groups'. In words that need to be read carefully in our own institutions, the authors note: 'Most universities have a department-centric organization. Each department's faculty judges its peers according to the norms of their own discipline, a perspective that makes it difficult for interdisciplinary faculty to receive a fair hearing'. While issues of tenure are not a matter of concern in the overwhelming majority of Indian institutions, the importance of promoting cross-disciplinary faculty is still to be recognized, during the process of recruitment and in the decision making process on research grants. Departmental and disciplinary boundaries are rarely violated in India, placing our institutions in a poor position to exploit research opportunities that arise at the interfaces of traditional subjects.

The *Science* editorial points out that in the United States 'early career professors often seek to integrate

their research and teaching, eager to bring the vitality of their own science into the classroom to engage students'. They add, undoubtedly, with a tinge of regret: 'Unfortunately, great teaching skills are still considered to be of secondary value to career success at research universities'. To bolster the case for teaching as a critical component for ensuring the health of academic institutions, they quote from Carl Wieman's testimony to the US Senate: 'To maintain US economic competitiveness and leadership in innovation, we need to also have leadership in STEM [science, technology, engineering and mathematics] education'. Are these issues relevant to the Indian situation? They must be, if we are to ensure that the ongoing expansion of science education and research is to catalyse a real process of change. A very substantial part of India's investments in scientific research focuses on national laboratories, highly specialized institutions sometimes mandated to work in areas whose current relevance may be less than optimal. The intersection of these institutions with the educational process is negligible. The creation of many small research institutions, with a limited range of subjects of study appeared to be attractive some years ago. In the present context it might be wise to reexamine the virtues of size. Should the science and technology system in India consider a strategy of mergers and acquisitions; an approach that seems to have been so successful in the corporate world?

In addressing the issue of a transformational agenda for science, Gentile and Boehlert talk of the need for 'building a critical mass of individuals for long-term cultural change' within science departments in universities. Interestingly, this analysis was followed by yet another editorial in *Science*, which reflected on 'China's research culture'. The advance of China in recent years is a phenomenon that is widely admired. Chinese science, as measured by the conventional metrics of publication statistics, is moving rapidly forward, threatening to overshadow the advanced countries of the West. Yigong Shi and Yi Rao, two senior academics in Beijing note that, 'government research funds in China have been growing at an annual rate of more than 20%, exceeding even the expectations of China's most enthusiastic scientists. In theory, this could allow China to make truly outstanding progress in science and research. . . . In reality, however, rampant problems in research funding – some attributable

to the system and others cultural – are slowing down China's potential pace of innovation' (*Science*, 2010, **329**, 1128). This frank assessment will find a sympathetic Indian readership, which grapples with similar 'cultural problems'. In discussing funding for large projects, the authors note: 'The key is the application guidelines that are issued each year to specify research areas and projects. Their ostensible purpose is to outline "national needs". But the guidelines are often so narrowly described that they leave little doubt that the "needs" are anything but national; instead the intended recipients are obvious. Committees appointed by the bureaucrats in the funding agencies determine these annual guidelines. For obvious reasons, the chairs of the committees often listen to and usually cooperate with the bureaucrats. "Expert opinions" simply reflect a mutual understanding between a very small group of bureaucrats and their favourite scientists. This top-down approach stifles innovation and makes clear to everyone that the connections with bureaucrats and a few powerful scientists are paramount. . . . To obtain major grants in China, it is an open secret that doing good research is not as important as schmoozing with powerful bureaucrats and their favourite experts.' The 'culture', described in this frankly worded critique, 'even permeates the minds of those who are new returnees from abroad'. In words that might be equally applicable to many of India's best funded institutions, Yigong Shi and Yi Rao describe the situation in China: 'A significant proportion of researchers in China spend too much time on building connections and not enough time attending seminars, discussing science, doing research, or training students (instead, using them as laborers in their laboratories). Most are too busy to be found in their own institutions'. Their assessment of China's research culture is brutal: 'It wastes resources, corrupts the spirit, and stymies innovation'. Their call is worth heeding: 'The time for China to build a healthy research culture is now, riding the momentum of increased funding and a growing strong will to break away from damaging conventions'.

Asia's drive to catch up with the West in scientific research, by building new institutions, refurbishing old ones and by dramatically expanding investments in research and development, has been a subject of great interest, worldwide. In a commentary entitled 'Achieving scientific eminence within Asia', A. S. Huang and C. Y. H. Tan return to a, now, familiar theme: 'We sense that Asian countries share some aspects of mindset and culture that limit their aspirational reach. . . . After considerable investment in buildings and equipment, Asian countries have come to appreciate that more is needed to build a vibrant research culture that is capable of world-class competitive research' (*Science*, 2010, **329**, 1471). In

sentences that need to be carefully read in India, the authors emphasize a regrettable aspect of the culture of science in Asia. 'Unfortunately, throughout Asia, the respect for scholarship has translated to a virtual worship of the Nobel Prize and branding opportunities offered by top universities. Nobelists and professors from well-known Western universities represent the ultimate intellectual authority. Huge sums of money have been and are being spent in the hope of fast-tracking scientific institutions in Asia by associating with famous universities abroad. . . . How can Asia nurture its own scientific leadership with such a lack of confidence in its own talent? If not corrected, intellectual colonialism can become a serious barrier to Asia's quest to build capacity in science.'

Coincidentally, the same issue of *Science* carries an editorial 'Young leaders for biology in India', which highlights government programs that facilitate 'repatriation' of Indian scientists trained abroad. India has not followed 'China's and Singapore's strategy of offering lavish resources to established US or European scientists to either move to or create outpost laboratories in Asia'. A mentoring program ('Young Investigators Meeting'), organized for Indian postdoctoral fellows in biosciences, who are considering returning to India is described. The concluding sentence of this editorial returns to the theme of 'culture': 'The best guarantee for future success is to imbue young scientists with a sense of mission, to nurture not just the science but a culture that fuels the will to succeed in countries long thought of as second choice options for research careers' (Tole, S. and Vale, R. D., *Science*, 2010, **329**, 1441). Many new schemes being thought up, especially in biology, seem to cast adrift the large numbers of young scientists trained in Indian laboratories, placing an undue emphasis on areas and problems that are approved by Western scientists. 'Social networking', increasingly facilitated by excessive travel to foreign laboratories, appears to influence the framing of research agenda's in India. The bogey of 'intellectual colonialism' raised by Huang and Tan may well prove inhibitory to progress.

Asia is not alone in worrying about a competitive future. Bruce Alberts, the former President of the US National Academy of Sciences and the Editor-in-Chief of *Science* has raised a concern about 'overbuilding research capacity' in the United States, in the area of biomedical research. In his words: 'The current trajectory is unsustainable, threatening to produce a glut of laboratory facilities reminiscent of the real estate bust of 2008 and, worse, a host of exhausted scientists with no means of support' (*Science*, 2010, **329**, 1257). Science, in Asia and elsewhere, is clearly facing the pressures of a changing age.

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