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EDITORIAL

Ph Ds: Uncomfortable Questions

'India must produce more Ph Ds', is a statement that is constantly heard in bodies that discuss science policy. As research funding grows, the easiest quantifiable measures of progress in science appear to be the number of papers published in journals covered by the *Science Citation Index*, and the number of Ph Ds awarded annually by our academic institutions in science and engineering. Comparative statistics are frequently projected, with China rapidly forging ahead in the race to increase the production of researchers with Ph D degrees. A favourite and well worn quote that I have often heard is: 'MIT produces more Ph Ds annually in computer science than all of India's institutions combined'. As the custodian of a highly visible academic institution in science and engineering, I have begun to dread the question: 'What was your score of Ph Ds last year?'. This is quickly followed by the supplementary questions: 'Did you cross the figure of two hundred? When will you touch three hundred?' Even as I struggle for an answer, I am reminded of the anxiety with which Indian cricket fans waited for Sachin Tendulkar to score a double century in Tests, having always managed to fall short of the magic figure, despite many sterling performances. These questions also remind me of one that I confront frequently, from aggressive and critical colleagues, when I don my editor's hat: 'Why does the impact factor of *Current Science* not improve more rapidly?' Quantitative measures are often useful in judging progress and achievement but, at times, comparisons of chosen indices can be extremely disconcerting, when the true import of the metrics are poorly understood by those who use them. The quality of theses which are approved for the award of doctoral degrees varies dramatically across the wide spectrum of institutions in India. In the best places, students registered for doctoral degrees are the main drivers of research activities. When the best of students are associated with knowledgeable and scholarly supervisors, the quality of theses produced can match the best in the world. Unfortunately, there are also many institutions where research students receive little attention and formal review mechanisms are deficient. The ongoing expansion of higher education in science and engineering will significantly increase the number of Ph D producing institutions in India. Most of the new institutions, IISERs and IITs amongst them will undoubtedly be well funded, with the expectation that high qua-

lity research will flow, in addition to the training of the best of undergraduate students. Research students at centrally funded institutions invariably receive financial support in the form of scholarships, a factor that eases to some extent the uncertainties of a course that may take several years to complete. Are our Ph Ds in science and engineering employable in India? Do academic institutions and national laboratories have job openings for the newly minted Ph Ds or even those who enter the market after a brief post-doctoral period? Are industrial R&D laboratories on the look out for Ph D scientists? Can the widely discussed 'faculty shortage' be alleviated by increasing the production of Ph Ds in science and engineering? These are all questions that are often raised. There is little consensus on the answers. In thinking about Ph Ds I was drawn to an article in *The Economist* entitled 'The disposable academic'. The sub-title was even more provocative, declaring: 'Why doing a Ph D is often a waste of time' (Dec. 16, 2010).

The Economist article begins by tracing the origin of the word 'thesis' to the beginning of the Reformation, which led to the split in the Christian church and the rise of Protestantism. Martin Luther is credited with nailing 95 theses 'to the door of a church' in Wittenberg in 1517. *The Economist* points out that 'in those days a thesis was simply a position one wanted to argue'. For good measure, the article pointedly notes that Luther's thesis 'asserted that Christians could not buy their way to heaven'. Momentarily diverted, I could not help marveling at the soundness of this thesis, nearly six centuries later. But the *Economist* was not addressing the history of the reformist movement within the Christian clergy; the opening sentences were intended only to highlight the transformation of 'theses' over the centuries. In Luther's time 'a thesis was simply a position one wanted to argue'. The modern thesis which is required to obtain a Ph D degree 'is both an idea and an account of a period of original research'. Indeed, writing a thesis constitutes the most difficult period for all those who wish to call themselves a 'doctor of philosophy'. A Ph D is almost the minimum qualification need to enter a career in academia. It is the starting point of a research career in science. It is also a degree sought by many who believe that the honorific title 'doctor', confers an aura of scholarship and distinction. Administrators and bureaucrats write theses

and obtain Ph Ds in disciplines, which often have little to do with their daily work. Politicians find that acquiring honorary doctorates may be an easier option, raising their status as scholars in the eyes of an uninformed public. While Ph Ds can be acquired in almost any discipline, it is really science and engineering that are the areas where there is a thrust to increase the number of doctoral degrees awarded in India. *The Economist's* thesis that 'doing a Ph D is a waste of time' seemed to state a point of view that is diametrically opposite to the prevailing consensus in Indian higher education, where the focus is clearly on increasing the number of Ph Ds produced. Undoubtedly, the article's focus was on the situation in America or Britain, where newly minted Ph Ds face a declining job market in both industry and academia. The dramatic expansion of the American research university system over the past few decades has contributed to the glut of Ph Ds. In many areas of science, most notably the disciplines that contribute to biomedical research, the size of research groups has grown dramatically over the years. Large teams of Ph D students and post-doctoral fellows work under the supervision of principal investigators (PIs), who generally are tenured members of the faculty. The number of Ph Ds produced has grown very much faster than the available positions in academic faculties and in industrial R&D laboratories. Low salaries, the uncertainties of the job market and diminishing opportunities to begin independent research careers are beginning to raise serious questions about the Ph D programs in many disciplines. *The Economist* notes that 'the fiercest critics compare research doctorates to Ponzi or pyramid schemes'.

I was struck by this reference to an investment scam, made famous in recent times by the disgraced financier, Bernard Madoff. Can the vast edifice of graduate research be likened to the dubious stratagem of paying dividends to the first generation of investors by using capital raised from the next generation, without any productive activity? Is academic science a self-perpetuating exercise in which expanding Ph D programs serve only the interests of an existing professoriate, with little regard for career opportunities for those who spend years in long drawn out doctoral programs? These questions are being increasingly asked in the United States and Britain as a sluggish economy accentuates the problems created by an over-production of Ph Ds. The situation in India appears dramatically different. The ongoing expansion of the sector of higher education is creating a new demand for faculty with Ph D degrees. Private sector research also seemed poised for growth, although projections are harder to make. Corporate captains often publicly bemoan the shortage of well trained Ph Ds; stating their intention to recruit, but implying that their specific

requirements are not addressed in the training that students receive in academic institutions. India produced about 8500 Ph Ds in science and engineering according to statistics for 2005–2006. The numbers are unlikely to be significantly different today. A recent assessment of the Indian academic science noted: 'the status of doctoral education in India is disturbing. Its numbers are not increasing to meet the growing demand from the public sector research labs and higher education institutions. There are a small number of university level institutions that produce a decent number of doctorates. Even among them, there is a suspicion about the quality of doctoral education, especially in the institutions that are not known to be reputed yet contribute to a significant number of doctorates' (Agarwal, P., *Indian Higher Education: Envisioning the Future*, Sage, New Delhi, 2009, p. 258).

One of the most serious concerns about doctoral education in India is the wide variation in the quality of the Ph Ds produced. In a few of the top tier institutions, students undergo a program of courses, cross the hurdle of a qualifying examination and produce research that is usually published in peer-reviewed journals, before a doctoral thesis is written. The dissertation is then subjected to external review, with the reports being subjected to further internal scrutiny before a formal oral defense is conducted. This elaborate procedure can be subverted, at times, but the existence of a formal supervisory academic structure generally acts as a deterrent. In the best of institutions, seminars, group meetings and work presentations contribute substantially to a student's training. Unfortunately, many institutions have few formal requirements to be met and theses are almost entirely the responsibility of a student. Ph D training is a form of apprenticeship with students interacting closely with a mentor. Sadly, in a significant number of institutions mentorship is often lacking and the overall ambience is not conducive to academic research. In such situations the student often ploughs a lonely furrow. A major concern in our institutions today is the poor communication and writing skills of Ph D students. These deficiencies are hard to correct, but there is a pressing need to devise remedial courses that can address this problem, which is assuming epidemic proportions. The next generation of faculty in our expanding higher education system need to be able to teach, and teach well. Producing well trained technicians who will serve Western laboratories may hardly be a desirable goal.

Ph D students are the lifeblood of academic research. Ensuring their future must be a central concern of science policy discussions, which cannot ignore uncomfortable questions.

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