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EDITORIAL

Training a new generation

June is the month when college and university admissions are in full swing. The results of most entrance examinations have been declared and career choices loom before the prospective entrant to our institutions of higher education. June brings both the monsoon and examination results, which often cast a pall of uncertainty over the lives of hundreds of thousands of students. June also brings hundreds of prospective students to the gates of our research institutes in search of an opening that will permit them to enter scientific research. At the Indian Institute of Science (IISc), Bangalore the largest numbers of students congregate, in disciplines that lie as far apart as biochemistry and mechanical engineering. In a week of interviews, students who have qualified through a variety of screening examinations, are assessed for their suitability, with only about 10% of the candidates eventually obtaining a passport for admission. This is a process played out, albeit on a smaller scale, at many other prestigious institutions across India. A striking feature of the students who come to IISc (and, indeed, many of our national institutions) is that they are truly representative of India's diversity; their degrees having been obtained at universities from Kerala to Kashmir and Gujarat to Arunachal Pradesh. Irrespective of origins, academic accomplishment and skills to communicate, the students are desperate to get a foothold in research. The wide variations in the Master's degree programs at Indian universities, places those who emerge from some institutions at a disadvantage; their exposure to their chosen fields limited by inadequate facilities and teaching. But, for the interviewer (and I have just played that role), the week of questioning prospective students can provide some insights, not all of them comfortable, into India's sprawling higher education system, with a focus on science.

University science departments, and I believe there must be very few exceptions, have become academically fossilized, with internal debate almost invariably focused on the politics of administration, to the exclusion of discussions on modernization of courses, laboratories and student training. Dedicated teachers are rarely recognized by university administrators, who masquerade as academicians of distinction. In many departments, even the mindless system of 'rotation' of administrative responsibility has been unable to provide brief interludes, where academic issues are purposefully addressed. In the West, administrators in universities and academic institutions are judged by the collective successes of their academic colleagues; in India they seem to be beyond assessment. In some fields, the absence of academic discourse is most evident, because of the great pace of change in these areas. Biology is a dramatic case. Traditionally, universities have had botany, zoology and microbiology departments. Biochemistry, although a century-old discipline, has rarely merited a separate department in many universities. The high tide of molecular biology has changed everything. The unity of biology was never more evident; plants, animals (humans among them) and microbes share a genetic and biochemical heritage, rendering disciplinary borders, both porous and inconsequential. Yet, our universities have erected impregnable walls between departments; a situation for which academics alone must bear responsibility. The mushrooming of 'biotechnology' departments has further diluted the training of a new generation of students. In some places, one of the biology departments is usually magically transformed, becoming an automatic recipient of government grants aimed at promoting biotechnology. In the newer universities, omnibus 'life sciences' departments were created, which have failed to develop strengths in traditional areas, while struggling to carve a niche in modern biology. Teaching has been a major casualty; interviews with the products of this system quickly reveal that little of the excitement of contemporary science has been conveyed to students. The situation is not very different in areas like physics and chemistry, where changes have been less turbulent over the last thirty years.

The research institutions, which admit students with highly variable backgrounds, make little attempt to introduce rigorous pre-Ph D course programs, a feature that American research universities have so successfully implemented for decades. Teaching is not an activity that commands much respect, within our research departments and deemed universities. Even while bemoaning the limited training and exposure of new entrants to re-

search, scientists and faculty at our most prestigious institutes view potential students as 'technicians', whose exertions serve primarily to advance the careers of their supervisors. The long-range goal of training the next generation of scientists is not discussed with seriousness in the academic bodies of these institutions; indeed many Ph D granting establishments even lack the formal supervisory academic mechanisms that ensure the standards of Ph D degrees. The divorce between postgraduate teaching and research is almost complete in India; efforts to redress this situation by creating 'National Institutes of Science' may flounder because of difficulties in recruiting motivated faculty in adequate numbers at diverse locations, some of which may prove inhospitable for institution building.

Indian research institutions also compete with Western universities to attract the best of our B Sc and M Sc students to research programs. Institutions in places like Singapore and Australia have also begun to look attractive to prospective researchers. The need to induct the most promising students into research has attracted the attention of universities worldwide. The attempts to reform undergraduate science education have been vigorous in the US. A news item in *Science* (2004, **304**, 810) highlights a report of a panel of 'students, faculty and administrators' at Harvard University that 'urges the university to give its undergraduates a genuine view of the excitement of research science'. These initiatives aim to 'provide a more interdisciplinary approach to life and physical sciences'. Harvard is only one among many North American universities to continually worry about reforming undergraduate science education. In India, there have been many laudable attempts to promote summer research internships that permit B Sc/B Tech and M Sc students to experience the atmosphere of research laboratories, during vacation periods. The two national programs, which together support between 200 and 300 students for two-month periods every summer, are run by the Indian Academy of Sciences and the Jawaharlal Nehru Centre for Advanced Scientific Research, both based in Bangalore, with financial inputs coming from the Department of Science and Technology. These programs are a wonderful opportunity for a prospective student to gauge the requirements for research. Most degree-granting institutions at B Tech/M Sc levels have also introduced 'project work'. Unfortunately, most such institutions do not have facilities or faculty directly interested in research. Students need to fend for themselves, searching for placements, where 'projects' can be executed. The situation is scandalous in the area of 'bioinformatics' and 'biotechnology', with institutions, which charge high fees, providing no facilities for mandatory 'project work'. Although many of these courses and institutes have received formal recognition and accreditation, academic norms appear to be observed only on occasion.

An experiment which began some years ago at IISc was designed to attract students into research by offering admission to Ph D program immediately after a B Sc degree. This 'integrated Ph D' model has found some favour in a couple of other institutions. The program requires a mandatory course load, laboratory rotation and a research project before settling into a doctoral thesis project. The program caters to a very small number of students, some of whom leave midway to enrol in universities overseas. But these programs have consistently attracted good students, suggesting that inductions into research can be successfully accomplished after our undergraduate degrees. There are some obvious benefits to students who may graduate a bit earlier, having slipped into research without the intermediacy of a two-year M Sc program. For faculties, who are loath to teach, these programs appear to be an extra burden; few realize that teaching and research are two sides of the same coin. In the overwhelming majority of institutions, research degrees appear to have become a private contract between students and research supervisors ('guides'); departmental requirements and responsibilities are minimal. If standards of post-graduate education and research are to improve, it is necessary that universities and research institutions critically evaluate their academic programs. Institutions which treasure autonomy must also awaken to their responsibilities.

Science affects almost every aspect of modern life. Training the next generation of scientists is a pressing task. The constant lament about the flight of students from science has become a convenient excuse. Clearly, not enough is being done for those who do enter science courses.

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