

Higher education in science: A matter of training technicians?

'A man who earns a reputation for being skilled at a technical art is idiotic. Because of his foolishness in concentrating his energies on one thing, he has become good at it by refusing to think of anything else. Such a person is of no use at all.'

—Jocho Yamamoto (1658–1719)

After the bomb, an odd newcomer has joined our nationalist iconography: the old couple of Jawan and Kisan has now been reinforced to complete a modern trinity – *Jai Jawan, Jai Kisan, Jai Vigyan!* Interestingly, the latest addition is curiously disembodied: beside the marching Jawan and the toiling Kisan there appears – not a Scientist, but *Science*. Is this merely because *Vigyan* rhymes better with Jawan and Kisan than *Vaigyanik*, or are we allowed to read more into this? I would like to use this faceless *Vigyan* as a metaphor for what I want to say about our training of scientists. Specifically, since this is what I am familiar with, I shall be discussing the teaching of what, in many universities, is still thought of as 'modern biology' (as opposed to ...?). Much of this will surely apply to other areas of science as well.

After a decade of teaching post-graduate biology to students of biotechnology and microbiology, I find myself looking back in ... well, if not anger, then certainly uneasiness. What are we training our students to be, and why? It is not a question we ask ourselves too often, not even when we ponder changes in syllabus, which are simply made to 'keep up' with developments, or to remedy perceived lacunae. It is an article of faith that we are training our students to become good researchers. Who would want to quarrel with that? But then, how do we judge who will become a good researcher? Someone with well-developed skills for satisfying the demands of the formal evaluation system? Someone well-versed in the standard lab techniques? Or is there something more? And where will this good researcher be required – in laboratories of universities and research institutes, in industrial

research labs, or even in agricultural, medical or ecological field work, in India or abroad?

The answers are not clear, but to my mind, two aspects stand out: (i) The design and operation of those biology courses which are not altogether obsolete, is directed towards producing technicians. (ii) A large fraction of the students who perform well in these courses eventually go abroad, often for good.

These two aspects are not entirely unconnected. The scientific labour market saw extensive globalization long before it became the buzz word it is today. Crudely put, the advanced capitalist economies require scientific manpower, and we provide a part of that requirement. This is not to say that individual Indian scientists cannot do well or occupy positions of eminence when they work abroad. But on a larger scale, what the scientific enterprises of countries, like the USA in particular, require from countries like ours is not scientists to occupy positions of leadership, but technical personnel to run their labs. And that is what we provide. If the destination of so many of our best-trained students is labs in the USA or Europe, and if those countries require scientific labour, then perhaps training our students as technicians is the right thing for us to do. If, that is, we wish to see ourselves as ancillary third world units turning out a product which happens to be people. Only, unlike other ancillaries, we do not get paid for this product. So why produce it?

Or perhaps we are fulfilling a need within the country. After all, we are trying to build – or at least modernize in certain thrust areas – a strong scientific enterprise in India. Surely there is a requirement for competent technicians right here in India? But is that the best our educational institutions – the better colleges and university departments – can do? Do we not all acknowledge that far too much of the science practised in India is derivative, unimaginative, aimless? That we need more scientists with some vision and an imagination that goes a little beyond the purely technical? Are we producing such scientists in sufficient num-

bers to populate more than a few labs in some elite institutions?

But how can a system as moribund as our university system – a system which does not *encourage* mediocrity but *enforces* it – do any better than to apprentice students into technical competence (where the facilities for even this limited objective exist)? I cannot see any answers to this dilemma. But I do think that if in places which have *something* going for them we *choose* to be content with providing mere technical training, then there is little hope for improvement. We just have to pray that the system will permit a sufficiently large number of 'escapers' – individuals who manage to excel *despite* the system rather than *because* of it.

Lastly, is it really fair to say that we are geared towards training technicians rather than complete scientists? I believe it is, and that we are actively working towards creating (or consolidating?) a narrow, Philistine outlook in Indian science. Admittedly, the malady does not begin with higher education, but has its roots all the way back in primary education and more general social values. But we do little to reverse it. The biology we teach is a curious menu of bland facts to be assimilated, with only the occasional garnishing of logic and context. It is a strange world in which correlation easily collapses into causality; a world in which the whole is less than the sum of its parts (and is often altogether lost from view). We teach students about what happens inside cells, but not to care about how an entire creature is put together, far less how it actually looks from the outside. We teach what happens with genes on time scales of seconds, hours, days... but not over millions of years. Evolution might rate a mention when students learn that haemoglobin and myoglobin show sequence homology – beyond that it is considered a waste of time to talk about it. Increasingly, experimental techniques take precedence over the basic concepts and biological questions to which these techniques are meant to help find answers. Perhaps we need to infuse a breath of old-fashioned natural history into our biology teaching, so that we do

not fail to see the organisms for the molecules, and it is not forgotten that these organisms, singly and in populations, lead integrated lives outside of test tubes and away from shiny instruments and easy-to-use kits.

Is it then a surprising situation if students enter a course with naive aims like 'finding a cure for cancer', only to leave with the noble aim of cloning and

sequencing a gene, never mind which one? Are we not creating a situation where the techniques justify the ends, where the techniques *are* the ends? To me, that is an intimidating thought. *Vigyan* practised by scientists with no concerns or informed opinions beyond their technical expertise may be convenient for governments and bureaucracies. But in an age in which science and technology

are increasingly confronted with moral dilemmas, a *Vigyan* devoid of ethics (and aesthetics) will readily lend itself to abuse.

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Where are our C. V. Ramans?

The discovery of fossils of multi-celled animals which date back to 1.1 billion years by Pradeep K. Bose has made great news, and rightly so. The media flashed this news on 1 October. Some newspapers, while reporting the news, focused on the conditions under which he had carried out this research work. At least one newspaper soon followed this up by an editorial which showed that it was honestly concerned about it and wanted to highlight poor infrastructure which this university professor had—no access to internet in his office, no computer at home, insufficient funds, no mentor nor pedigree, lack of encouragement and so on.

While this is fine and does need to be highlighted, there are several questions which the public, the media and the decision makers need to answer. What fraction of teachers in the 250-odd Indian universities have access to internet in their office or have a computer at home? There are many university departments which do not even have a telephone. How many teachers in Indian universities have proper or reasonable funding for carrying out their research and the necessary laboratory facilities of analysis, synthesis and computation? It is only on such occasions when one of these teacher-scientists discovers something really big that public attention turns to the 'poor teacher'. This is indeed a complex problem and it is necessary to analyse it from various angles.

There are three kinds of universities in our country. There are about a dozen universities established by an act of the Union government and financially supported by the University Grants Commission or directly by the Ministry of Human Resource Development. Then, there are

about 75 deemed universities whose funds come partly from the centre and partly from the state. Finally, there are about 150 universities created and supported by one of the state governments. The facilities and infrastructure available in a central university far outweigh those available in a state university. There are quite a few state universities where the departments do not have a telephone line.

The office culture, the ten-to-five working hours, failure to recognize and encourage excellence, failure to sift the good from the not-so-good at all levels from the university to the UGC or state governments and tolerance of mediocrity are some other factors which contribute to the ethos. The recruitment procedure and policy on teaching positions in most universities lead to anything but excellence. I have yet to come across a single university where the faculty does not complain about the poor library services. It would be pertinent to ask as to how many departments allow teachers and research students to work beyond regular office hours. It is just not recognized that research is an altogether different kind of activity which is quite unlike any other activity.

But unfortunately, many state governments do not expect their university and college teachers to do any research work. Teaching is the primary and main activity. If the teachers engage themselves in research activity, it is their own responsibility and the university or the government allows little remission in their teaching load or any funding for research.

The condition of teachers in colleges is even worse. They do not get basic infrastructural facilities such as a table, chair, cupboard, etc. for their academic

work or study. In spite of these poor conditions, fairly heavy teaching load and little encouragement from the higher-ups, several teachers do wish to go for higher academic pursuits.

There is, of course, the other side of the coin too. Teachers cannot escape the blame altogether and they are responsible for the situation they find themselves in. They, as a class, barring exceptions, have failed to deliver the benefits of education to the society. They have become entangled in politicking and have failed to show that they can participate in nation building in a major way. As a result, they are losing sympathy and support from all the major sectors of society—public, industry, and government.

As a nation, we take pride in creating new institutions, very often to satisfy individual egos, rather than strengthening the existing ones. Such institutions take away a large chunk of budget in the name of modernity and excellence, further depriving the poorer institutions. However, we are unable to sustain its growth or even its status quo over a longer period of time. An institution may reach its peak within years of its establishment, but the downslide soon sets in after a few individuals leave the institution. Of course, I have not counted the few peaks of excellence in terms of individuals or departments or universities. What has been described here is applicable to any other area or endeavour, be it industry or sport.

After independence several national laboratories were established to cater to research in various areas. They were created outside and independent of the university system. The river of central funds flowed through these national labo-