The success and failure of Indian science*

Kanury V. S. Rao

I must confess that I have neither the expertise nor the breadth of perspective to address the title with any justification. My own limited sphere of activity and, therefore, experience is in the area of Biological Science. Moreover, quantification of either success or failure in scientific endeavours is largely a subjective exercise, depending upon partisan definitions of the term, 'success'. Therefore, what I shall do is to restrict my discussion to biological research in our country. Furthermore, rather than use the weighing-scale of 'success', I would prefer to simply share some personal perspectives on factors that control the growth of the knowledge base in biology.

If one looks into our immediate past, it is obvious that there has been an added impetus to research in biology in our country. This is clearly evident from the fact that publications in quality journals have become more common. This, of course, is not to say that we were not publishing in such journals before. But simply to highlight that the consistency of such publications has increased, and draws from a wider spectrum of research laboratories in this country. This is undoubtedly a heartening development, and, at least some credit for this must be given to the Department of Biotechnology. In my view, this is one of the rare government agency that does not suffer from pecuniary myopia. This agency has understood that scientific growth can only occur hand-in-hand with infrastructural growth, and does not shy away from investing large sums of money to further such objectives.

Of course there is the flip side to this, a criticism that one often hears from a variety of affected quarters. And that is the fact that facilities to pursue modern science are becoming concentrated within a few national institutes, whereas universities falter on the brink of subsistence. While there might be some merit in this criticism, it is probably not fair to abjure the University system of all responsibility in this regard. It cannot be ignored that the increased politicization of campuses, continued inbreeding within the faculty, where nepotism is pre-eminent over meritocracy, have contributed towards the marginalization of at least some of the universities today. Although it is difficult to quantify the extent of such contributions, it is however clear that many Universities and their departments that were venerated when I was a student, have been reduced to the commonplace today.

The other hard reality that one has to accept is the ever-growing costs of biological research – as it becomes more and more technology intensive. It is not enough anymore to simply have a good idea in order to publish a paper in a good journal. A good idea, today, must be supported by extensive experimental data – preferably generated using state-of-the-art techniques. Under such circumstances then, it is perhaps wiser to focus resources in the direction of demonstrated competence rather than spread them out so thin that nothing meaningful can ever be achieved. In my view it is enough to ensure that competitive funding of research proposals is governed solely by the principles of merit – and let natural selection then take its course.

Realization that merit-based, rather than idealism-based science needs to be promoted has become imperative given the rapidly changing scenario of biological research. While we may take some satisfaction in the gradually improving standards of biological research in this country, we must also be concerned with the fact that this pace has not been fast enough. We must take note of the fact that the rate of progress of international science has been exponential in comparison. This makes the task of achieving competitiveness – leave alone leadership – that much more difficult. Nothing exemplifies this better than the recent landmarks achieved in sequencing of a variety of genomes which, interestingly, has coincided with the start of the new millennium. The remarkable degree of success in these ventures, as also the spin-off technologies that they have generated, have forever changed the very character of biological research. They have ensured the irreversible transition from an individualistic – even iconoclastic – idea-driven exercise to an assembly line, serendipity-driven enterprise. A transition from the days of Copernicus, Galileo and Newton, to the present age of international networks and global consortia. However, because of the high throughput approaches that newly developed technologies allow, the statistical probability that serendipity-based science will bear fruit is extremely high. For example, it is now possible to simultaneously study expression of thousands of genes when, until only recently, study of expression of even a single gene required meticulous, time-consuming efforts. This simple fact of statistics alone greatly increases chances of success, requiring no greater intellectual input than what has been committed in the past. Indeed many promising products that have resulted from such approaches are already in the pipeline of the major biotechnology companies. So, in the end, we need to run that much harder simply to stay in the same relative position.

Against this backdrop then, where do we stand with respect to the future? While it may be true that the degree of national competency has marginally improved, it is equally true that the danger of slipping back into total obscurity looms up larger than ever before. This is simply because the pace of our forward movement has been so minuscule compared with that of the developed world, that the net distance between us and the vanguard continues to increase. Let me take just one example to illustrate this. Although a recent entrant, the technologies for generation of transgenic and knockout mice are now being commonly employed to unravel mechanisms, particularly in the area of infectious diseases. Indeed the technique is now so routine that descriptions of generation of such mice are reduced to a single paragraph in the materials and methods section of a good quality paper. Contrast this with our own scenario where, except for perhaps one or two isolated cases, it continues to remain a daunting if not impossible task. And, ironically, while the demand to develop vaccines becomes persistent, no thought

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is given to the fact that the present lack of both the knowledge base and infrastructure has already rendered such projects as absolute non-starters.

How then do we bridge the gap between us and them? Or, to put it more realistically, how do we ensure that we retain at least some measure of competitiveness so that the gap remains minimal? The more experienced and wiser members of readers surely have better ideas than I do in this regard. Nonetheless it seems to me that a minimum starting point would be to radically change a current mindset that is becoming increasingly dominated and, at least in my opinion, is threatening to stranglehold the development of science in this country. This is a mindset which views science as a one-dimensional exercise in empiricism, rather than an independent pillar that enriches in multifarious ways. By empiricism, I mean the current view that science is a social activity where every endeavour must result in an immediate benefit to the society at large. While no one would argue the fact that science – a largely public funded enterprise – must eventually benefit society, it is the underlying vision that accompanies such an expectation which becomes a crippling force.

Science has always been, and will continue to remain, a dialectical exercise. A process that is propelled by impassioned curiosity, and tempered by the skepticism of peers. Any benefit that results is a by-product of this process; although the time scales at which they occur is variable, and their eventual value virtually impossible to predict. For example, who in the early 1900s could have predicted the influence – either direct or indirect – that Einstein's thought experiments, or Schrödinger's cat-in the-box reasoning, or even notions such as 'wave particle duality' would eventually have on our lives today?! Indeed it must have been all too easy, at that time, to dismiss these experiments as 'ivory tower' gibberish of no relevance to real life.

In principle, there is nothing wrong in asking the question; 'What will your science give to society?'. However, it must be realized that the value of such a question is automatically proscribed by the expectations of the questioner, and is usually limited by experience, biases and preconceptions. Therefore, the implied act of reducing the entire spectrum of science to within the framework of this question becomes an exercise in self-limitation. An exercise that simply translates into trivializing the fundamental character of science itself. The bedrock of science is curiosity, with potential benefits as a natural fall out. In my view, it would be unwise to re-mould it as a social engine whose primary purpose is to fulfil, what we perceive, as an immediate requirement of society. History has taught us that the scope of science, but rarely ever our vision, extends far beyond the tip of our nose. Reducing science to the level of the predictable, then can only impoverish it. And to aim to achieve the predictable is to only ensure the continued sustenance of mediocrity.

Most of us who work in the area of biomedical science are often faced with such questions as: 'What diagnostic kits will your research produce?', or, 'What vaccines can you promise?' These queries are frequently posed either by the funding agencies, or the presiding deities of Indian science. However, in reality, the former question simply translates into what diagnostic kits existing elsewhere can you duplicate? Whereas the latter question constitutes an exercise in continued self-deception. It completely ignores the fact that global inability to counter currently prominent infectious agents – be it HIV, malaria or tuberculosis – stems solely from our ignorance of mechanisms governing pathogenesis and immune-evasiveness of these pathogens. And herein lies the irony!! While an empty promise to develop a vaccine attracts large sums of money, a proposal to understand mechanisms of pathogenesis draws – at best –, a sneer. And as a result, even the most committed of scientists are slowly but surely enforced into addressing purely specious questions. Questions that investigate Indian clades of pathogens, or the unique mutations in Indian strains or, even, simply the immunogenicity of select antigens – in spite of our ignorance of parameters governing protective immunity. All of this in the name of 'service to society!!'. But is any real purpose served by such investigations; particularly as a substitute for substantive science. I must point out that we are one of the few nations in the world that has both a wide-ranging spectra of clinical disease, as well as the requisite scientific expertise. And it is my submission that in our eagerness to develop vaccines, we have tragically lost an opportunity to establish competence at least in the area of disease pathogenesis. Empiricism may satisfy a dispossessed Narcissus, but it surely leaves Muse abegging.

If we re-frame the question that we asked earlier as; 'what has Indian science done for society?', it is possible that the majority answer would be, 'not much at all!' And if such a question is posed with a view to redressing our failures, 'how then do we remedy it?' would be the obvious follow-up. It is my personal view that if – at least in the overall – Indian science has indeed failed us it is not due to any perceived lack of direction. The benefits of science, both tangible and intangible, accrue in many dimensions and cannot – should not – be circumscribed. Rather, our failure has been in ensuring quality control of our output and, more importantly, permitting laxity in standards in the name of social obligations. If at all, it is here that the scientific leadership/management can play a defining role. By shedding the millstones of 'buddy networks' and 'paternal benevolence', and settings standards of quality that must rigidly be met. It is my humble suggestion that the guiding motto for the future growth of science in India needs to be: 'absolute, unconditional meritocracy – but without any blinkers' But then, do we have the conviction, the courage, and even the perspective to rigidly enforce such a principle?

Kanury V. S. Rao is in the International Centre for Genetic Engineering and Biotechnology, Aruna Asaf Ali Marg, New Delhi 110 067, India (e-mail: kanury@icgeb.res.in).