

Indian researcher: The reluctant tool maker

'With a hammer in one's hand, the world looks surprisingly like a nail.'

—Abraham H. Maslow

The decline in Indian science has been echoed often in the columns of *Current Science*. I would like to highlight one aspect that might give direction for a remedy.

We Indian researchers have shown considerable hesitation in inventing new research tools or techniques. We prefer time-tested methods/models from the West. Rarely does a new method or improvisation find acceptance in our labs. I have personally come across research supervisors vigorously discouraging their subordinates from improvising on existing methods. Such improvisations, though few and far between, are often stillborn on account of the vociferous opposition from peers and superiors alike. Variations that save labour and time are looked upon as compromises rather than innovations. Those who hit upon ideas, sometimes compelled by lack of facilities, are hesitant to publish their findings because they are unsure of peer-acceptance.

Karl Popper has noted that science walks on two legs, one of which is purely conceptual and the other, being technology (applied science). Technology generates new and superior tools for better methods of measurement. And such tools catalyse future progress in conceptual science. Scientific revolutions are more often driven by new tools than new concepts, said Freeman Dyson, a well-known theoretical physicist and author. The PCR is an example of how a technique per se could change the pace and direction of genomic research. The introduction of a new journal *Nature Methods* underscores the pre-eminence of techniques/methods in science.

Indians have great respect for the printed word. Our examination-obsessed educational method teaches us to read, remember, recall, regurgitate, respect and repeat rather than observe, think, hypothesize, question, challenge and change established traditions. The mania for good grades forbids the 'good' student from doubting the 'correct answer'. This implicit obedience and orthodoxy is perhaps one reason that makes Indians popular abroad in the subordinate role of a PDF.

Indians excel as surgeons and physicians all over the world. Doctors in India have

a lot more hands-on experience because they treat many more patients than their western counterparts. The large population of India and its immense diversity are two factors that substantially augment the scope for clinical research and therapeutic innovations. The multinational companies have realized this and today, 20–30% of the clinical trials are being conducted in developing countries. The law against medical negligence is so lax that medical and surgical errors often go unchallenged, even unnoticed in India. Despite all this 'nefarious opportunity', it is surprising that there have been very few indigenous innovations in surgery or medical practice. The reason is nothing but self-doubt.

Feudal traditions, which continue to influence our thoughts to this day¹, have taught Indians to despise manual labour as something low, associated with a lower social rank. Using one's hands has always been regarded *infra dig*. It is not therefore surprising that if Indian science, which is considered an elitist enterprise, should look upon tool making as a low occupation.

Abundance of cheap labour worked against invention of machines to replace manual labour. The caste hierarchy guaranteed a steady supply of obedient and inexpensive labour. Naturally, tool making remained a low priority among the leisured elite. Why a washing machine, when a pair of hands is cheaper? Why have wheels under suitcases, when coolies can carry them on their heads? If necessity is the mother of invention, the converse must be true as well. Kerala, which thrived predominantly on a coconut-driven economy till recently, never improvised a machine for dehusking a coconut. A crude contraption, stagnant in both design and mechanism, became popular just a decade ago.

Another reason why tool making did not progress in India is because the Industrial Revolution never touched India. The explosion in the repertory of tools and techniques occurred with the Industrial Revolution. Market economy had little impact until the arrival of globalization. Further, patenting of a tool or technique never became a part of India's thinking. Innovations were neither authored nor rewarded. Material assets are valued more than intangible assets such as intellectual properties and scholarship. Talent is undervalued and brain drain is its consequence.

While on the one hand we pay scant attention to crafting of methods, there is an unexplained enthusiasm when it comes to procuring new equipment. Nothing fascinates us as much as the toys of technology. While quality is indeed an important concern, issues such as cost effectiveness, developing and encouraging indigenous alternatives etc, are rarely addressed. While tools are being trumped as the *sine qua non* for good research, there are others who have lamented that '...Despite an increase in funds for purchase of instruments, no proportional improvement is seen in research output'... '...Equipment is sometimes kept as a showpiece... and not a single publication is made... even after 4–5 years'².

Tools cannot be a substitute to human intelligence. 'Some of the outstanding research works in India and abroad have been done under austere and challenging conditions' says Chopra³.

The greatest research tool built by an Indian, the Raman Spectroscope, was developed on a shoestring budget. C. V. Raman himself never subscribed to the Indian reverence to western gadgetry. He derided this slavish veneration for gadgets in a scathing attack 'Shah Jahan built the Taj Mahal to bury one of his favourite women. The National laboratories were built to bury scientific instruments'.

Unequal emphasis on research, which entirely neglects innovations in methods, obviously weakens not just the creativity of the individual but also the vision, perspective and scale of ambition. The restricted repertory of tools also limits scope for conceptualizing. True innovation lies in transcending the shackles of techniques. I know a successful scientist, who insists on his student developing a method, even if it is only a minor variation of an existing one, as a precondition for a Ph D award. This has encouraged several students to innovate freely without hesitation.

Why does serendipity elude Indian scientists? 'Eyes do not see what the mind does not know... A certain amount of irreverence is necessary for the pursuit in science', says Mashelkar⁴. Democracy offers a better opportunity for science¹. But as Boutros Boutros Ghali puts it, 'democracy is a state of mind'. We have to liberate our souls from the shackles of the feudal past. Times are indeed chang-

ing. The Internet will change the way we think. Youngsters are becoming a little irreverent'. And according to Mashelkar, this irreverence could eventually save India.

1. Unnikrishnan, M. K., *Curr. Sci.*, 2003, **84**, 484.
2. Kar, A., *Curr. Sci.*, 2004, **86**, 7.
3. Chopra, K. L., *Curr. Sci.*, 2004, **86**, 497.
4. Mashelkar, R. A., *Curr. Sci.*, 2003, **85**, 860–870.

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Women in science

This is with reference to the 'news' item by Monika Kaul Moza¹. While I am glad to see this news item, I must confess that I am rather distressed with the word 'Luring' in the title. Let me say at the outset that I very much commend the DST for having started such a scheme. The scheme indeed has been a godsend for many of the recipients of this DST award. I myself have 'shown off', in talks to an international audience, the much more enlightened approach of the Indian national science agencies to aid the women who have had a break in their scientific careers due to the usual extracurricular reasons.

In fact, I personally know of many such women scientists who had been desperately looking for ways to get back to the way of life that they have had to leave for a while. However, I am sure that none of them needed to be 'lured' back to science. Removing obstacles in their return to science and facilitating ways to help them get out of the state of being stifled, can hardly be termed 'luring'. I cannot but help feel that the use of the word is a reflection of the unconscious bias that we all seem to have that women need to be told what is good for them!

Incidentally, the utility of this otherwise useful piece of news would have been further enhanced had a web address been given where the interested women scientists could get more information on the scheme. Such information and application forms are available at: http://dst.gov.in/doc/wos_advt.doc, and <http://dst.gov.in/scprog/women.htm>. As an aside, the word 'fellowships' might be better suited to describe these awards rather than 'scholarships'. The news item uses the two words interchangeably.

Apropos women in science, it may be mentioned that both, the Indian Academy of Sciences (IASc) and the Indian National Science Academy (INSA), had formed over the past two years, special committees to look into the issue of women in science. The IASc committee came up with a set of recommendations for action points for the Academy to facilitate better and higher participation of women in science. Some of those may be taken up soon. The INSA had set up a committee to bring out a report on women in science. This report, based on a survey conducted by the Research Centre for Women's Studies (RCWS) of SNDT University, has been released on

11 October, in Delhi and copies should be available soon. A further brainstorming meeting is also being planned where specific course of action to be taken by various science agencies and organizations to improve the situation may be discussed further.

Note added in proof: The University Grants Commission has also recently announced 100 awards of part-time research fellowships for unemployed women who hold a Ph D degree, to pursue research in many different disciplines. The award is for a maximum of five years and the terms seem very reasonable. I came across the advertisement in the *Times of India* of 20 November 2004 and at present do not know official websites etc. where more information may be available.

1. Moza, M. K., *Curr. Sci.*, 2004, **87**, 852.

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CET watch 2004: The middle class love affair with 'scope'

It has been known for some time that the middle class (an euphemism for the top 5% or so of the population) has a fascination for disciplines that have 'scope'. I became acutely aware of this when my son came up for counselling a few years ago. While it was clear to us that he should go into Mechanical Engineering discipline, because he bought my argument that Mechanical Engineering was the 'Mother of all Engineering', most of his coevals were opting for the Information and Com-

munications Technology (ICT) branches. We were bemused by calls from well-wishers who wanted to know why our son was choosing a 'useless branch'. Our answer was that it was natural since he came from a family which had three generations of civil, mechanical and aeronautical engineers. Others asked, 'Does Mechanical Engineering have scope?'

Many years ago, when I wrote a review for *Current Science* of A. P. J. Abdul Kalam's *Wings of Fire*, I found myself pre-

aching, hopefully addressing my younger audience of aspiring engineers that 'I was particularly intrigued by the following paragraph on pg. 18, which I thought the most meaningful lesson for a young person preparing for a professional life:

"The trouble with Indians [was] not that they lacked educational opportunities or industrial infrastructure – the trouble was in their failure to discriminate between disciplines and to rationalise their choices,"