

## **OPENING MINDS WITH SCIENCE IN PAKISTAN**

by Pervez Hoodbhoy

Science is taught in schools for a good reason – we owe the modern world to it. The prosperity of nations and individuals is contingent upon our ability to understand, apply, monitor and, when necessary, control science. Take the products of science away and we would return to the dark days of our ancestors when a child at birth was more likely to die than live.

There is another excellent reason to study science. Far from being a cold and soulless collection of facts, it is a delicate and beautiful human pursuit imbued with principles that are amazingly simple and precise. At the same time, scientific principles are incredibly powerful and universal. Exactly the same laws explain why the universe is expanding, stars shine, the sky is the colour blue, human hearts beat and birds fly. Science engages the imagination and fascinates endlessly.

But science is more than gadgets and processes. It is even more than a beautiful and elegant terse description of nature. Fundamentally, science provides a way to comprehend reality in ways that enable truth to be approached incrementally through a rigorous step-by-step process. Science insists on relentless questioning and testing of assumptions, using both logic and empirical verification. This makes science the weapon of choice for combating the madness of fundamentalism that is now sweeping the globe.

C.N.R Rao, president of Third World Academy of Sciences, lost a nephew in the World Trade Center attack on 11 September 2001. But he preferred not to interpret the terrorist attack as solely to do with the Islamic world. Instead he wrote,

*I am convinced that whenever and wherever fundamentalism dominates, blind faith clouds objective and rational thinking. When such forces take hold, they create a mindset that allows people to do unusual – indeed sometimes unspeakable things.*

This is precisely right. But fundamentalism needs to be defined carefully and precisely. As I understand it, fundamentalism is a delusional state of mind – an extreme form of hubris – in which an individual is convinced that his or her belief system has the right answers to every possible question concerning

human existence. Even when fundamentalists pretend to engage in a dialogue with those who think differently, they never let go of their blind convictions. The defining characteristics of fundamentalists – religious or secular – are a complete absence of self-doubt, unconditional acceptance of dogma, rejection or marginalization of alternative ways of looking at the world and a desire to inflict punishment on those who deviate from the perceived true path.

Science is a lethal antidote for every kind of dogma and fundamentalism. Consequently, it is deeply feared by the orthodox. To appreciate this, let us revisit the epic trial of Galileo. It was not a question of cosmology or physics that worked the papacy into a hangman's frenzy. The church could not really have cared whether the sun goes around the earth or vice-versa. Crucially important, however, was that the word of god stood in danger of being shown up. If, heaven forbid, the Earth actually encircled the sun, the Bible would be proven wrong, suggesting that its authors would have flunked freshman physics. This would have placed into jeopardy the entire text of the Bible, including all miracles. All the glorious stories of Joshua and Gideon – which good Christians must accept without question – would have been placed in doubt. Science, which nags constantly for empirical proof and obsessively asks for reasons, was simply too annoying – and threatening – to be tolerated or even ignored by the 17<sup>th</sup> century Catholic church.

In more recent times, archaeological science repudiates the fanatics of the Vishwa Hindu Parishad who in 1992 instigated bloody riots in India after pulling down a 400-year-old Babri mosque, claiming that the god Ram had been born in a temple that had once existed in the same place. Molecular biology and genetic science have made nonsense of creationism and intelligent design, cherished by Christian fundamentalists in the United States who continue to mount a relentless campaign to include in school curriculums their faith-based views of how the earth and its living organisms came to be. Some extremist Jewish groups also derive additional political strength from antiscience movements. For example, certain American cattle tycoons have for years been working with Israeli counterparts to try to breed a pure red heifer in Israel, which, by their interpretation of chapter 19 of the Book of Numbers, will signal the coming of the building of the Third Temple, an event that would ignite the Middle East.

## **In Pakistan**

Pakistan is much in the news these days because of growing fundamentalism and a militant Taliban movement that has seized administrative control of some parts of the country. How is it doing in science in the face of these difficulties? Splendidly well, says the government of Pakistan.

Indeed spending on higher education and science has increased by about 15 times over the last five years, and the number of universities has nearly doubled.

The claims are many: Research activity has vastly increased and research publications from Pakistan have risen by 300 percent as a result of new financial incentives; nine new engineering universities with Asian and European teaching faculty are in the process of being established; mathematics is emerging as a strong discipline in Pakistan; more than 3000 Pakistani students have been sent overseas for higher degrees; PhDs produced annually from Pakistani universities will soon approach the spectacular figure of 1500; and so on.

One wishes that all the above indicators signified genuine progress in science and mathematics. But I am afraid that this is not the case. Indeed science in Pakistan continues to languish despite the vast investment that has taken place.

Indeed genuine science in Pakistan – which must be distinguished from publishing papers of dubious quality – has shrunk, not grown, over the last 30 years. With more than 160 million people, Pakistan has fewer than 10 physicists who enjoy an international reputation (all but a couple are over 50 years of age) and still fewer mathematicians. (This excludes the few dozen foreign mathematicians, many from Romania, who have been employed on short-term contracts at a mathematics centre in Lahore.)

Huge per-paper monetary rewards have boosted publication rates enormously. But this increase has come at the cost of an explosive growth in plagiarism, publication of trivial results and falsified data, and a flood of slightly different versions of the same paper in different journals. A review of international databases shows that other scientists rarely cite papers published by Pakistani scientists.

In short, the government's campaign to increase the number of publications has largely been a paper exercise that has helped to raise the income of some professors who know how to play the game. But it has had scant impact on science either within Pakistan or elsewhere.

### **Thinking Matters**

It is not my intent here to make a point-by-point refutation of the official claims rendered by Pakistani officials. The more important question is: Even with a sizeable budget and strong affirmations of the need for encouraging scientific growth, why is Pakistan's performance so undistinguished?

As in many other developing countries, the dead hand of tradition blocks progress. The Pakistani educational system, shaped by traditional social and cultural values, discourages questioning and stresses obedience.

Tyranny of the teacher lies at the core. In Urdu we say that the teacher is not just a teacher, he is your father. Since a father is all-wise, he dare not be questioned. Instead of experiencing science as a personally fulfilling quest for understanding, under the watchful eyes of despotic teachers, students memorize an arbitrary set of rules and an endless number of facts. X is true and Y is false because that is what the textbook says. (I grind my teeth whenever a master's student in my university class gives me this argument! But this is this is the inevitable consequence of authoritarianism.) The mindset needed for authentic science is alien to the educational environment of schools, colleges, and universities in countries such as Pakistan.

How can countries that remain mired in such a thought-deadening process of education develop a true scientific mindset?

The first thing that must be stated is that to begin the effort in colleges and universities is to begin too late. Change must be instituted at the primary school level. Good science pedagogy requires deliberate inculcation of the spirit of healthy questioning in the classroom among five- and 10-year-old children not just 20 year-old young adults.

Correct attitudes start developing naturally when students encounter questions that engage their mind rather than test their memory. For this, it is important to begin with tangible things. One does not need a doctorate in cognitive studies to know that young people learn best when they deal with

visual, auditory, tactile, and kinesthetic objects. As their experience grows, they learn to understand abstract concepts, manipulate symbols, reason logically, solve theorems, and generalize. These abilities are destroyed, or left woefully undeveloped by rote memorization.

It should therefore be normal practice for teachers to raise such questions as: How do we know and learn? What is important to measure? How can we confirm our measurements and conclusions? What evidence has been brought to bear on the question? How can we make sense out of the results? Is there a counter explanation, or perhaps a simpler one? The aim should be to get students into the habit of posing such questions and then framing answers.

Bad science teaching in Pakistani schools and widespread scientific illiteracy has made the siren song of unreason ever more sonorous and attractive. In older times, only the ignorant and illiterate accepted the idiocy of the aamils, pirs, mullahs and assorted soothsayers and charlatans. Today, however, college graduates and the rich and powerful, calmly accept – indeed embrace such nonsense – as high wisdom that guides their thinking and values.

Good science education can help change this. In fact, the demons of superstition and narrow-mindedness can only be chased away by those who know and understand the spirit of science.

Though difficult, the situation in Pakistan is by no means hopeless. Let me give one personal example that shows that, bucking the mind-deadening ‘education’ in schools, Pakistani kids are still curious. Inspired by the world-renowned scientists Carl Sagan (of *Cosmos* fame), some time ago I created and presented a series of popular science programmes for Pakistani television. The response was phenomenal. I received thousands of letters, many from young students living in remote villages. Dozens of young people personally came to my department: I even had an unannounced visit by the entire student body from a remote village school in southern Punjab!

Science cuts across every boundary – cultural, political, social, even psychological. The only way to get a handle on many of today’s conflicts is to enable people to learn to think more scientifically and to encourage them to move away from the various fundamentalisms derived from religion, nationalism and other exclusivist ideologies that create impenetrable, yet false, boundaries between me and you and us and them.

The message of science is that we are one human family. The process of science proves that the only way to effectively deliver this message is through clear and rational thinking that has been nurtured through good education and challenging and rewarding experience. Money counts in achieving this humanistic goal. But mindsets count even more.

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