Scientists – making sense and being sensitive

The present crisis in the middle-east, the events leading to unnecessary suffering for mankind and post-war problems should make us, the scientists, ponder a while. This confrontation between Iraq and the American-led allies started with the issue of piling up and use of weapons and ammunition not only in the conventional sense but also due to the controversy of the threat of application of biological and chemical weapons.

In this context, 'a bargain that may prove to be too difficult to resist and not so profitable to use' could well have been a remark made by Franklin James about the way applications in science and technology are being perceived in the development of ammunition, missiles and the deadly biological and chemical agents. An analysis of the contributions of scientists and technologists and the impact their work has had on society and mankind especially in defence research, shows that tremendous advances in pure science during the 20th century, particularly in physics, during the first half and in biology during the second half, have completely changed the relationship between science and society.

In early 20th century, a scientific finding and its practical application were well separated in time and space. Following a discovery, it would take decades before an application was found, and then it would be taken up by different people, mostly engineers in polytechnics or industrial laboratories. The detachment of scientists from general human affairs led them to build and stay in an ivory tower, pretending that their work had nothing to do with human welfare. The aim of scientific research, they asserted, was to understand the laws of nature; since these are immutable and are not affected by human reactions and emotions, these very reactions and emotions had no place in the study of nature.

As a result of this exclusivity, scientists developed certain precepts and principles about science to justify their work as distinct from reality. These included: 'science for its own sake', and 'science cannot be blamed for its misapplication'. Today the scientist dons many hats. He needs to forecast technologies that will sell and maximize economic return on investments in science and technology. Many scientists, especially those working in the basic areas of scientific research, may not agree with this viewpoint. They may say that most scientists live untouched by reality and the words 'profit' or 'earning' is something that they only read in their institute's annual budget reports (if at all they have access to them). At best, every practising scientist thinks that he has at least a tiny grip on the very powers that move the universe and gets paid to do things that completely fascinate him which is a rare state of affairs elsewhere.

There is an anecdote that is commonly told in many physics laboratories of how Rutherford wanted John Cockroft and Ernest Walton to get a 'million volts from a soap box' when he directed them to build a home-made accelerator to split the atom. Sure enough, using glass cylinders from petrol pumps, a couple of bits of wood and some recycled nails they successfully carried out the task at Cavendish laboratory, Cambridge in 1932. With their cheap and cheerful machine they split the lithium nucleus using a proton beam and thereby achieved a breakthrough in modern physics. However the days when science could get by with little more than string and sealing wax are long gone and it has now become an expensive business while funding is getting tighter. If Rutherford were alive today, he would also ask his colleagues to 'generate a million pounds from a soap box'!

However in the pursuit of commercializing science or seeking profit, should we as scientists forget the social impact of our work and the ethical issues it raises? Should we not accept responsibility for the human and environmental consequences of scientific research? These questions did not arise in the distant past because there were very few such consequences. In those days, science had no role in the day-to-day life of people or in the security of states. The only motivation for scientific pursuit was sheer curiosity – the same impulse that drives scientists today – with no avowed practical aims.

We now live in a world community with ever greater interdependence, due largely to technical advancement arising from scientific research. Thus an interdependent community offers great benefits to its members, but by the same token it also imposes responsibilities on them. Every citizen has to be accountable for his or her deeds. Scientists, more than anyone else, have a responsibility to society. Today, people are talking about cloning 'designer babies', genetically modified food and even starting colonies in space. It is true that science has become a dominant element in our lives. It has brought enormous improvement to the quality of life, but it has also created grave perils. These include environmental pollution, squandering of vital resources, increase in transmittable diseases and, above all, a threat to the very existence of the human species through the development of weapons of mass destruction.

The mathematician Michael Atiyah, explained the reasons for the special responsibility of scientists in his 1997 Schrödinger lecture: 'First there is the argument of moral responsibility. If you create something, you should be concerned with the consequences. This should apply as much to making scientific discoveries as it does to having children.' Atiyah went on to outline four further reasons why scientists needed to take responsibility for the consequences of their work. He said that scientists could understand the technical problems better than the average politician or citizen, and such knowledge brought with it responsibility. Further they could provide technical advice and assistance for solving the incidental problems that may emerge. Scientists are better equipped than the common man to warn of future dangers that may arise from current discoveries. And more than anything else, scientists form an international fraternity that transcends natural boundaries, so they are well placed to take a global view in the interests of the human race.

We therefore come to the most important question: Should we as scientists think and use science with a 'human face'? I say this because, however lofty our ideals may be, however exciting our work may be, the truth is science can only answer certain types of questions at

certain levels of matter and the universe. But when we get down to the levels in which we actually live out our lives: our relationships to other human beings; our aspirations, politics (micro and macro), personal choices and moral dilemmas, at these levels from a 'human' perspective, science has no precise answers. Science can at best offer open-mindedness and willingness to consider facts. While we as scientists strive to make this world a better place to live, it is perhaps good to remind ourselves of Mathew Arnold's famous *Hymn of Empedocles*.

That we must feign a bliss
Of doubtful future date
And while we dream on this
Lose all our present state,
And relegate to worlds yet distant our repose?

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Decline of Indian science

It has become fashionable to lament the declining quality of Indian science as reflected in certain scientometric studies. One of the causes allegedly responsible for this decline is the spurt in engineering education which is seen to be draining away talent from science. *Current Science* too has suggested that the IITs must 'consider emphasizing postgraduate education and research and to lower the rising barriers between science and engineering[1]'. If this kind of argument is taken to its logical conclusion, then the only way to 'save' science is to curtail opportunities in engineering, cause disaffection in that part of the society that is hungry for engineering education and then hope and pray that some frustrated elements will break ranks and join the science stream. This 'dog-in-the-manger' attitude is reflective of the intellectual bankruptcy of our leaders in science.

Engineering is no more a 'professional' course. Those who graduate in engineering rarely pursue a career in their chosen discipline and as noted in *Current Science*[1] drift to finance, management, information technology and elsewhere, where employment opportunities abound at any given point of time. The engineering course is popular because it confers a certain employability on those who pursue it. In this sense, it is very much a 'vocational' course. In these days when the traditional vocational institutions such as the Polytechnics and the ITIs (Industrial Training Institutes) are closing down for lack of human input, the IITs and engineering colleges are stepping in to fill the vacuum. The proliferation of engineering colleges has in fact provided spectacular opportunities for the educational and social advancement of the lower middle and poorer classes in both urban and rural areas – a very heart-warming development by any measure. This is also in keeping with our age-old policy of making vocational education available to all. Real professions such as those in science, arts or humanities, depending as they do solely on government largesse, can scarcely contribute to social advancement on such a scale.

Failure of leadership is one cause of decline of Indian Science. Growth of science is critically dependent on each generation of scientists mentoring an entire new generation. The senior scientists in India (especially those in the age group 55 years and above) have completely failed on this front. This is no doubt an old problem. Talking of Saha, Bose and Raman (S, B & R), Chandra says, 'Those who made significant contributions were constantly aware of those successes. They wanted to be regarded as unique individuals, and therefore they turned around and discouraged younger people or attributed all kinds of motives to their contemporaries'[2]. Soon after independence, a whole generation of scientists got exposed to the western world. They acquired their early (doctoral/post-doctoral) training abroad and worked in eminent universities or with eminent associates and returned to India with this borrowed glory to occupy important positions here. What S, B & R had done on the national scene in an earlier time, these petty tyrants have done more recently within their respective spheres of influence – be it a department, an university or a national institution. The added misfortune was that they were not even good scientists. 'Mentoring' was not a word they knew even remotely.

While most of us can recall a kindly school or college teacher who encouraged us to study, how many of us can recall receiving any sort of encouragement in the early years of our career?

Failure of policy is another cause of decline of Indian science. Our science policy seems to be built on two equations.

Good science = Good papers = Modern instruments = More Funds = A few centres of 'first rate science'. (1)

Talent search among our 1 billion population = Raman/Ramanujan = Nobel prize = Good science. (2)

The limitation of such a policy are too obvious to require further elaboration here.

1. Balaram, P., *Curr. Sci.*, 2003, **84**, 613.
2. Wali, K. C., *Chandra*, Viking Penguin India, New Delhi, 1990, p. 248.

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