

Some Faces of Indian Science – Its Present And Its Potential¹

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Let me start by talking of the visible aspects of Indian science. Some of the areas that come to mind are connected with a few institutions that have been major players for some time. There has been significant progress in the field of atomic energy, including a movement towards achieving a fast breeder reactor. Use of thorium as nuclear fuel might actually happen. There are many hurdles and challenges in front but also a hope that we might get there within the next decade. While the technical achievement in the area of atomic energy has been of a very high order, the total amount of power delivered to the country has not been very significant. This lacuna has been due to the requirement of high investment in this area as also political decision-making. Environment considerations and reduced availability of cheap oil and gas might change the situation in future.

There have been other spin offs of the atomic energy program. They include nuclear medicine and development of capabilities in a host of technological areas.

In the area of space technology there have been some brilliant achievements. The Polar Satellite Launch Vehicle (PSLV) has proved to be a reliable workhorse. Building on the basic design of PSLV and adding a cryogenic stage has led to a Geo-stationary launch capability.

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This would soon lead to operational systems capable of launching two-ton payloads into the Geo-stationary orbit. Satellite technology has been demonstrated in several launches, both for communication and remote sensing. We now have about 120 transponders available on Indian INSAT satellites and our meteorological and remote sensing satellites are proving to be of excellent quality and great use to the country. Offer of channels for education and science is a welcome outcome of the success achieved in the design, manufacture and deployment of space hardware.

Atomic energy and Space are two areas where major developments have been made by the public sector without critical technical assistance from abroad. This is important to remember. Rising up by pulling on our bootstraps can lead to endogenous and self-confident development that can survive even during years of outside embargoes.

In the area of chemicals and pharmaceuticals the country has moved significantly forward. We are beginning to be recognized as a significant power in these fields. There are a large number of capable people available and their number is growing. Young persons come into research laboratories and industry with much greater competence and self-confidence. Industry has been coupled with laboratories to a much larger extent than in many other areas close to physical and medical technology. Biotechnology is now much in fashion, even in the school curriculum! I cannot help feeling that the current hype is louder than the tune, even though one feels that great things lie ahead. We do have a great vaccine, namely that for hepatitis-B which would be highly expensive if it had to be all imported. One is highly pleased by the manner in which some Indian companies have been able to fight

the multinational pressure to supply Anti-aids drugs to Africa. Smell of ethics emanating from this highly competitive and bottom-line conscious industry makes me feel proud of my country. Of course, this is not enough to cancel the shame of the burgeoning business of spurious drugs that our crime fighting agencies are not able to control.

It would be a big gap if one does not refer to a rising effervescence in the area of information technology. Bulk of this major explosion comes from the fact that India has developed to be a major destination for off shore information services. We are basically providing service functions to outsiders. We have to keep remembering that while we are acquiring technical competence in many areas by working on tools invented abroad, and while it is true that some of that competence is also beginning to improve the efficiency of some of our operations and services, this is not great original science. Science must contain elements that have been originally thought of and progressed through our initiative. What is happening is exceedingly useful, but it should not lull us into a mindset that we have become scientifically innovative or creative. We might also remember that the more we use the gadgets that are mostly invented and manufactured abroad and the more we succeed in doing such business for others the greater would be the disparity between us and them.

I meet lot of young people these days. I am thrilled by their basic quality. It is not true that they are not interested in science. They observe, they experiment and they seek answers. Those answers are usually not available in the disintegrated, didactic and overloaded curricula of their schoolbooks. The teachers are also wrapped around the same curricula and pressured to "finish the course" and not waste

their time on things not likely to figure in examinations. Many discovered questions of children therefore remain unexplored and unanswered. And soon after that begins a phase when such questions are consigned into "no need to know" bin. The world does not have to be understood. Brainwashing and slogans begin to take predominance. And when the State itself begins to provide respect to Astrology as a science to be taught in universities, the story is completed. But all this is not immutable. This can be easily altered and we can begin allowing the hidden and natural talent amongst the young of this land to emerge and change the scene within a few years. I suspect some of this is beginning to happen.

I see another change in the science scene of the country. Information systems are finally getting introduced in our colleges and universities. It has taken a long time after the Inflightnet was established by the UGC over 13 years ago. I am sure it will make a difference but only if we use it to increase the dimensionality of education and not go on making new prisons we call syllabi. Lot of learning will happen from living and taking varied courses, from colleges or the net. We would need to develop respect for the gifted dropouts and not keep stamping them with a failure label. Education will not be finished in schools, colleges and universities but in work places that should stop looking only for formally educated people. If we start transitioning in that direction then we would be surprised that we already have an enormous learning system in the country from which we had cut off relations when we set up our formal systems about a century ago. Contexts might get seamlessly connected with formal education and research. I am sounding overly optimistic about these possibilities, but this is so because I find more and more people who begin to think this

way. The experts within the established system are likely to be the biggest opponents of such a change. Because if this comes about all the prestige attached to the administrators of competitions and controllers of examinations would be difficult to maintain. Large centralized examinations can be justified only if contexts are neutralized and dimensionalities are limited. Examinations are best administered in prisons of thought and competency.

The success and vibrancy of a number of Inter University Centres and Consortia like the Nuclear Science Centre (NSC), the Inter University Centre for Astronomy (IUCAA) and several others gives me personal satisfaction. We should proliferate such a culture in multiple ways. A number of institutions like the TIFR, PRL, IISc, CCMB, NII, and several others have not shown any signs of decay while some others have come up. One begins to see some movement towards a proposal made 15 years ago that some of our national laboratories should start functioning like universities. Several universities like the JNU, Poona, Hyderabad and a few others do occasionally scintillate but most are still caught in the quagmire of ill-administration and orthodoxy. But excellent people are found everywhere often un-noticed, even though shining.

A number of marvelous facilities have been set up for research and exploration. There are many places now with first-rate facilities for chemical and biological research – not just facilities but also competent people who know how to make use of them. In physical sciences the setting up of an excellent telescope at Hanle at an altitude of over 15,000 feet is a significant event. This telescope can be operated remotely from Bangalore and in principle from anywhere in the

country. Coming in of this instrument is beginning to the growth of several young astronomers and many observation proposals have already been accepted. The meter wave giant telescope, GMRT, is fully operational and is already giving first class results in astronomy. One does have a slight dearth of young people with visions of doing science in preference to management and commerce. This is worrisome and needs to be addressed in a cooperative way. It should not be difficult to persuade brilliant young people that there is deep fun in discovering a new pulsar, the spawning of a new planetary system or engaging with questions like "why the universe is as it is and why did it bother to exist"! Selling of soap, cosmetics, colas or chocolates might fetch more money but cannot be intellectually as challenging or spiritually as fulfilling.

One is delighted that we also have organizations and collectives of scientifically competent and concerned individuals who analyze, critique and even crusade for the greater good of society. I refer here to institutions like the Centre for Science and Environment, and people like Vandana Shiva. It is a wholesome development in our country. Another development that might have a far-reaching impact in making India a humane and scientifically literate country is the increasing recognition that innovators of all kinds are sprinkled liberally in the folds of our society. We need to respect their efforts and build on them. The work of people like Anil Gupta and the setting up of a National Innovation Foundation might be a dawning recognition that in order to give contextual validity to our efforts to soak science and technology into the interstitial layers of our society we have to set up a two way transaction between elite science and the grassroots talent and ways of learning and doing. Resonating with these efforts are a

large number of people's science movements whose diversity should not blind us to their basic urge to establish a two way conduit between people as they are and the way they might develop without being sucked into a cauldron of revivalism.

In the end we have to remind ourselves that we are still the world's most illiterate country. Not more than 1 % of our people get to study rudiments of science at college level. Unless we do something about this all dreams of India becoming a great scientific power would remain somewhat hollow.

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