INDIAN SCIENCE IN THE BLAST FROM THE NUCLEAR TESTS[1]

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Introduction

The nuclear tests of May 11 and 15 created a major turbulence in India, the sub-continent and the world. In the process, strange events were observed. For instance, a phalanx of directors of CSIR laboratories gave a standing ovation to the Minister of Science when he announced India's successful nuclear tests. And the Prime Minister added "Jai Vigyan" to the "Jai Jawan" slogan so that scientists could join soldiers in the march of the nation. Even more telling was a photograph of India's leading nuclear scientists in military camouflage uniforms at Pokhran. Indian Science began to be highlighted as a major determinant of the present and future. Suddenly, the external linkages of Indian science and its internal condition have become central issues for scrutiny and assessment.

This issue of *SEMINAR* is an excellent medium for such a discussion. In this paper, the focus will be on the way the nuclear tests have exposed the relationship between Indian science, on the one hand, and Indian society, its state, humanistic tradition, morality and its scientific community on the other.

In fact, such an analysis is overdue because an excellent opportunity for a critical assessment of Indian science was missed in 1997. Last year's celebrations of the 50th anniversary of Indian Independence provoked a large number of articles in various newspapers, magazines and journals on politics, economics, industry, agriculture, infrastructure, etc. Many of the discussions were scholarly, insightful, enlightening and of archival value. In striking contrast were the articles on science in independent India, which ended up as pedestrian diaries of the growth of post-1947 Indian science. They were lavish in their praise of its so-called "achievements", but unfortunately they were almost completely lacking in criticism and analysis. For instance, there was no attempt at a SWOT or Strengths-Weaknesses-Opportunities-Threats analysis. There was no discussion of the external linkages of Indian science to the Indian state and to Indian society. There was also no treatment of the internal health and functioning of scientific organisations and of the scientific community. And after the anniversary, non-introspective normalcy and self-satisfied smugness soon returned.

Indian Science and Indian Society

Discussions on Indian science must start with the country's poverty -- for, this is its defining characteristic and fundamental reality. In 1951, India's poor numbered 164 millions; in

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1993-94, the number had increased to 312 millions, that is, double the Independence number of people who could not meet their daily subsistence requirements. Between 1950-51 and 1993-94, the population below the poverty line declined by less than 1% per year. One in three Indians go to bed hungry. Life expectancy is about 60. Half the Indian population cannot read or write. The Human Poverty Index (HPI) is about 37% -- this index is a composite of *longevity* (19.4% of the population expected to die before the age of 40), *knowledge* (48.8% are illiterate), and *standard of living* (19% are without access to safe drinking water, 15% without access to health services and 53% of the children are malnourished/ underweight). India belongs well and truly to the club of poorest nations. The country can move out of this cursed club only through sustainable development.

It is this Indian reality that must guide the direction of Indian science. Instead, what is observed is a lack of correspondence between the thrust of Indian science and the problems of the Indian people. Going by the expenditures on R & D, it appears that the bulk of the expenditure (about two-thirds[3]) goes to the Defence Research and Development Organisation, Department of Space and Department of Atomic Energy, all of which have overt and/or covert military implications. Of the balance, a large percentage goes to industrial research, but this caters largely to the needs of the elite. In fact, going by the militarist-elitist expenditure pattern of Indian R & D, one would think that the primary problems of Indian society concern external security and upper class consumption wants, rather than poor health, illiteracy and basic needs.

This mis-orientation of Indian science is not a surprise. It follows from the fact that the country consists of small islands of urban splendour amidst vast oceans of rural misery. This situation is often referred to as a "dual society" -- a small politically powerful elite (constituting a mere 10-15% of the population and consisting of industrialists, landlords, bureaucrats, professionals and white-collar labour) living in conspicuous affluence amidst the abject poverty of the politically weak masses.

[3] The Union Budget, Expenditure Budget, Volume II gives 59% for Defence R&D, DAE and DOS, and the Stockholm International Peace Research Institute website http://www.sipri.se has an article “Nuclear deterrence, nuclear tests and science in South Asia: Selected statistics and quotes” compiled by Eric Arnett which states that the “percentage of government funding for science spent on military, nuclear and space R&D” was 68% in FY 1996-97.

Indian Science and the State

Free India started with the Nehruvian idea of science as an essential accoutrement of a modern society. Today, the nuclear tests have shown the determination of the rulers to make Indian Science a servant of the state and its internal and external political ambitions. The idea that science is the people's ***astra*** (weapon) against poverty is being jettisoned. The Jai Vigyan pronouncement symbolises this attempt by the government to co-opt scientists.

But, this is not an unrequited one-sided desire to embrace. In turn, scientists have been wooing the ruling establishment with a desperate desire to be in the corridors of power. When the Government kept them at an arm's length -- as seems to have been the case in the Narasimha Rao regime -- scientists felt quite bitter and rejected. They even considered that period as the nadir of post-Independence Indian science.

In contrast, the giants of Indian Science, in particular Raman and Saha, considered their independence from government in the years immediately after 1947 to be a matter of pride. But, power was irresistible to the lesser scientists who followed. And the only way this desire could be fulfilled was to woo government through its scientific ministries and their secretaries. Scientific academies courted secretaries of scientific ministries to be their presidents and office-bearers. There was no regret that, in the process, the academies lost their independence. Or, that their voices could not be distinguished from those of government. This in a country where there are very few other institutions that are independent enough to come up with perspectives different from the government. In the West, the universities provide independent policy studies, but such independence is rare in India.

Thus, scientists wanted to be, and became, a pressure group. All this has become clear after the tests when a former Prime Minister revealed how the nuclear scientists lobbied the Government to give them a chance to prove their capability. The scientists had not done a comprehensive cost-benefit analysis of the tests and their fall-out. They did not reveal a national perspective. Despite this, they pursued a narrow departmental, if not personal, agenda, perhaps emulating their political masters.

Are the Tests a Great Achievement of Indian Science?

The tests are a great achievement only if one has an inferiority complex, and has doubts about whether Indian scientists are as good as their "Western" counterparts. There is no need at all for such inferiority. It was always known that, given a clear mission and the necessary resources, Indian science can reach the highest heights of achievement. Any residual doubts can be set at rest by noting that the best universities, institutes and industries of the US are filled with scientists of Indian origin. Indians are as good as the best. The tests have only confirmed this truth. There was no need for euphoria after the tests.

Of course, it is difficult under Indian conditions to deliver a ***product*** -- as distinct from an idea or concept. This has been done. To that extent, the tests are an achievement. Also, it is widely believed that Indians have serious problems working together. The bomb squad has worked as a team. This is another achievement. But, we must take into account the large number (thousands) of scientists in DAE, the enormous amount of money spent over the years (thousands of crores) and the decades of time (≈ 20 years for Pokhran I and 24 years for Pokhran II).

And, a great deal of information is available on the Web and in the public domain. Even the Teller-Ulam configuration of the hydrogen bomb has been described. In any case, we must not forget that the fission bomb is 53 years old technology, and the fusion bomb is 46 years old technology. So, we have replicated half a century old achievements. And, as Pakistan has demonstrated, "What one Abdul (Kalam) can do, another Abdul (Quader Khan) can!"

Indian Science and the Country's Humanistic Tradition

Indian science cannot escape the fact that it is operating in the land of Gandhi. He said: "Recall the face of the poorest and most helpless person whom you have seen and ask yourself if the step you contemplate is going to be of any use to him. Will he be able to gain anything by it? Will it restore him to control over his life and destiny?" Quite clearly, this Gandhi Talisman was ignored in the whole process of preparing for and carrying out the nuclear tests. If the heritage of Gandhi was denied by Indian science, an even greater sacrilege was committed by using the code: "The Buddha has smiled!" to convey to Indira Gandhi the message that Pokhran-I had been successfully exploded. This sullying of the memory of Buddha was compounded by choosing Buddha Jayanti to set off the recent explosions.

Indian Science and Morality

The roots of this disjunction between Indian science and morality go much deeper. Modern science has been based on two dichotomies: (a) separation of the subject from the object and (b) separation of feelings and emotion (the non-cognitive self) from thought and analysis (the cognitive self). Accordingly, a scientist's first duty is to separate himself/herself from the object under study, and the second duty is to eschew feelings from the analysis. Thereby, science claims objectivity. However, the first dichotomy leads inevitably to degradation of the objects of study (even humans) into things, and the second, to the removal of feelings for objects (plants, animals and finally human beings of different castes, tribes, nationalities and religions).

All this leads to the conventional view that science is amoral and neutral. We must not forget that Oppenheimer said that the first atomic bomb was "technically sweet". Or that, at the 1988 Bangalore “National Workshop on Nuclear Plants with specific reference to Kaiga," a Department of Atomic Energy scientist said: "Hiroshima provided us with a fortunate opportunity to study radiation effects!" The claim of amorality is a clever way of escaping responsibility for the horrors that have sprung from science, for instance, for the Hiroshima bomb after computing and prescribing the height at which the bomb must be exploded to maximise the number of people

who would die. This neutrality of science is also implicit in Kalam's repeated statement that "he is only an engineer" and that "his missile can also be used for delivering flowers." But, the youth of the 1960s in Europe and North America rejected that sophistry. As did the post-World War II judgements at Nuremberg which ruled that the Nazis charged with war crimes (like all human beings, even soldiers) cannot claim immunity on the grounds that they carried out orders; they have to bear full responsibility for the consequences of their actions.

The relationship between the subject (the scientist) and the system under scientific study (the object) must be dialectical so that initial separation (and distance) ends in subsequent unification (and embrace). The suppression of emotion **during** analysis must give way to emotion **after** analysis. The functioning of scientists as individuals, groups and institutions must be constrained and limited by moral strictures and bans. Otherwise, the synergism between the isolation of the subject from the object and the removal or absence of emotions and feelings leads inevitably to science becoming the instrument of violence, oppression and evil. Science, therefore, is not neutral and amoral. It can be -- and must be -- encoded with ***life-affirming*** values.

From this standpoint, there are no life-affirming values associated with the nuclear tests and the attitude of the Government to weaponization. In fact, if there are any values at all, they are life-destroying. And the Prime Minster's *Jai Vigyan* pronouncement is tantamount to eulogising activities of science that can end up killing lakhs of non-combatants -- children, women and men -- in a nuclear attack. There is a pernicious value system underlying all this *Jai Vigyan* stuff which is only a ploy of the rulers to win over scientists to the militarization of Indian science. By going euphoric over science as an instrument of mega-death, the Government is sending a message commending the nexus between science and evil. The link between science and morality must be re-established.

Indian Science and the Scientific community

The nuclear tests also exposed the internal condition of Indian science. Faced with a complexity of issues raised by the tests -- issues of (internal and external) security, trade and economics, politics, ethics, national traditions -- it would have been natural for the body of intelligent and creative scientists to develop a spectrum of views. Instead, the virtually unanimous euphoria was astonishing. And, the silence of the present and past leaders of science, their academies and their journals was deafening. Since, it is statistically unlikely that almost the whole body of scientists had independently arrived at a single view, one has to probe deeper to find an explanation.

The vitality of science in a society depends upon the challenges thrown up by the innovation chain leading to technology as well as upon its internal momentum arising from the backlog of unresolved problems.

An understanding of science-society interactions in India has to take into account, on the one hand, the existence of a dual society, and on the other hand, its strong interaction with the industrialised countries. The coupling with the industrialised countries leads to the dominance of foreign-collaborating industry based on the import of western technology, and the dual character of Indian society results in an overwhelmingly elitist thrust of indigenous technology. Further, even these indigenous technological efforts consist almost wholly of the imitation and adaptation of western technology, rather than of innovation.

This almost complete decoupling of science and technology from each other has a profound impact on science in India and produces its first major abnormality. Because of the preponderance of technology imports and of the imitative character of indigenous technology, the initial part of the innovation chain (consisting of research, design and development, and engineering-for- manufacturing) hardly exists in the country. As a result, its scientific system is not subject to the pressure of basic problems emerging from technology. And, without this pressure from technology, indigenous science is deprived of a powerful driving force. If Indian science is to flourish, it must depend solely upon its internal momentum which is the product of the "mass" of scientists and the "velocity" or pace of scientific research.

The pace or tempo of research activity depends upon the existence and maintenance of an atmosphere of excitement which in turn requires a conviction of being "hot on the trail" of important discoveries. Such an atmosphere is facilitated by rapid communication between scientists through personal contacts, seminars, symposia and conferences and through well-referred journals which ensure quick publication. The pace of research is usually set by outstanding scientists who attract a following. The point is that scientists tend "to hunt in packs" behind leaders.

The "mass" of scientists depends upon the size of the scientific body, but not merely upon the number of scientists. What is required is a ***community*** of ***interacting*** scientists with the well-established traditions of a peer system. Scientific peers are crucial for discussions, brain-storming and testing out ideas, for acquiring different ways of looking at a problem, for enhancing the quality of seminars, symposia and conferences, for rigorous assessment and constructive criticism of work, for help in improving its quality, for weeding out defective work, for a process of recognition that is appreciated, and so on. In short, without the environment of an actively interacting scientific community, there cannot be the natural selection of scientific ideas and data which alone will ensure that the fittest theories and experiments survive.

Natural selection of ideas implies competition and diversity. It cannot arise if there is a monoculture of views. Truth cannot emerge if there is an absence and/or exclusion of dissent[4], and certainly not, if dissenters are branded anti-scientific and anti-national. It is against this

[4] Appreciation of the importance of dissent can be found in most unexpected quarters. **The Hindu** of 5 July (page 7) has a report that the CIA has an officer in charge of “contrarian thinking” whose failure “to challenge the experts of the agency and other intelligence agencies” was the “key incident” contributing to the “worst intelligence failure” in recent times of the US not predicting the Indian nuclear tests.

background that one notes that there are no major scientific controversies within the Indian scientific establishment. Bitter enmities between some leaders of Indian science are well known, but they are only due to conflicts of ambitions and careers; they are not on scientific issues. The only controversies that have arisen -- the Bhopal gas leak, the Sardar Sarovar project, nuclear power, etc. -- have arisen from scientists who are outside the establishment or are treated as renegades and ignored.

The standard way of avoiding genuine controversy and peer review is to exclude unorthodox views from seminars, committees, journals and other forums (including the peer-reviewing process). So, one finds internationally acclaimed experts not being invited to meetings on their subjects because they hold "unacceptable" views or they are not in the hierarchy. The dialectic of truth is frustrated even in so-called institutes of "advanced" studies. Of course, all this distortion of scientific tradition cannot survive if there were transparent democratic functioning. That is why there is a striking lack of transparency, undemocratic functioning and manipulation of peer review.

Underlying all this violation of the scientific tradition and its codes of behaviour is the fact "he who pays the piper calls the tune." Government and quasi-government sources are responsible for the overwhelming share of science funding so that scientific activity depends strongly on this funding, and almost all scientists are on the government pay-roll or perk-roll. There are also a number of cash-carrying prizes and awards which act as further inducements to conform, rather than dissent. No wonder there was a stampede of scientists to applaud the nuclear tests and prove their patriotism as perceived by the establishment. Fortunately, in spite of all this pressure for conformity, there were scientists who dissented and their numbers grew with the waning of the euphoria.

Conclusion

The nuclear tests and threat of weaponization have exposed the serious weaknesses of Indian science. They have shown that Indian science is responding more to the militaristic and consumption ambitions of the elite than to the problems of the poverty-stricken Indian masses. Rather than be a force that balances the demands of the state and civil society, the tests have revealed that Indian science has become a servant of the state whilst pressuring the state to advance the vested interests of Indian science and its scientists. The tests have revealed that the science-state nexus is strong. Indian science has betrayed the humanistic heritage left behind by Mahatma Gandhi and Lord Buddha. Sheltering behind the argument that science is amoral and neutral, Indian science may become an instrument of violence, oppression and evil. It has not encoded itself with life-affirming values. Immediately after the nuclear tests, the majority of Indian scientists echoed the official line in a regimented fashion. They did not show the independence of perspective and diversity of views characteristic of a community of interacting scientists with the well-established traditions of science.

Is there hope for Indian science? Yes, and it is to be found in the movements of dissent that emerged from many scientific institutions after the nuclear tests.[5] If these "nuclei" grow and coalesce, then there is hope for a "phase transformation" through which the character of Indian science will change. Then, the poor and the meek shall inherit Indian science. The state will be enriched by having a significant fraction of scientists reflecting independent views through the institutions of civil society. The morality of Indian science will become a tribute to the legacy of Gandhi and Buddha.

[5] See the website http://www.geocities.com/CapitolHill/2959 of ***Indian Scientists on the Nuclear Tests***

An Anti-Nuclear-Weapons Agenda for Indian Science

Now that the tests are over, Indian scientists must move forward. They must stop (a) the jingoistic exploitation of the event by forces with short-term political interests, (b) the erosion of democracy, (c) the further diversion of scientific talent away from the problems of the poor towards military applications of science and (d) an arms race with our neighbours. They must contribute to the process of international disarmament. And above all, they must turn their attention to the historic mission of giving all Indians -- and particularly the underprivileged -- a better life at least in the next century.

They have several roles as intelligent people privileged with technical training.

(1) They must spread awareness of the enormous consequences of the path the government may choose from the nuclear option to tested weapons to deployed weapons to weapons on hair-trigger alert. For example, the effects of one primitive Hiroshima-type bomb on Bangalore or Chennai or Calcutta or Delhi or Mumbai must be estimated and publicised. And independent calculations must be made of the financial costs of the ruinous path the country is being urged to choose.

(2) They must build an independent peer group outside the establishment to verify the claims being made. Secrecy stifles independence, erodes excellence and breeds mistakes (and even lies!). For example, independent estimates of the costs of nuclear power have already revealed serious flaws in DAE's costing. No wonder that secrecy is an important weapon used by insecure establishments to prevent rigorous peer review.

(3) They must reorient the thrust of Indian S & T. Unfortunately, this demand leads to the spotlight being turned on fundamental research which is asked to justify its usefulness. But, fundamental research accounts for less than 10-15% of the total expenditure. This share should be given -- no questions asked -- to the fundamental scientists. In return, all that must be insisted upon is that they set up and implement rigorous quality control measures and strive for excellence. The real accused is applied research and technology which consumes the bulk of the R & D funds. It must be carefully chosen to ensure that its thrust corresponds to the country's problems.[6] And in the process it must not be forgotten that India is a dual society with a powerful elite and disempowered masses.

(4) Scientists must be involved in new coalitions of people against the militaristic turn in the affairs of the nation. They must join forces with peace activists, development workers, environmentalists, women, dalits -- in fact, all those who are concerned about the future.

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[6] That this is possible even under present conditions was proved by several governmental and autonomous institutions as well as non-governmental organisations in the late 1970s and the 1980s which evolved innovative efforts and methodologies to re-unite science and the people.