

Ailments of Indian science and suggested remedies

It is heartening to see a series of communications in your journal, starting with Avinash Khare (*Curr. Sci.*, 1998, 74, 191), dealing with ailments of Indian science and suggested remedies. From time to time, since the early 1970s, many reports and writings have been available dealing with this topic. It is also nice to sing praises of our achievements, provided these help boost our budding young scientists. We still have plenty of them available but the worry lies in their dwindling with the passage of time. Perhaps our leaders in science as well as the environment around have not helped matters to improve. It is my feeling that we have attempted mostly symptomatic treatments, just scratching the surface of the sick body. May I put forward some viewpoints that may sound unconventional/revolutionary:

1. Can we work out mechanisms that may convert all the national awards/prizes/incentives presently offered to individuals into ones that are bestowed only to successful teams of scientists?

2. Let us forget identifying criteria for excellence in black or white! Excellence is too transparent to need parameterization. It is embedded in diligent work put in towards achieving a set of high goals, free of self-centred objectives.

3. Everyone agrees that rejuvenation of the entire educational system is central to success in the long run. We need to break all bureaucratic hurdles in order to generate teams of scientists consisting of right persons from universities, national labs and industry to achieve accelerated rise in our economic wealth by developing nationally-desired technology missions. Can we not reshape the rules rather than bow down before outdated procedures, rules and regulations, laid down by persons long dead! Political will can become available provided we scientists are honest about objectives based on the needs of our society.

4. Discipline at the work place should be based on the actual progress made towards achieving the objects. Personal dictates of any individual need to be curbed, as also the feelings about high and low status of working individuals.

Wherever the spirit of free give and take prevails, best results can be expected.

5. Some mechanisms need to be worked out that may help generate viable teams. This may require free transfer of positions from one institution to another in order to achieve the desired objectives.

6. It is worthwhile to discourage research publications of low impact quotient. Instead, there is a strong need to encourage studies and results worthy of patents of some commercial value.

As and when our national wealth and economic status rise to an international trigger level, we can afford to provide greater freedom to self-centred individuals to do whatever they may fancy. It is hoped that the ongoing dialogue and discussions will continue through your esteemed journal.

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New restrictions on animal experimentation – Where do we go from here?

The Government notification, received from 'Ministry of Environment and Forests' 8 September 1998 came as a startling and brutal shock to the scientific and medical community of this country. In fact, progress made by India in nuclear science, computer science and the slogan given by our Honourable Prime Minister 'Jai Vigyan, Jai Kisan' was supposed to boost the morale of the Indian scientific community. However, the notification on the restriction of use of animals for lab work will adversely affect biomedical research.

No one can deny that certain ethics are to be followed to prevent animal cruelty and suffering during experimen-

tation. In fact the 3 'R' principle proposes to reduce, refine and replace animals by providing suitable alternatives including *in vitro* models. A school of alternatives to laboratory animals has also been established to serve the purpose. It is pertinent to mention here that the National Centre for Cell Science (NCCS) serves as a National Cell Repository for supply of animal cell cultures from mosquito to man to scientists and researchers in the country. This will help to reduce animal experimentation. However, it is impossible to replace animals in all situations, particularly in final stages of drug and vaccine development, transplantation studies, toxicology, etc.

The strong rules and regulations laid down by a statutory body like CPCSEA for use of animals are necessary beyond any dispute. Rather, they should be applauded for their efforts in forming this body to look after animal maintenance and welfare.

It is erroneous and noxious to demand prohibition of animal experiments for demonstration purposes and also for not repeating the experiments, wherein results are already conclusively known. It is also mentioned in the new rules that the experiments should not be performed for the purpose of attaining or retaining manual skill. All these rules and regulations imposed by the Government are probably designed to

uproot the teaching, training programmes taking us back to 16th century (rather than 21st century).

It is rather hard to believe that when the entire world is engaged in finding solutions to problems like scarcity of human tissue by advocating xenotransplantation, we are going backwards in an attempt to take extra care of animals. Performing experiments on animals without acquiring necessary skills is more inhumane than handling of animals by a skillful researcher.

The production and use of transgenic animals has enhanced the number of scientific experiments and procedures performed on laboratory animals all over the world. It cannot be denied that the transgenic technology could provide significant benefits, for example, in the manufacture of biopharmaceuticals. It may be noted that animals involved in

these experiments are given good care. Scientific ambition and commercial opportunism are likely to overwhelm every other kind of consideration in the use of animals. Thus in this changing scenario it is difficult to stop animal experimentation and go backwards when we are ready to take a leap into the 21st century.

The clause in the notification about applying for written permission with the exact number of animals required, complete experimental design and acquiring sanction from the funding agency seems impractical and ridiculous. The authoritarian approach of various Government agencies, lack of expert manpower with technical knowledge on the various individual projects and 'swift movement' of sanction papers will not allow the scientist/researcher to perform his work in the

optimum time frame. This seems to be a potential problem in obtaining sanction for the use of animals.

With a lot of atrocities and whimsical myths displayed in the notification, one wonders whether we are interested in promoting good scientific culture and ethos or promoting a culture of inefficiency. Probably, Indian scientists will never be able to generate a 'Dolly' and would still be proud of it because as Indian scientists we have started loving our animals more.

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Nuclear breeders

Here are some comments on the paper 'India's Nuclear Breeders: Technology, Viability and Options' by Rahul Tongia and V. S. Arunachalam (*Curr. Sci.*, 1998, 75, 549-558).

1. Projections of the power generation capacity and the efficacy of proposed strategies are strongly dependent on the assumptions. Optimistic assumptions would naturally lead to a rosy picture and conservatism to a pessimistic one. It is not always easy to strike a proper balance. As a result, a close examination of the assumptions for realism as well as completeness is essential for a proper assessment of the projections and strategies.
2. The authors of the above paper have concluded that the three stages of the previously enunciated plan for nuclear power in India appear non-realizable even in a fifty-year time span. It is obvious that they have in mind the first half of the next century. They recommend commissioning of a substantial number of heavy water reactors as well as light water reactors, to enable a reasonable growth in nuclear power contribution in the immediate term. For some time now, the plans of the Department of

Atomic Energy have also provided for such a mix of reactor types.

3. Taking the conclusions of the paper further, let us examine the scenario. The paper projects a total installed capacity in the country of about 600 GWe over the next fifty years¹. If nuclear power based on light water reactors were to contribute even a modest 10% of this, 60 such reactors (each of one GWe rating) would need to be built². To realize this in fifty years, four parallel teams would need to be deployed, each working on a 2 GWe station and taking seven years for its completion before moving on to the next similar project.
4. Natural uranium requirements for 60 such reactors over a forty-year working life amount to about 290,000 tonnes. This is about four times the size of the indigenous uranium resources. If the technology and the fuel materials for LWRs were indeed procurable from outside sources, the strategy would tremendously supplement Indian fuel resources. But, unless arrangements are possible for recycling the plutonium produced in these reactors, the dependence on outside sources would be perpetual. However, such recy-

cling in this same type of reactors could at best help maintain power generation at the same level.

5. A noteworthy result arrived at by the authors is that starting with plutonium accumulated only from PHWRs operating on indigenous uranium, it is possible for nuclear power to grow to as much as about 240 GWe (30% of a total capacity of 800 GWe as indicated in Figure 5 of the paper) in a matter of fifty years, providing that we build fast breeder reactors designed to operate on fuel in metallic form and select a dry process for recycling the fuel. This growth rate, it should be noted, is based on rather conservative assumptions by the authors. Fast breeder reactor systems of the kind mentioned above were advocated in DAE quite sometime ago³. Theoretical analyses were made and laboratory scale studies on the techniques of reprocessing are going on. What, in effect, this paper now points to, but does not mention, is that earnest efforts should begin right away for indigenous development of the required FBR technology, to be able to benefit from it later.
6. The current proposal to build a PFBR, which is to operate on oxide