Science practicals at the Intermediate level neglected

Practicals in science have never received the due attention and importance which they demand. This is particularly true of chemistry. Not long ago, practicals in chemistry were considered as waste of chemicals going down the drains. Only a few students are drawn towards practicals with interest and seriousness, to verify existing theories and principles. However, the situation has worsened with the commercialization of education, and by the qualifying examinations for medical and engineering fields.

Educational institutions give priority for making money rather than imparting education and training. This has a direct impact on the quality of practicals, in an effort to save the expenditure on costly chemicals and equipments, but which are a must for complete education. Only time will prove whether such institutions can survive or would opt to change their priorities.

The students of Intermediate classes have to work really hard right from the first year, to prepare themselves for the qualifying examinations. These examinations have become so competitive for various reasons, that it is not only intelligence but also hard work that would enable a student to secure admission in the desired institution. The preparation needs time, and here again it is the practicals at the Intermediate level that become the casuality. The students invariably avoid, neglect or pay less attention to practicals in order to save time for their theoretic studies. They are well aware that it is not the practicals that can take them through the qualifying examinations and they need only to pass in practicals at the Intermediate level. There is nothing wrong in this intentional neglect of the practicals, it is purely a question of management of time for maximizing its usefulness. If one has an opportunity to see an intermediate student working hard for regular as well as qualifying examinations in addition to attending regular classes, one can appreciate the value of time. One can only blame the system, the faulty planning and mismanagement of resources at the top level for this neglect, and not the students, parents and the institutions.

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Rationale for the fast breeder reactor

While commenting on the 500 MWe Prototype Fast Breeder Reactor (PFBR), Ashok Parthasarathi (*Curr. Sci.*, 2002, **82**, 1211–1219) has mentioned that the energy scenario is grim in India and the domestic oil and gas production is very low. The paper does not indicate a solution to meet the large energy needs of the country. The Fast Breeder Reactor (FBR), which is under development in India, during the last 25 years has the following rationale.

- India's population has crossed 1 billion and is still continuing to grow. With a modest per capita average electricity consumption of 2000 kWh, which is the present world average, India would require about 500 GWe installed capacity. A large fraction of this capacity would have to be in the form of bulk electricity generation systems. Such large energy requirements cannot be met by any other presently developed system, except FBR.
- FBRs open up a very large energy potential in our uranium and thorium resources, capable of meeting a major portion of the country's power needs for a long time. The energy equivalent of our proven uranium resource is about 180 billion tonnes of coal equivalent (btce). If thorium resources are also considered (we have the largest thorium resources in the world), the energy potential will be enormous. According to present projections we would soon reach the full potential of PHWR capacity, based on presently known indigenous uranium resources. The need to introduce FBRs is thus urgent.
- It provides energy free from greenhouse gas emissions.
- It provides energy free from vagaries of the world fuel-supply market.
- FBR can also be used to incinerate high level radioactive wastes arising from the reprocessing of spent fuel from thermal and fast reactors.

It is stated in the article that except Japan no other country is following the FBR programme. This is incorrect. Today the FBR programme is being followed in the Russian Federation, Japan, China, Korea and India. Every country has to consider its energy requirements, available resources, policies and available technologies. One cannot stop an important programme if some other country does so, unless there are some basic issues. Many FBRs have operated well. The view that there are serious technical, safety and environmental problems in FBR is also incorrect.

The PFBR project is a result of indigenous R&D having reached a stage of commercial demonstration. If in its place, a coal-fired power station is built, it would cost about Rs 2500 crore. Therefore, Rs 3000 crore for a new technology is not a lot of money. It is commented that one should include capital cost of fuel fabrication and reprocessing plants along with reactor cost. These are all accounted for in the fuel-cycle cost. If a coal-fired plant is built, one does not discuss the cost of additional mining or transport infrastructure. Only the cost of coal and transport is included in the cost of electricity. The fact that the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam is today in a position to launch a commercial demonstration project with enormous potential to secure future energy needs, is indicative enough of the best possible use of investments in R&D at IGCAR.

I may also add that except for certain information, which is strategically important, all information on the nuclear power plants is open to the public. Media is regularly informed on plant perfor-

mances, costs, safety, etc. Information is also available on the Internet. A number of seminars are held to inform the specialists. A large number of scientific and technical papers are published on PFBR. Many visitors are taken around the nuclear facilities to learn about the role of nuclear energy, including safety. IGCAR is ready to discuss PFBR-related issues – the need, safety, technology and economy on any platform. For the first time in the country, a public hearing was held in July 2001 for obtaining clearance to a nuclear power plant, i.e. PFBR. Therefore, it is wrong to say that it is being done in secrecy.

With regard to the Fast Breeder Test Reactor (FBTR), one needs to recognize that the fuel material and core configuration were modified successfully, when it became clear that the highly enriched uranium needed for the reactor would not be available due to political constraints. The indigenous plutonium–uranium carbide fuel has successfully attained a burn up of 92,000 MWd/t as against the original design target of 25,000 MWd/t. The reactor has met its technological targets. The fact that even this very advanced technology reactor was built with 80% expenditure within the country should be a matter of pride for any Indian.

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Choosing research guides

In recent times there had been much correspondence in these pages discussing ways and means to attract students to science[1,2]. I want to draw attention to the next level – sustaining the interest of students and producing successful scientists. This is not only a problem of India, but of international dimension.

The required passport to the career of a scientist is a Ph D degree. For that, students register themselves in a research laboratory/university. The problems start with the selection of guides (research supervisors). Each prospective student has to choose a research supervisor to guide him through his dissertation work. This in many cases, is not by choice. If the student is lucky, like Barres[3], he/she, would end up saying 'Mentors (*and I add research guides*) are made in heaven'. The general situation however, is as described by Lawrence[4]. The student simply toils and if he really is a genius, his supervisor enjoys the fruits. Situations akin to those in the case of Barres are difficult to get.

The student's choice depends on job opportunities (the label of the guide helps here), fellowships available and the behaviour of the guide towards his students (this experience is distributed free of charge by the senior students). It is not necessary that even if a student gets a guide of his choice, he will really be able to get guidance from him. While, at the department level, more often than not, all the prospective guides of department sit together and distribute students among themselves, there are situations when the students are distributed through lottery. It often happens that a student is pushed into a field in which he/she is not interested.

Is it not time to think about the situation and devise a methodology, such that we generate scientists who are experienced and interested to continue research for the sake of science?

1. Virk, H. S., *Curr. Sci.*, 2002, **82**, 1308.
2. Unnikrishnan, M. K., *ibid*, 2002, **82**, 1195–1196.
3. Barres, B. A., *Nature*, 2002, **416**, 365.
4. Lawrence, P. A., *ibid*, 2002, **415**, 835–836.

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Some issues related to application procedure

A couple of issues relating to the application procedure have been raised recently in *Current Science* (see, for example, Subir K. Sen, *Curr. Sci.*, 2002, **82**, 245–246). One such issue is the attesting procedure. The attesting business is not only a burden for the attestation-empowered officers, but also a nuisance for the applicants. Those residing in far-flung rural areas have to struggle hard to find one such officer who can oblige by putting his signature on a few xerox/true copies. Even in the cities, we face a lot of problems. Attestation of a document may generally take one day. A close look at this attestation business reveals the worthlessness of what is involved. In almost all the university hostels/student delegacies, we can find ready-made stamps of a number of authorized officers. These stamps are used freely whenever needed. The candidate presumes that unless the statements being made are found false, the attestation will never be verified. I too feel that this is a distant possibility. So he puts some fake signatures freely. Without repeating Sen's views, I would like to make a few suggestions.

1. Self-attestation by the candidate for the contained information be made legally valid, unless and until some extraordinary need arises for getting true