nuclear fuel. India is developing an Advanced Heavy Water Reactor (AHWR), which would employ thorium-based fuel. We expect to complete the detailed project report of the AHWR in the 9th Plan and would like to launch its construction thereafter. AHWR is a unique concept because of the use of thorium fuel and incorporation of passive safety features.

1. Sundaram, C. V., Krishnan, L. V. and Iyengar, T. S., *Curr. Sci.*, 1999, **77**.
2. *Fuel Map of India*, Central Electricity Authority, August 1998.
3. IAEA Publication, *Radiation, Health and Society*, November 1997.

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Academia–industry collaboration

The editorial on 'Conflicts of interest' (*Curr. Sci.*, 10 December 1999) typically reflects the cat on the wall position of scientists in India. Indian scientists are all happy publishing papers and collecting awards including for technology, while all the time criticizing every move to make science relevant. This is nothing but *hypocricy*. The world over, academic institutions are adapting to the demands of industry and it has only helped basic science. In fact many industries have better facilities to do basic research. There are many examples where scientists have admirably partitioned their time for consultancy and academic responsibility and often the two commitments have complemented each other. Industries setting up research laboratories on campuses is a welcome sign and I do not believe that MOUs can be one-sided favouring the industry. But, please remember that no MOU can be made public since these are privileged documents and one company does not want another to know the details. Academic institutions will lose credibility if they make MOUs with individual industries public. The editorial seems to find fault with every initiative taken by government to promote academia–industry collaboration and if it has been subverted to produce nothing, the responsibility lies squarely on the scientist and not on the establishment. It is not true that every aspect of industry research is shrouded in secrecy and many findings form part of publications with joint authorship. To make money is not a dirty word, so long as it is done by honest means and I do not believe that academics need to sacrifice their academic commitments to teach commercial courses. I understand that in India college teachers teach commercial courses to their own students and you cannot blame industry for this attitude! I wish the editor had thought more deeply before he wielded the pen.

K. N. BHARADWAJ

Researching a Ph D in USA

There has been a lot of discussion about the status and quality of Indian science in general in the recent issues of *Current Science*. I would like to share my experience of doing a Ph D in the US, to try and provide an inside view on teaching and research there, so that the readers may decide on the good and the evil in the American system and may find some useful ideas which may help towards improving the quality of teaching and researching science in India.

I started my Ph D after completing a Master's degree in Applied Geology from Indian School of Mines in 1990. One of the first conversations I had with my American advisor was about teaching a senior undergraduate class in two days and I remember being surprised at the level of responsibility that was given to me at the very outset. We also had a very general conversation on what was expected of me if I were to make it to the end of the programme and get my degree. First, my definition of a good student underwent an instant transformation. I was told that good grades in courses I would take would be assumed. Any grade below B would land me in trouble as far as my scholarship was concerned. More important for a good graduate (M S and Ph D) student was to do 'new stuff' with the knowledge gained during the courses. A natural caveat of this was that diversity of content in the courses taken would lead to different perspectives and view points on the subject and help in doing 'new stuff' and cutting-edge research. Given this, it also followed that I would not be expected to do my Ph D 'under' my advisor but 'with' him. This meant that he not only expected to teach me but also expected me to pick up things which he could learn from me; a real give-and-take relationship. He said that this was essential because otherwise he would only be creating clones of himself in his students and that would be bad for all concerned and science in general and cloning was best left to the biologists. He urged me to develop a niche for myself as a researcher on the long run and said that the Ph D would just be the first stepping stone in that process. In keeping with this, he urged

me to develop my own research project and generate my own funds to support the work. Unless, I could manage that, my Ph D would not be complete and I would have to leave the programme with a Master's degree.

The basic types of research that could be carried out were also categorized. First, the most basic and 'safe' type of research was popularly described as 'me too' research. Under this category, one would apply known principles and technologies to a problem in a different geographical area (e.g. fieldwork in some other country) and come up with results which are not new in principle or technology but just add to the global database. At the next level, research could involve using known technologies to solve a new problem. Alternatively, new technologies may be developed to address old questions and improve upon the available answers. Efforts to use tools routinely used in one discipline to address questions in another would fall under this category of research. Finally, the most exciting research would consist of developing new tools and technologies and applying them to completely new problems. This would invariably involve researching in completely uncharted territory and building-up solutions to problems brick-by-brick resulting in a strong niche and specific expertise for the researcher.

As far as teaching was concerned there was a very systematic lay-out to all undergraduate and graduate courses. The graduate courses had very few time-bound, in-the-hall examinations keeping with the philosophy that it was important to know what was in the books and the published research papers but it was more important to learn how to apply the knowledge to new research. In keeping with this, examinations in graduate-level courses, if conducted, were of take-home type or at least open-book. The flip side of this is, for course, that the ability to remember things and have information at the finger-tips is lost gradually and books and papers need to be referred to even on occasions when other people can pull the information right off the top-of-their heads. During job interviews, however, interviewers were more interested in how innovative my research was and the difference it had supposedly made to the existing knowledge than how much of the published literature I actually remembered. More often than not, even if I did not make the cut, I walked out of the interview with critical comments on my research that helped me improve the quality of my research work.

I developed a certain instruction philosophy as a result of taking a wide variety of undergraduate and graduate courses. I realized that all instructions must be based on a lucid and succinct presentation of material based on the following guidelines: (i) At the introductory level the scope of (earth) sciences must be defined to include any systematic knowledge (arts, sciences or engineering principles) applied towards understanding the processes that were or are operative; (ii) At the next level, the systematic and logical approach to understanding and solving problems must be discussed; (iii) At the advanced level, the focus of instruction must shift from merely 'informing' students to encouraging independent thinking in them.

One of the most difficult aspects of my Ph D was securing financial support for it. My advisor had a tradition that every Ph D work coming out of his laboratory had to survive the ultimate litmus test he had formulated, namely to submit the research project as a NSF proposal for funding. The proposal had to be submitted in the name of the advisor, and if the proposal was successful, funds were also released to and administered by him. The student got salary and logistic support out of the grant and was also responsible for completing the work approved in the proposal. The entire process of getting such a grant and working under such conditions was extremely stressful to say the least. When the $80,000 NSF grant did come through and I knew that my ideas had survived the ultimate test, there was more relief that elation. After that it was a question of execution of the work and five full-length papers later I had my Ph D all worked out.

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Bioprospecting – Options for India

The convention on Biological Diversity held at Rio and subsequent national level meetings organized in India recognized the sovereign rights of the countries over their biodiversity, the biological capital of different countries. Till the end of 20th century, the biotechnologically-rich developed countries continued to exploit the bioresources of biodiversity-rich developing countries through their gene technology, leading to a situation of 'biopiracy' or 'gene robbing'.

It is now an urgent issue for the biodiversity-rich nations like India to identify their useful plants, their phytochemicals, genes controlling them and to document their bioresources. Such an effort will certainly be useful in conserving and sustainably utilizing indigenous biodiversity. Even if any developed country tries to exploit the valuable biodiversity of a developing country, she will have to pay the desired amount of money proposed by the country having the sovereign right.

Thus 'bioprospecting' has become the most relevant issue for the biologically-rich countries and gene prospecting and chemical prospecting (drug prospecting or pharmaceutical prospecting) are the frontier issues of the 21st century.

During recent years a worldwide interest has been created in the field of ethnomedicine, ethnopharmacology and ethnopsychiatry to find new and effective herbal drugs. Herbs are staging a come-back and a 'herbal renaissance' is blooming across the world. Herbs have