In this issue

Nuclear fuels

The Indian Atomic Energy Programme had been launched in the late forties and early fifties through the visionary initiative of the late Homi Bhabha who had recognized the importance of this new source of energy and its vital relevance to the industrial development of the country. In cogently arguing on the imperative need for developing nuclear energy Bhabha had highlighted the problems and limitations regarding the other energy sources, like coal and hydro-electricity, and emphasized that – apart from the problems arising from the poor quality of coal and the transportation of coal over long distances and the difficulties of harnessing hydel energy in the Himalayan regions – these resources will also be inadequate to meet the increasing energy demands in the country even in the foreseeable future. These arguments are even more valid today.

Thanks to the organized and sustained efforts over the past four decades, the Department of Atomic Energy has been successful in establishing a comprehensive science and technology base spanning the entire nuclear fuel cycle, particularly designed to suit the resource position with regard to nuclear materials in the country. The only naturally occurring fissionable nuclear fuel is the uranium-235 isotope which forms a minor fraction (0.7%) of natural uranium, the more abundant isotope being uranium-238. However when uranium-238 is irradiated with neutrons in research or power reactors, it gets transformed to a new element plutonium (which does not occur in nature). Plutonium being chemically different from uranium can be separated by chemical processing, and like uranium-235 it is also a fissionable nuclear fuel which can be used for nuclear power generation. Similarly, thorium which is more abundant in nature than uranium can be transformed in a nuclear reactor to uranium-233, which again can be used as a power reactor fuel.

It so happens that the Indian resources of uranium have been assessed to be rather limited compared to more abundant thorium resources. This has necessitated the organization of the Indian Atomic Energy Programme in three stages:

1) The use of natural uranium in water-cooled power reactors, aiming to set up an electrical generation capacity equivalent to some 10 to 15 thousand megawatts.
2) Extraction of plutonium from the fuel discharged from the first generation power reactors, and using it as fuel in the second generation fast breeder reactors. (The fast breeder reactors will enable the progressive conversion of uranium-238 to plutonium-239, and a power generation capacity as high as 350,000 megawatts (electric) is potentially possible with these reactors.)
3) The deployment of thorium at an appropriate stage is necessary when the uranium resources are getting exhausted, so that sustained nuclear power generation will be possible for many centuries, using the thorium–uranium-233 cycle.

It should be emphasized at this stage that though international efforts have been pursued on futuristic energy options like nuclear fusion and solar energy, as of date the plutonium-fuelled fast breeder reactor is the only technology demonstrated on a large scale as a clear possibility for the interim time frame. This has been recognized in the nuclear energy programmes of countries like Japan, France, and Russia, which like ourselves are keen to achieve self-reliance and independence in regard to energy supplies for the future.

The paper by R. Chidambaram and C. Ganguly (**page 21**) comprehensively deals with the various science and technology aspects of the utilization of plutonium and thorium, where the Indian achievements have been impressive and unique, offering good promise for the future. The paper also refers to the successful nuclear explosion experiment that was conducted at Pokharan in May 1974. While the political implications of this test have been the subject of discussion ever since, the paper presents a scientific analysis of the test results. The experiment has also contributed to the establishment of an advanced research programme at Trombay on the behaviour of materials at very high pressures and under shock wave conditions.

C. V. Sundaram

Diverse benefits from documenting biodiversity: A success story

Scientists are driven by a diversity of desires. Some pursue only frontier (read fashionable) science; others useful science. Yet another group (perhaps unwilling to do either) may take initiative for improvement of science education. Some have a global perspective; others would rather be patriotic. Some remain confined to their own superspeciality (and vigorously defend doing so) others advocate (with equal vehemence) active participation in social development. Some study science for its own sake; others explore the possible commercial potential of every finding. It is impossible to think of a focused research programme which simultaneously caters to all these motivations.

Or is it? Going by the account of 'Documenting biodiversity: an experiment' (**page 36** of this issue), Madhav Gadgil seems to have pulled off this apparently impossible feat. This is a story of the study of biodiversity of Western Ghats, conducted by a network of 20 undergraduate colleges and 5 NGOs, from five states, involving over 30 teachers and 200 students, working in close collaborations with scientists from other research institutes. The information gathered by this group is of considerable scientific interest and could lead to publications in major international journals in this fashionable field of biodiversity. It may have commercial potential – in terms of data on medicinal plants, for example. It would also help India to fulfill her international obligation (as a signatory to Convention on Biological Diversity) of documenting, monitoring and conserving biodiversity. Moreover, the participating students got an excellent opportunity for experiencing first-hand the excitement of doing science. Pointing out the very modest financial outlay of the project, the author makes a very convincing case for using this as a model for studying biodiversity at other places in India as well as other parts of the (third?) world.

Not every one will subscribe to this rosy picture, however. Some would question the validity (if not the sanity) of putting the act of counting crows and lizards on the same footing as that of measuring the magnetic susceptibility of temperature superconductors. O would argue about the superiori learning (even by rote) the law thermodynamics – over the app excitement of being able to see distinction between two sul species of spiders. A third set, with rigorous experimental manipulations using high-tech expensive) biochemicals, would haps dismiss all field work as no but picnics. However, none can c the vital importance of the data lected herein for devising strat for site-specific, sustainable an tional management of pre natural resources.

N. V.