

phenology of the crop and wild weedy relatives, pollination mechanism, means of pollination, same or different insect species visiting the crop and related species, extent of out-crossing in self-pollinators, pollen tube growth and fertilization after pollen deposition, seed set, viability of seed set under field conditions, germination, growth and fertility of such hybrids and their natural back crossing with wild and weedy relatives would determine the gene flow. The major concern is for the spread of transgenes conferring resistance to herbicides into wild and weedy relatives which could make them resistant to the commonly used herbicides. Even without growing any of the transgenic crops and with limited use of herbicides in Indian agriculture, development of herbicide resistance in weeds has been observed in wheat fields in Punjab. With the import of semi-dwarf rice and wheat cultivars in the mid-sixties, their extensive cultivation since then has not resulted in any appreciable spread of the semi-dwarfing genes into other cultivars.

Transgenic crops can contribute a great deal towards increasing crop productivity, enhancing the stability of the yield, reducing production costs and use of toxic chemical pesticides and consequently the adverse environmental impact of the production systems. Shelf life of the fruits and vegetables can be enhanced to reduce post-harvest losses. Therefore advanced countries have adopted a more pragmatic approach based on risk-benefit analysis.

India has lagged behind China and other developing countries of Asia in field evaluation of transgenic crops. The national efforts in developing such crop cultivars with desirable agronomic traits would take some more time to reach field evaluation. Meanwhile, as stated by Ghosh, two requests for field evaluation of transgenic materials developed abroad and imported by private sector seed companies have been approved. Many other private companies, national and multinational, wish to bring such materials, which have already been approved abroad, in our country. They however, have apprehensions about timely environmental approvals and protection of the Intellectual Property Rights. For environmental clearances experiences gained in other countries should help us in arriving at our own decisions for upscaling and approvals for commercial cultivation instead for repeating the experiments in our environment to establish the safety of specific crop-transgene combinations. At the same time, the scientists aiming to develop transgenic crops with their own efforts should plan ahead to provide all the biosafety data for their constructs. Further, after the approval of the Genetic Engineering Approval Committee of Ministry of Environment and Forests, the transgenic crop varieties should be treated like any other crop varieties developed by the private seed companies or the publicly funded research organizations by the Ministry of Agriculture and the Central Seed Certification Board. There is also an urgent need to create greater

public awareness on the biosafety aspects of transgenics in comparison with the conventionally developed crop cultivars, as some environmental activists can create a scare in the public mind based on imaginary issues.

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## Indian science as cultural heritage

The post-independence generation of the scientific community has grown up in, and contributed significantly to, the slightly haphazard and breathless expansion and proliferation, both horizontal and vertical, of scientific and technical institutions in the Government, academic and private sectors. No other ex-colonized country - China excepted - has engaged in such a spree of scientific run-making, by strokes all around the scientific field, not all of which can be characterized as elegant or worthy of emulation in the matches to come. But there is no gain-

saying that the batsmen, including the scientific cross-bat wielders, have clocked-up a respectable total on the board.

However, one inevitable casualty of this style of play has been the lamentable loss of awareness, appreciation and significance of the cultural heritage and related fine-structure of our scientific endeavour that has been inherited by the children of the post-independence generation.

The celebrations of the 50th anniversary of our Independence provide an historic

opportunity to repair and restore the physical artefacts of this inherited scientific legacy. I have in mind such sites as the scientifically constructed infrastructure of our historic maritime trade and astronomical observatories; such legacies as the laboratory of Ronald Ross in Hyderabad, the great trigonometric survey, the Pasteur Institute, and the artefacts belonging to the Allahabad-Calcutta 'research axis', which axis was closely associated with the freedom movement.

We are, of course, notorious for not having any sense of history at all - and

that goes also for several members of the scientific leadership as well. So, the primary purpose of the above exercise would be to establish and convey a sense of connectivity between the present and the efforts, both modest and titanic, of the principal actors of the immediate and more distant past. Without an established and transmitted connection with the artefacts and the actors of the past, many

of the present generation, and an alarming number of the next, will view the Indian scientific enterprise as an imported consumable, merely locally import-substituted in hard times, and not even that when money has been more comfortably provided. One of the many adverse consequences of such a happening will be that, although we will be able to identify – in parts even with justifiable pride – science

in India, we will be hard-put to identify, map and transmit to the generations to come the continuing story of Indian science.

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## Extinct species

Khoshoo (*Curr. Sci.*, 1996, 71, 506–513) has rightly suggested that India needs a National Biodiversity Conservation Board and it is one of the most welcome suggestions which would help to save our rare species otherwise, they would undoubtedly become extinct if no tangible efforts are made to protect them. However, he has given a sizable list of plants which are alleged to have become extinct in India. Included in this list are two species of the genus *Isoetes* L. (Isoetaceae: Pteridophyta), e.g. *I. dixitei* Shende and *I. sampathkumaranii* Rao, a plant to which we have devoted three decades of pointed attention.

*I. sampathkumaranii* was initially described by Rao (*Curr. Sci.*, 1944, 13, 286–287) along water margins in shallow depression in granite rocks from Government Botanical Gardens, Bangalore. This species might have become extinct as its type locality was subsequently destroyed to beautify the garden in question. Moreover, to the best of our knowledge and belief a search for this species at the above type locality and also elsewhere, has yielded nothing positive. There is no later report of its occurrence during the last 25 years or more from any other region.

*I. dixitei* was for the first time described by Shende (*J. Univ. Bombay*, 1945, B14, 50–52) from Panchgani, Maharashtra as

occurring in the shallow rock pools on the Tableland. It is specifically mentioned in the above paper that this species became extinct in 1868; but strangely enough this species was described only in 1945. It is therefore, indeed curious, that the species, which was actually described and brought on record as late as 1945 is said to have disappeared in 1868. Even otherwise this species today continues to occur not only in its type locality, Panchgani Tableland but other Tablelands of Panchgani as well as Mahabaleshwar, Maharashtra. However, its protection is essential to save it from the ravages of extinction.

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### T. N. Khoshoo replies:

The paper was written with the primary purpose of highlighting an urgent need for a National Biodiversity Conservation Board. The national and international response to such a need was indeed overwhelming. To that extent the paper has achieved its objective.

Among other things, the data about extinction of our biota during the last 100 to 200 years was available only with the World Conservation Monitoring Centre. However, before recording the information from WCMC I wrote the following in the aforementioned paper: 'Though no professional studies have been made on the extinction of biota in India, the following species appear to have become extinct'.

Based on Srivastava's information, the WCMC may consider deletion of this particular species from the list of extinct species in India. I also wrote the following in the same paper: 'Although the loss of foregoing (24) species has come to light, there may be many more species which have become extinct. A systematic study has to be initiated by BSI and ZSI involving university system.' Let me hope that credible data on endangerment and/or extinction on Indian biota would be generated in India so that one does not have to depend on outside sources.

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