

the state of affairs in universities still operating in a feudalistic way and lack of interdisciplinary research. He thinks that time is ripe for the burgeoning life sciences research in India and the acid test would be the percolation of the benefits of biotechnology and modern biological sciences down to the poorest of the poor.

K. S. Jayaraman details the biotech boom of India with facts and figures to the hilt. This year the Indian biotechnology enterprises, together crossed the US\$ 1 billion mark. Nobody can deny contributions of Indian biotech majors – Biocon posted revenues of US\$ 150 million in the current year, Shantha Biotech with its indigenous recombinant hepatitis B vaccine almost routed the multinational giant GlaxoSmithKline (GSK) and Serum Institute is credited as being the world's largest producer of diphtheria, pertussis and tetanus vaccines. Currently there are close to 300 companies registered under the biotech sector and achievements of some of the lesser ones are no less impressive. The setting up of The Centre for Genomic Applications (TCGA) at New Delhi's Mathura Road with capability of three trillion operations per second by the Chatterjee Group in association with CSIR and DST is in line with the likes of Sanger Institute (UK). However the challenges, which need to be addressed are – innovation in the pharma sector in the face of the new WTO order, availability of low cost indigenously manufactured scientific equipment and appropriately trained skilled manpower.

Another article brings out the travails and tribulations of one of the biggest clinical trials in the world, for cholera and shigellosis, which are being conducted under the supervision of NICED

(National Institute of Cholera and Enteric Diseases) scientists in Kolkata. India is strategically placed in terms of availability of affordable medical services and is poised to become the hub of contract research organizations (CROs) for conducting clinical trials for drugs. Although it has its own downside, expansion of infrastructure for the said purpose is going to benefit the research organizations, the technically qualified personnel and the public alike. I once asked a friend of mine, a member of faculty at IIT Delhi – 'I wonder if career in biology would ever become an alternative to the blue-eyed disciplines of engineering and medicine?' Pat came the reply – 'it already is!' Though not exactly same, more or less similar sentiments have been echoed by Mariganka Sur (Massachusetts Institute of Technology), who suggests a number of measures to improve the research performance of our universities. Preferring to refrain from flogging a dead horse, I must say that lately research funding to Indian universities, especially to life sciences departments, has substantially improved.

From other chapters in the supplement, one gathers the impression that the scientific establishment in India is seized of problems faced by the scientists and all efforts are being done to clear the roughshod. The major government agencies which are saddled with the responsibility of overseeing funding and monitoring research in India are in the process of fostering better coordination and red tape is being cut to size. Scientists may be spared from the agony of preparing 30 hard copies every time they think of submitting a research project and regulations are being enacted to encourage women scientists.

From the pages of this supplement one may also glean major activities of some of the best research institutes of our country such as their thrust areas, publication records, patents granted, faculty profiles and in the process, get inspired to emulate them. A chapter on AIDS (The coming epidemic) in the same supplement may have a sobering effect though. It seems that major efforts are underway to contain the epidemic though the odds are against us.

Satyajit Mayor's (National Centre for Biological Sciences, Bangalore) 'Coming Home' epitomizes what it is to work in a state-of-the-art life sciences laboratory. After having worked for fifteen years in some of the best institutes of the 'El Dorado of science' he does not seem to regret, even for a minute, to have joined back home. This speaks volumes about the transformation, which our research institutions have undergone of late. After having taught long, to some of the best and not so best students, I know that there is emerging a genre of young postgraduates in science who are looking up to role models like Satyajit Mayor and the likes in other institutes. And this may prove to be the turning point in the already fired up science scenario in India.

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J. S. VIRDI

*Department of Microbiology,  
University of Delhi,  
South Campus,  
Benito Juarez Road,  
New Delhi 110 021, India  
e-mail: viridi\_dusc@rediffmail.com*

## Need for legislative impediments to avoid mass harvesting of bryoflora

One of the main targets of the millennium is biodiversity conservation, combating desertification futhered by sound water management to ensure environmental sustainability<sup>1</sup>. The Himalayan region is a reservoir of a large number of medicinal and aromatic plants. This is largely because of the diverse ecological and climatic conditions existing in the area<sup>2</sup>. Although the Himalayan region occu-

pies only 15% of the country's geographical area, it accounts for about 30% of the endemic species in the Indian subcontinent<sup>3</sup>.

Bryophytes are ecologically important, diversified plant communities that differ morphologically and physiologically from vascular plants. Although bryophytes form a minor component of the total biomass of biota, they play an important

role in nutrient cycling<sup>4</sup>. The percentage occurrence of mosses in India is quite high when compared to any other plant group. About 27.5% of the world's mosses and 11.26% of liverworts are present in India<sup>5</sup>. Bryophytes form an important and striking part of the cool and humid Himalayan scenario. They impart a lush greenery and verdant cover in every possible shade of green tinged with a hue

of brown, red and yellow to almost all kinds of habitat like rocks, boulders, stones, hillsides, tree trunks, forest cover and various artificial substrates in and around Kumaon hills<sup>6</sup>.

Liverworts and mosses, the pioneer invaders on barren hills, provide seed beds to other vegetation, retain moisture and add organic matter to make the environment congenial for forest establishment. They are of immense use in biomonitoring and phytoremediation studies. However, these plants have received minimum attention from Indian botanists.

Due to rapid urbanization and pressures inflicted by the inexorable growth of the human population, landslide, forest fire, mass harvesting by professionals and researchers and other anthropogenic activities, the gene pool inherent in the Himalayan belt is being lost at an alarming rate. Further, the insurgency on other Indian hill spots has resulted into many fold increase in mobile population, thereby intensifying the bryo-wealth depletion. Therefore, there is an urgent need to protect this unique cryptogamic mosaic of our fragile and developing Himalayan ecosystem. The indigenous population of high altitudes utilizes a wide range of biological resources in diverse ways<sup>7</sup>.

In most of the Indian universities, bryophytes such as *Pellia*, *Marchantia*, *Porella*, *Frullania*, *Lejunia*, *Dumortiera*, *Notothylus*, *Targenia*, *Anthoceros*, *Cyathodium* and *Riccia* are dealt with at graduate and postgraduate level. These plants are required in large quantities for laboratory work. A few of them are rare while others are vulnerable. During collection, generally the scientific suppliers and students studying various biological courses harvest the bryo-vegetation completely without leaving a single plant for regeneration. Besides, unskilled people collect and destroy mosses in large amounts for orchards, nurseries and packaging material.

Bryological communities belong to comparatively small, fragile and disturbed ecosystems. Furthermore, the small size of individual plants increases their vulnerability due to inappropriate observation and collection techniques. It is incumbent upon bryologists to recognize the ecological importance, sensitivity and vulnerability of bryophytes to the changing environment and to promote a code of conduct for field trips.

To enrich bryo-wealth it is necessary:

(i) to prepare an inventory of common and rare bryophyte species and revise it annually;

(ii) to shortlist the bryophytes being used as study material at graduate and postgraduate level;

(iii) to promote a code of conduct for field trips of both commercial exploiters and researchers;

(iv) to develop moss garden at various locations;

(v) to prepare legislation to avoid mass harvesting;

(vi) to develop a proper framework to ensure the tightened compliance of legislations;

(vii) to restrict field work and collection in sensitive areas having endemic population;

(viii) students to be always accompanied by senior staff members.

(ix) to submit information periodically for publication on the *Red Data Book*.

(x) Three-dimensional natural and original pictures should be used as a software tool for study of bryophytes instead of live or preserved material.

These plants are fast vanishing from their habitats without being scientifically catalogued or studied. There is need for a fresh checklist by re-exploring various natural habitats. Central and State Government organizations, various funding agencies, and botany students at universities and

colleges should contribute in this exploration of the botanical wealth of our country<sup>8</sup>. Uncontrolled scraping of bryophytic layer from Kumaon hills by commercial exploiters who indulge in this type of illegal business, tolerated by forest authorities, naturalists and environmentalists, is another cause of the vanishing Himalayan greenery. Today, there is a need to protect this lush green Himalayan bryo-wealth from such intrusions. Otherwise the liverwort and moss species may vanish, some of them even before being scientifically catalogued.

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ANUJ SAXENA<sup>1,\*</sup>  
D. K. SAXENA<sup>2</sup>

<sup>1</sup>Department of Botany,  
Sacred Heart Degree College,  
Sitapur 261 001, India

<sup>2</sup>Department of Botany,  
Bareilly College,  
Bareilly 243 005, India  
\*e-mail: anuj saxena2807@rediffmail.com

## Is Gulf of Mannar heading for marine bioinvasion?

Sharma *et al.*<sup>1</sup> have comprehensively delineated the threat of 'invasive species' to biodiversity. To understand the impact of species invasion it is important to evaluate the consequences of species addition in an ecosystem. 'Over 40% of all imperiled US

native plants and animals are at risk because of invasive species'. A report<sup>2</sup> claims that invasives cost the US alone, more than 140 billion dollars yearly. Even in India, a number of exotic species have acclimatized and have in turn affected the native

species. Any species could become invasive if it is deliberately introduced to new areas in which it can outcompete the native species and disrupt the ecological balance.

The 'global invasive species database maintained by the world conservation union