that the waters are several thousands of years old and are slow-moving, with a speed of about 5 m/year. The stable isotope composition indicates that the waters originated in much colder areas *outside* Rajasthan, but cannot be of glacial origin. This is because glacial rivers Ganga[3] and Chenab[4] have more depleted heavier isotope composition ($\delta^{18}O = -10‰$ to $-11‰$ compared to the buried channel water which appears to have had a value of above $-9‰$ at the source). It means that the groundwater in the buried channel has no headwater connection very high in the Himalayas, but more likely in the Sivaliks. This agrees with the references in the *Brahmanas* and the *Puranas*[5]. There was hence no intention to suggest that Saraswati did not go underground.

Rigvedic rishis' prayer 'Oh Indra! On your being born and with fear of your rage, heavens trembled. Huge mountains were fearful and river waters started flowing moistening the desert. Oh Indra! You struck down barriers and broke open mountains', indicates the sudden appearance of the *Saptasindhu* following the breaking up of mountains. This distinctly points out tectonics being responsible for the birth of Saraswati and other rivers. Glacier melting would have taken thousands of years for the river to attain the majesty and the tempestuous roar described in the Rigveda.

It is now generally acceptable that the tectonics-induced migrations of Yamuna to the east and Sutlej to the west were mainly responsible for the dwindling of Saraswati. But the later burial of the remnant stream under Aeolian sand due to aridity cannot be ruled out.

It is clear from the above that the legendary Saraswati was not of glacial origin and its present subsurface flow is a good possibility.

3. The authors hint at the possibility of Govardhan Parbat episode in the *Mahabharata* (in fact, it should be the *Mahabhagavata*) as referring to the possible neotectonic movement resulting in the subsurface feature of the Delhi–Hardwar Ridge, which in turn was responsible for turning Yamuna east to join Ganga. Whatever be the merits of this conjecture, it needs to be noted that the *Mahabhagavata* describes Krishna playing with his cowherd friends on the banks of Yamuna (near Mathura) even before the Govardhan Parbat episode, indicating it was already flowing east at that time.

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S. M. Rao

15, Sarovar,
Sector 9A, Vashi,
Navi Mumbai 400 703, India
e-mail: smrao1@myiris.com

Response:

1. Neither the 'moisture underground' nor the presence of 'plentiful and fresh groundwater' proves that the Vedic Saraswati is having a subterranean flow.

2. How does the presence of 'several thousands of years old' groundwater, which has a movement at the rate of 5 m/year, prove that the Vedic Saraswati is having a subterranean flow even today? The Siwalik rivers are all rain-fed and cannot have the perennial flow of waters. The Ghaggar may represent the case in point. One should not try to read too much on the values of $\delta^{18}O$ because of the fact that the stated variation of 1‰ could well be within the error limit of detection.

The proto-Saraswati must have originated hundreds of thousand years ago, after the rise of the Himalayas. We fail to understand why such a river could not have attained the 'majesty and the tempestuous roar described in the Rigveda' at a much later period.

Neotectonic studies suggest fragmentation of earlier river system that flowed through the region, parts of which could have remained buried under the sands, while some others must have turned into saline lakes[1].

3. We mentioned about Goverdhan Parbat only as a passing reference to the timing of the neotectonic event that caused Yamuna to swap its course to the east, as we do not have any other proof of the date of this event. We agree that it could have been a pre-*Mahabhagavata* event.

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A. B. Roy*
S. R. Jakhar

Department of Geology,
Mohanlal Sukhadia University,
Udaipur 313 002, India
**For correspondence*
e-mail: abroy_g@yahoo.com

The accuracy of modern mass spectrometric measurements of $\delta^{18}O$ is ascertained to be ± 0.5%.

– Editor

Phytoremediation: An emerging crucial issue and its present market trends

Plants can be used for phytoremediation, that is for pollution abatement and as sentinel organisms (indicators) to measure toxic effect of pollutants or as scavengers of the environment[1].

Aquatic plants have been used as *in situ* biomonitors. Freshwater microalgae have been the test species in most phytotoxicity tests and in some cases as surrogates for marine species, and microphytic species. Recently the duckweed toxicity test has received much attention[2]. Among the rooted aquatic plants, *Myriophyllum spicaticum* has been used more frequently than others in pesticide toxicity evaluation[3].

Phytoremediation applications are reaching commercial utility. They include phytoextraction, the accumulation of high concentrations of certain contaminants in plant biomass; the creation of hydraulic barriers or vegetative caps through uptake and transpiration of large amount of water; and rhizofiltration, the removal of contaminants from aqueous waste-stream by absorption onto plant roots. In other applications, the contaminants are degraded or metabolized within the plant (phytotransformation), sometimes coupled with the volatilization into the air from plant biomass (phytovolatization). Contaminants may also be degraded in the soil by the action of secreted plant enzymes (in one form of phytotransformation) or by plant stimulation of microbial biodegradative activity (phytostimulation), or contaminants may be immobilized in the soil by plant exudates or other mechanism (phytostabilization). There are at least two dozen companies in the U.S., Canada and Europe known to have phytoremediation expertise.

Does the technology work, and if so, how well? It is important that there be some generic proof to show that the technology is efficacious, to give it legitimacy and to make it a viable option. Two things are needed to satisfy these goals. First, generally accepted testing protocols for determining whether phytoremediation can be a cost-effective option, and second, a set of broadly applicable, credible data providing generic evidence of efficacy in certain well-defined scenarios.

The use of plants is generally considered to be an aesthetically pleasing means of remediating a contaminated area compared to the use of heavy machinery for excavation or other remedial activity which can involve noise, disruption, frequent worker activity and unsightliness. Basic research is needed to improve performance to gain greater market in developing countries like India, especially in the following areas:

(a) Obtaining a better understanding of mechanisms of uptake, transport and accumulation;
(b) Improved collection and genetic evaluation of hyperaccumulating plants;
(c) Obtaining a better understanding of plant root interaction with the microbes and biota in the rhizosphere.

Recombinant DNA technology and improved tissue culture technologies offer significant promise towards improving those naturally occurring plant species that are used in phytoremediation. Some success has been already scored along this path. For example, genes encoding the cadmium-binding protein, metallothionein, have been expressed in plants in a seemingly successful attempt to increase cadmium bioaccumulation. Introduction of genes responsible for metal accumulation from the wild metal accumulators is another successful step. In the absence of known phytoremediation genes, this may be accomplished via somatic and sexual hybridization followed by extensive screening and backcrossing of progeny. However, a long-term effort should be directed toward developing a 'molecular toolbox' composed of genes valuable for phytoremediation. Systematic screening of plant species and genotypes for metal accumulation will broaden the spectra of genetic material available for optimization and transfer. Mutagenesis of selected plant species may also produce improved phytoremediating cultivars.

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B. S. MOHAN*,†
B. B. HOSETTI#

*Department of Biology,
T. John College,
Bannerghatta Road,
Bangalore 560 083, India
#Department of Applied Zoology,
B.R. Project,
Kuvempu University,
Shimoga 577 115, India
†For correspondence
e-mail: mohanbettageri@yahoo.com

Bambusa bambos: A rich source of a nutritive liquid – Bamboo 'neera'

Accidental observation of the exudation a nutrient sap from the cut ends of bamboo culms belonging to *Bambusa bambos* sp. is being reported. Work on the technology of extraction, quantum of the sap produced, best season for extraction, chemical analysis of the sap, etc. are yet to be studied.

Bamboo is a giant grass belonging to family Gramineae. Among the different species of bamboo, *B. bambos* or thorny bamboo is the most prominent one in Kerala. Wetlands in Kerala up to 1000 ft altitude are suitable for its growth. Attappady area and Palakkad region are heavily inhabited by bamboo colonies.

A bamboo colony usually contains more than hundred culms, up to 30 m long and weighing 100 kg. New culms are produced during the monsoon months and they mature within four or five months. A colony is in bloom by thirty years of growth, and after flowering and seedset the colony perishes. Cutting of mature culms of 3–4 years of age is recommended during the summer months.

While cutting bamboo culms during July 2001 for construction work in connection with a research project at the Integrated Rural Technology Centre, Mundur, a peculiar phenomenon was noticed. Out of the 30 culms cut off, two exuded a colourless liquid in large quantities from the stumps and got converted into a white mass. The mass increased in quantity each day and accumulated around the base of the stump, the white material gradually turning into brown downwards. Bluish fungal growth appeared on the surface on the mass emanating clouds of fungal spores (Figure 1). *Drosophila* flies hovered over the mass and different varieties of beetles and caterpillars were found in plenty inside the mass. The sap was rather tasteless, except for a little sweetness. The exudation continued up to one month.

The bamboo has an underground stem, a rhizome, and the culms are the branches of the plant, as in the case of ginger plant. The foliage of the plant, the physiological source, synthesizes the carbohydrate-rich assimilates by photosynthesis and this assimilate passes downwards, towards the