the major water movement occurs through main vein. In minor veins, water cannot rise vertically except for short distances but can traverse to mesophyll cells. An impressive account of reproductive behaviour and other aspects of coconut tree were also presented by Iyer (CPCRI, Kasargod).

Another feature of the seminar was an evening lecture by R. B. Singh (Director, IARI) who put before plants scientists the challenges for future. Mohan Ram gave a special lecture on Changing Scenario in Plant Sciences. According to him, the science changes not merely by observing but by questioning and attempting to unravel the mysteries and in developmental botany, problems related to embryology, flowering, apomixis, will have to be solved using newer molecular techniques. Other avenues that will need attention of botanists in future, according to Ram, are the defense mechanisms and utilization of more plants for other needs.

Overall the seminar was well conceived and well executed by the organizers. The proceedings of the seminar reassured that the young botanists bubbling with curiosity will bring about a change in research and teaching in botany in this country—a change that will also be catalysed by persons such as Mohan Ram – and those who have concern for the society and are willing to accept newer approaches.

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OPINION

Biotechnology: What's in a name

A. S. Rao

Who is a biotechnologist?

While for example every department of chemistry or physics in the country is headed by people who are formally qualified in their respective subjects, i.e., M Sc (chemistry or physics) and Ph D (chemistry or physics), no department of biotechnology in this country is headed by a person who has formal qualifications in biotechnology. Not just the leader, even the rest of the faculty do not possess formal qualifications even at M Sc level, though we had been rolling out M Sc (Biotech) students since 1987. The leaders and the faculty of the biotechnology departments in this country come from an incredibly large number of backgrounds. (I wonder whether those with biotechnology degrees would one day head other science departments.) Can this randomly assorted faculty deliver the goods?

In a medical college, the MBBS programme has so many subjects: anatomy, medicine, ophthalmology, etc. These subjects are taught by persons who have relevant qualifications in their respective subjects. Imagine a situation, when a single person teaches all the above subjects and evaluating the candidates! Is it not the situation in biotechnology departments in the country? (A typical M Sc (Biotech) programme consists of courses drawn from several major disciplines. Some of these disciplines, even have full fledged two-year M Sc programmes. I do not know how an M Sc (Biotech), compares *vis-à-vis* these students in these disciplines.)

When biotechnology has been projected as something to change the destiny of the nations, is it not necessary to ensure the desirable number and kind of faculty and, of course, the funding, to ensure biotechnology teaching and research programmes, of the desired quality? As mentioned above, the faculty constitutes a random assortment from a large number of backgrounds and their number also varies from one biotechnology department to another. And the variation in the amount of money spent on a biotechnology student and research programmes is tremendous, at several places in the country.

Moreover, what is the relevance of biotechnology departments, if the number of 'biotechnologists' outside the biotechnology departments far outnumber those within? As my observation goes, for every one faculty member in a biotechnology department, we have any where from 5 to 100 biotechnologists outside the biotechnology department, in the same institute! So, what is the relevance of a biotechnology department with so many fierce claimants from outside? Would it not be better if we bring them all together under one roof. (But, their number is so large that we may have to start separate institute/universities of biotechnology to accommodate them.)

In my opinion (a safe bet), India has the largest number of biotechnologists in the world. That is precisely the reason, why, in spite of the immense importance attached to 'biotechnology', we don't have an Association of Biotechnologists of India, the way we have SBC(I), AMI, etc. Can one imagine the Association of Biotechnologists of India, in case it is started? It would be like an Indian electorate. Electoral arithmetic and vote banks will be its keywords. There would be an immense diversity of groups: botanists/zoologists/physiologists/biochemists/geneticists/morphologists/taxonomists, etc. turned biotechnologists. We have dry weight (read biomass) estimators, enzyme estimators, effectors (those who see the effect of so many things on so many things), leaf area and root length measurers, etc. Of course, gel runners, ELISA readers, callus formers (I mean up to callus formation only), organogenesisers (thanks to Murashige and Skoog), *in vitro* fertilizers, embryo transfers, etc. Lastly, but not the least, gene cloners and sequencers (don't ask how many genes have been cloned and how many kilobase pairs of DNA have been sequenced till now and how this compares with the rate of gene cloning and sequencing elsewhere in the world). It is simply impossible to list out all the factions. One can imagine the functioning of this association.

Why is there this large-scale conversion and/or exodus of people (by all possible

means), into biotechnology? Why is there an irresistible urge to use the prefix 'Bio' and the suffix 'Biotechnology' with every term/title?

It is really puzzling to students and staff alike, that the contents of so many theses, research papers and other publications, conferences, seminars, etc. and research projects funded by different agencies, are the same, as it was once upon a time but for the prefix Bio and the suffix Biotechnology to their titles.

It is worth noting that even for the work carried out on modern lines, some prefer to use the above prefix and suffix while others do not. And, some even prefer to publish under the domain of old parent disciplines, like physiology, biochemistry, genetics, microbiology, etc., thought their work employs all the modern techniques. On the contrary, we have people, even if they run a gel once, they feel badly offended, if they are addressed as any thing other than as a 'biotechnologist'.

Why don't we (or don't we want to) discriminate between 'a technique' and a discipline or a branch of knowledge?

For example, ELISA is used by many researchers, plant physiologists, plant breeders, etc. Because of using this technique, they do not become qualified immunologists. Radioactive techniques find use in so many disciplines. Just because, somebody has used ^{14}C in his experiments, he/she does not become a nuclear physicist.

From time to time, new techniques keep on emerging, which can be made use of by many in their respective disciplines and to solve research problems. I do not know, because of a new technique(s) why the system should allow one to destroy other professions and programmes to the ultimate detriment of the education system as a whole?

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SCIENTIFIC CORRESPONDENCE

Groundwater development in the arsenic-affected alluvial belt of West Bengal – Some questions

Hydrogeology

It is now recognized that a huge alluvial tract bound by the Bhagirathi (Ganga) river in the West, Malda district in the North and 24-Parganas in the South (eastern boundary perhaps extending into Bangladesh territory) is affected by arsenic pollution of groundwater. The western part of Bengal, i.e. west of Bhagirathi river is not reported to have been hit. Also the northern part or the sub-Himalayan areas of West Bengal, i.e. West Dinajpur and Coochbehar districts, are as yet unaffected. Is Nature angry with the people of the eastern belt? What is the significance of this selective contamination from the hydrogeological point of view (Figure 1).

The Bengal basin has four phases of depositions and erosions coinciding with four inter-glacial and glacial periods in the Quaternary time (0 to 1.6 million years). Prior to the recent deposition of Sunderban Delta and active river banks, a deposition took place some time between 25,000 and 80,000 years ago (commonly known as the younger deltaic deposits, YDD). The sediments were mainly brought by the Ganga (Belt I in Figure 1).

The major part of the western alluvial belt (Belt II in Figure 1) called the Older Deltaic Plain (ODP) developed during Quaternary time between 80,000 and 1.6 million years ago by 2 or 3 glacial–interglacial cycles with sea level fall and rise coinciding with the glacial and deglaciation phases respectively. Sea level fall (i.e. Bay of Bengal's fall) results in an erosional phase and sea level rise results in depositional aspects in the river system. These sediments were brought from the Chotanagpur plateau of Bihar by easterly flowing river systems like the Ajay–Damodar–Subarnarekha.

ODP extends into the sub-surface below the arsenic belt (YDP) and takes its proper stratigraphic position[1]. That is why perhaps deeper aquifers under the arsenic belt are as yet free from arsenic contamination.

The sediments comprising most part of the districts of West Dinajpur, Coochbehar, etc. (Belt III in Figure 1) were brought by Himalayan rivers coming from the North and therefore are different from the Ganga sediments.

Groundwater development structures

It is known that billions of litres of water have been and are being pumped out every year from this belt with the help of groundwater structures (Table 1).

Working schedule

Except during the rainy season (June to September), irrigation pumps are run for a few hours almost daily to irrigate the nearby fields. Pumping for eight hours per day is common. It has been estimated that on the average an irrigation pump runs for about 500–800 hours a year. Water supply tubewells, however, run throughout the year.

Arsenic mixing in the aquifers

In our earlier model we attempted to show how there was increased supply of oxygen to groundwater[2]. The cause of this increased supply of oxygen is due to the operation of tubewells known to cause extension of vadose zones (VZ), i.e. unsaturated air–water mixed zones (Zs) (Figure 2), during pumping, thereby supplying more oxygen/dissolved air with oxygen as an important constituent to the groundwater.

It is, therefore, expected that though arsenic-bearing bed (layer) may be found