Journey into space will continue

Tragedies of heroic proportions in the quest for truth are not rare in the field of science. The accident which led to the break-up of the space shuttle Columbia, leading to the death of seven astronauts including Kalpana Chawla, has stunned the world. Their death is an irreparable loss not just to India, Israel and America, but to the entire humanity. A deep sense of loss has engulfed the world scientific community and others alike. It arises from the intrinsic human quality which values pursuits of nobler causes; science happens to be one of them. The astronauts lost their life in scientific adventure. They were spearheading many scientific experiments, all meant to advance the frontiers of human knowledge. In science, there is no failure. The mishap teaches us a lot, both at the scientific front and in great human qualities such as courage, professionalism and spirit of adventure needed in the pursuit of truth. In these times of fanaticism and fundamentalism, the statement by the Nobel Laureate Abdus Salam that 'scientific thought is the common heritage of mankind', rings very true. Kalpana Chawla pursued, single-mindedly, a career in space science. Her heroic tragedy will be an enduring inspiration for the younger generation in the country. Many Kalpana Chawlas will emerge. No tragedy will dampen the scientific spirit, and the journey into space will continue.

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Inventorying biodiversity: Myopic planning!

Wilson[1] observed that 'Biological diversity must be treated more seriously as a global resource to be indexed, used, and above all preserved'. Now microbial diversity is on the agenda of most governments, but it appears that our administrators/planners are unaware of the recent and fast developments in accounting the role played by the seven kingdoms of living organism. Five kingdoms[2] include microbes alone, the major recyclers on this planet. They are highly diverse, versatile and adapted to all kinds of environment. They are ubiquitous, occur everywhere on earth, in water, air, as plant and animal pathogens, symbionts, and as saprobes, thus being the best recyclers of the planet's garbage. We talk of sustainable forestry and agriculture developments, but ignore the role played by diverse Mycorrhiza[3], which assist plants to obtain phosphorus from soil deficient in the element. We are perturbed by the poor regeneration of forests, but we overlook mushrooms and toadstools which European scientists have already notified as threatened species and have initiated preventive measures for protection of endangered mushroom species[4]. How can the forest give us produce for future requirement, if the mindless harvest of edible mushrooms and other forms is continued? No future policy exists, not even talk about this special group, except sporadic projects[5] to justify the expenditure of allotment. We talk of human/plant health, but we never think of inventorying the Actinomycetes, the first largest group of microbes and fungi, the second largest group of antibiotic[6]/microbial metabolites producing organisms. Fungi are now being discovered/explored and deployed in several countries for insects, weeds and fungal diseases as microbial pesticides[7–14] and eco-friendly approach for pest management, but no efforts are being made to systematically inventorize these beneficial fungi. So far we have no official authoritative up-to-date publication on microbial diversity of this peninsula.

We are trying to prove that our research on the tiger is on par with animal research in developed countries, but we are at the bottom as far as systematic and independent research on this threatened group is concerned. There is a big difference between cataloguing the diversity of plants and animals, and microbes. Mapping of diversity of these higher organisms (higher forms, viz. angiosperms and mammals) is comparatively easier being macroscopic, and preliminary work can be done even by a non-specialist, e.g. a forester can count 'pug marks' of various animals. On the contrary, microbial diversity needs expertise and experts of specific groups.

Fungi and other microbes are increasingly being exploited worldwide by industries for single-cell protein, enzymes, organic acids, vitamins and antibiotics, and extensively being deployed for food processing, cheese-making and for delicious, wild, edible fungi (mushrooms). Antibiotics, the microbial metabolite, represents one of the largest and most diverse groups of natural products. Microorganisms such as actinomycetes, bacteria and fungi produce the most number of antibiotics. So, tremendous diversity and hidden treasure of metabolites are present in these microorganisms; but this group of five kingdoms is badly neglected in mapping of the biodiversity of this peninsula. A fungus like *Tolypocladium niveus* (cyclosporin: the antibiotic, now used in heart surgery), *Penicillium notatum* or *P. chrysogenum* (for penicillin) may be discovered in future to lessen human sufferings apart from billions of monetary gain.

It is unfortunate that no attention is being paid to systematically inventorize these kingdoms with such a big scientific organizational set-up under the Ministry of Environment and Forests[5]. We have Botanical Survey of India (BSI), Zoological Survey of India (ZSI) and even Forest Survey of India (FSI). In fact, parallel to BSI, ZSI and FSI there should be Microbial Survey of India (MSI), with specialists/taxonomists and centres involved. The ministries concerned can turn out to be a gold mine, if good projects on microbial diversity are sanctioned to map the microbial flora of this mega-bio-

diversity country of the tropical belt. How can people think of self-sufficiency in nutritious food, clean environment and sustainable forest without microbes, the ultimate recyclers and the most modern tool/source on which biotechnology is based?

We often claim that we are among the top in scientific manpower in the world, but we have few taxonomists[14] for mapping/inventorying the biodiversity of this mega-biodiversity country. Without the help of a taxonomist and without naming an organism, no molecular biologist/biotechnologist can proceed to take up novel work. The situation is that 'taxonomists are now a vanishing tribe'. It is this constantly increasing deficiency in taxonomy that developed countries are taking advantage in patenting novel microbial metabolites/products. It is high time that we take steps to systematically inventorize[15–18] our microbial biota before it is no longer available for mapping. We may claim that we are living in the most advanced era of science, but it is also true that we are living in an era of highest mass extinction[1]. The present rate of extinction of various species in this planet is one species an hour[1].

A lot has to be done regarding planning, seeking advice from scientists and not only from administrators and political leaders alone. The ministry concerned should set its priorities in biodiversity research in terms of food, maintenance of clean environment, monetary gain and conservation of all kinds of biota[17] for future needs.

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The status of geoscience education in school curriculum

The science of geology continues to puzzle the common man and its scope is least understood, except for identifying it with something too specialized. Although geology is taught at present in almost all the universities in India, including Indian Institutes of Technology, the general public is geologically illiterate. The root cause for this is the absence of geology teaching at the school level. Thus, young minds never get an opportunity to acquaint themselves with various issues in the right perspective. Certain topics related to geology are, however, taught in classes VIII–X by geography or social studies teachers who possess only a partial knowledge of the multidimensional earth. This situation is not only true for India, but also for several other countries including the UK and USA. Here, we examine the present status of geoscience education in schools and suggest some measures for restructuring the curriculum.

The Central Board of Secondary Education (CBSE) has introduced certain selected topics of geology, like earth in our solar system, realms of earth, rock types, lithosphere, landform types, gradational processes, agents of gradation and movements in the earth's crust, in the school curricula[1–4]. While interviewing a number of school students about the relevance of these geoscience topics, it was found that they were unable to place these topics under the science stream. Students rated these topics as mere elementary concepts, because they do not find them in the science books of higher classes. It was pointed out by some of the class IX and X students that since these topics are not included in physics, chemistry or biology books of senior classes, these should be removed from the science books of lower classes as well. Students also questioned the rationale of inclusion of such topics in geography books, under the social studies stream. They failed to understand why these topics have been kept in geography text books, if they were really science topics. We deduced from this preliminary survey that the concept of science for school-going children revolves around physics, chemistry and biology, and at least for now, geology is not considered as part of the science stream.