

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 taxonomists¹⁴ 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 inventorize¹⁵⁻¹⁸ 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 extinction¹. The present rate of extinction of various species in this planet is one species an hour¹.

A lot has to be done regarding planning, seeking advice from scientists and not only from administrators and poli-

tical 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 biota¹⁷ 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 curricula¹⁻⁴. 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.

Srikantia⁵, in his sample survey of students coming out of high school, suggested that a great majority of them had not even heard the term geology, and they had not seen minerals and rocks in their natural habitat. Students were not aware that minerals are the resources of a nation and are not renewable. They did not know why earthquakes occur, volcanoes erupt, how rocks are formed, how mountains originate and why the earth's crust presents such a diversity of features. Obtaining a clue from the above, there is little doubt that students are unable to develop a right aptitude for the subject. Hence there is a strong need for reorientation of school curriculum.

Although several efforts have been made in the past to popularize geology among the young generation, nothing concrete has come up so far. In 1956, Jacob and Sadavisam from the Department of Botany, Presidency College, Chennai prepared a curriculum for introduction of earth sciences at the secondary school level and submitted the same to the Education Ministry⁶. Initially it was accepted; however, later it did not fructify. Another attempt was made in 1972 by the late Murthy from GSI, Balakrishna from NGRI and Rao from the Geology Department, Osmania University, Hyderabad⁶ and the syllabus was submitted to the Ministry. However, nothing came up. Now this aspect is no longer with the Ministry of Education, but with NCERT, New Delhi which prepares the syllabi. Till now no positive and concrete steps have been taken in this direction. Another such initiative was taken up, recently, by the Geological Society of India, Bangalore. The editorial 'Geology in school education'⁵ received numerous positive responses. The idea to launch geology as a subject at standard VIII was highly appreciated and applauded by many readers⁷⁻⁹. The decision of the Kerala government to introduce geology as an optional subject at the higher secondary level is a welcome step¹⁰, and it should be followed by other states.

The right approach to deal with this problem would be to introduce a separate stream of geoscience at the school level from class VI onwards, which would integrate the concepts of geography, geology and environmental sciences. It is suggested that there should be three parallel streams in school curricula, i.e. general science, geoscience and social studies. Field visits should be made an

essential part of the curriculum because they will really enthuse the young minds, generate awareness towards the earth and its environs and develop understanding of the nature and natural phenomena. They will inculcate genuine interest in students to explore the planet. Such geological excursions for school students turned out to be a great success, as they showed positive response in the field to what they were taught in the classroom¹¹. Thus there is no doubt that field work will also help to break the monotony of classroom teaching.

Apart from this, teachers will also need to reorient themselves in order to be able to introduce new concepts. Orientation courses in geoscience for school teachers would have to be conducted. Efforts made by the Mangalore University to conduct orientation courses are worth mentioning. Besides, faculty members of the Geology Department at Mangalore University visited schools in and around Mangalore and delivered talks¹². Such practices should be followed in other parts of the country also.

School-level pursuit of geoscience requires updating of libraries, both at the high school and higher secondary levels. In fact, we do not have adequate reference material in geoscience, which is authored and published in our country and at prices affordable to the students. We have been depending on books from foreign sources. Therefore, the immediate requirement would also be to have well-illustrated reference books in geoscience for school curricula. The following recommendations made in the Second International Conference held at University of Hawaii¹³ may serve as guidelines for strengthening the geoscience education in schools:

- Popularize 3-D demonstrations of geological concepts with simple analogies.
- Earth science topics in schools should be taught by geologists rather than by geography or social studies teachers.
- More emphasis should be laid on outdoor learning environment rather than within the four walls of a classroom.
- Need to develop curriculum, curricular material and educational resources.
- Stress should be given to the use of modern technology like computers in geoscience education. Strong need for interaction between the university and school teachers.

The need of the hour is to include a separate geoscience stream in the school curricula. Orientation courses for geoscience school teachers should be made a regular feature. There should be more emphasis on outdoor learning environment. It is high time that we come out with a blueprint justifying the need for introduction of geoscience in school curricula, and draw up a detailed syllabus and range of books needed for teaching.

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