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The earth sciences in *Current Science*

Geology is big and global in scope. Indian scientists' excessive preoccupation with local geology has made us blind to the exciting possibilities of bold, competitive research in the earth sciences. The publication policy of Current Science should encourage such research and keep out papers on insignificant matters.

C. V. Raman held the view that Nature, in spite of her immense diversity, was one and indivisible and that it was incorrect to fragment knowledge into a large number of small holdings with uncultivated boundaries between them. To him, the ultimate object of science was to unite and not divide knowledge. Spectacular and revolutionary breakthroughs are possible when votaries of different scientific disciplines come together. They tend to produce something greater than the parts. New subjects are created, extending the frontiers of knowledge. Such interaction between disciplines is urgently called for. *Current Science*, nurtured by Raman, should devote itself primarily to promoting interdisciplinary studies. Papers in it should be short, innovative, provocative and of interest to a broad readership. They should not cater only to the needs of specialists.

Blackett, once commenting on the difference between physicists and geologists, said that 'physicists know a lot about a little, while the geologists know a little about a lot'. Being the youngest of scientific disciplines, geology, of necessity, has to employ a wide range of approaches in the study of the earth. To the geologist, therefore, close cooperation with scientists of other disciplines is essential. The study of the earth, it has to be emphasized, is enormously rewarding because it gives us an appreciation of our entire physical environment, present and past, to an extent not obtainable through any other science. 'Earth, third planet in our solar system from its central star, the Sun, is just of the right size and composition, at just the right distance from a central star of just the right proportion to be one of the universal (but probably not rare) planets in the seemingly illimitable universe capable of supporting the evolutionary development whose acme man fancies himself to be. And the story of how scientists think that came about, although it may be told in the unemotional words of science, has an enchanting quality to match the most gripping flights of literary fancy.' So wrote Preston Cloud, a great contemporary thinker and renowned earth scientist. *Current Science* should project this enchanting quality of the science of the earth. This will become possible only when scientists of other disciplines start thinking about earth and its problems and allow ideas to move around in their minds.

Big thinking, bold research

The great discoveries that have caused a revolution in geological thinking since the sixties — the uniformity of the oceanic crust, the high heat flow, the occurrence of mid-oceanic ridges and rift zones encircling the world, the linear magnetic anomalies on either side of the ridges, sea-floor spreading—are not being reflected in Indian scientific journals. Too much preoccupation with local geology has made us blind to a consideration of larger issues. Most of the short communications in *Current Science* are of insignificant events or occurrences. But geology is something big and global in scope.

Imaginative thought is the life breath of geology. There is, therefore, an important place for what Hess, the author of plate tectonic theory, called 'geo-poetry', involving long excursions into space and time, and stimulating the imagination—'a process at the core of the highest education'.

India has the unique distinction of being that fragment of Gondwanaland which has moved the longest—8000 km from its original home 30° south of the equator to its present position. It admirably epitomizes geological history and provides an excellent field for piecing together the complicated history of this lithospheric fragment. 'This is big thinking at its best, a bold attempt to put together observations spanning vast stretches of geological time.'

The Indian continent presents some of the best geological sections and exposures. The Himalayan mountain belt, the deep continental crust of south India, the Proterozoic sedimentary basins and the

Deccan flood basalts—all these are excellent material. The geological aspects of these critical elements of the lithosphere should be highlighted. As C. N. R. Rao said, 'We have to compete at least in some areas with the rest of the world, at the same time identifying areas of special concern to us, where, through the application of science and technology, we can make a signal contribution in solving pressing problems.'

In spite of all the technological advances we are witnessing, our knowledge about the primary requisites of life, like air and water and the thin outer skin of the earth, which provides material for the sustenance of life, remains inadequate. How and in what form does water find its way through soil particles and contribute to groundwater storage? What is the velocity of its movement? By what mechanism are plants able to lift large quantities of water tens of metres? What climatic and biologic factors are involved in the production of different types of soils from the same rock? What is the composition of the air held between soil particles and its temperature? Many such questions can be posed. Knowledge about these has great practical significance. These are topics of research that have immediate relevance, areas where physicists, chemists, geologists and biologists could come together and cooperate in order to understand the key processes involved in the hydrological cycle.

Field geology

In recent years there has unfortunately been diminishing interest in field work. Laboratory work and manipulation with a computer are becoming more glamorous than hard and painstaking work in the field. A feeling is gaining ground that spectacular advances are possible only in the laboratory, so much so most universities and even survey departments are now giving low priority to field studies. If this tendency is allowed to grow, field geologists may become an endangered and vanishing species.

In the garb of making precise measurements and quantification, there is a shift of interest towards geochemistry, isotope geology, spectroscopy and the like, and downgrading of purely geological disciplines like stratigraphy and palaeontology. While the new disciplines are welcome as aids available for a better understanding of earthly processes, the neglect of traditional subjects is deplorable. The new-fangled developments have been compared by Ernst Cloos to a doughnut with a lot of exotic fields around the periphery and nothing in the middle. Only field work can provide a firm base and throw up problems for research. The words of caution of Pettijohn are worth recapitulating: 'Have we, in our new methods of data collecting, forgotten our primary goal? Is it that we have expensive tools looking for a problem rather than a problem requiring an answer by whatever means that are appropriate?'

Field geology is most rewarding. Work is carried on in solitude, ever in presence of what we call Nature, with her never-failing loveliness as our delight. To others too she is a joy, though most men think of her beauty and beauty only. To the geologist, however, she tells a story 'which is written over like a palimpsest, a story which we can but dimly read, which haunts and calls with the calling of the half-unknown'. *Current Science* should encourage field-oriented studies. Papers must be accompanied by geological maps and cross-sections. Maps can be and very often are 'objects of beauty, kindling the imagination and stimulation of the uninitiated and experts alike'. Geological maps are badly needed to solve many current problems in earth science. It is a great pity that even after forty years of independence, geological maps of our country are not readily available. Institutions entrusted with the task of mapping the country must make available geological maps of different sections of the country. These maps should be published and be subjected to critical review. It is only when facts get recorded, published and discussed that there will be real interest in geological research and a motivation to achieve something significant. The present complacent attitude and absence of motivation are dangerous.

Topics and issues for discussion

Environment. Degradation of the environment is one of the most serious problems facing man. The Bhopal gas leak disaster was one of India's worst tragedies and yet our scientific journals made no comment. Droughts, floods and earthquakes continue to cause havoc. Deforestation is taking place on a scale that will spell disaster if allowed to continue unchecked. Population is growing and, with it, pollution of water and air has assumed alarming proportions. Affluent societies would seem to have become 'effluent societies'. In addition, there is the threat of destruction of the earth's ozone layer, and, as a result of excessive burning of fossil fuels, the greenhouse effect with consequent rise in sea levels. Nuclear, chemical and urban waste disposal are serious threats to the environment. These are problems that require urgent and incisive analysis.

Minerals. India is well endowed with a variety of mineral and metal resources. The potential reserves are considerable, but before they can be classed as mineable reserves a great deal of effort is necessary. There must be continuous evaluation of and readily available information about the real status of our mineral resources and the problems concerning their utilization.

An unfortunate development in modern India is the

export of minerals in the raw state. Vast quantities of iron ore, manganese ore, chromite and bauxite are being exported without any processing whatsoever. The fact that resource utilization is an important factor in economic development has been lost sight of. India is exporting some of the best iron ore to Japan and is paid a small amount as price for the raw material. At the same time, India imports steel and ferroalloys from Japan at enormous cost, far in excess of the export earnings. Is it any wonder that the country is progressively getting poorer? Prosperity depends on resource utilization.

India's resource position is fairly satisfactory, but our failure to exploit these resources adequately and efficiently is a serious problem. Utilization of our mineral resources is best achieved through indigenous effort, indigenous design and problem-solving ability.

Oil. A columnist recently posed the conundrum, 'What is it that is in the rocks, but is not rock?, that flows like water but is not water?, that moves up-dip while water moves down?, that forms in one kind of rock but is found in another?, that originates from life but results from death?, that is one of the most useful to man of all mineral products but is useful to him only as he destroys it?' Obviously the reference is to petroleum. Although it is one of the most essential commodities of modern civilization, our knowledge about this resource is woefully lacking. The mode of occurrence of oil and the problems connected with oil exploration, the places where we should look for it, the present position of exploitation in the country, and where we stand in respect of this important resource are topics that demand informed discussion.

Soil, water and weather. Soil erosion, conservation of water and weather forecasting for agriculture are of obvious importance to India. Adequate attention has not been given to the problem of soil erosion. Raman, in one of his radio talks, emphasized many years ago that the conditions under which soil erosion occurs and the measures by which it can be checked deserve the closest study. Water stored at great cost is allowed to be squandered. Conservation of water is of fundamental concern to civilization. Raman also drew attention to the enormous importance of meteorology to India. The recent claim of Indian meteorologists that they have a reliable means of forecasting annual rainfall over India must be discussed and critically evaluated.

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