

data), but also to provide employment in the inter-disciplinary areas of earth, space and information sciences (e.g. simulation and optimization of transportation networks). That the recently instituted MSc course in Natural Resources Management offered by the Mysore University, succeeded in attracting a significant number of students, is an indication of the viability of the proposed approach.

(iv) From the 'smorgasbord' of courses, a geoscience department may choose appropriate course ensembles and specializations, and course structures to suit their academic and financial, resour-

ces, and biophysical and socio-economic situations. Those undergraduate departments of geology, which have only one or two teachers and are sub-viable, should be either merged to constitute viable units capable of offering instruction in employable knowledge and skills or abolished, as their continuance serves no useful purpose.

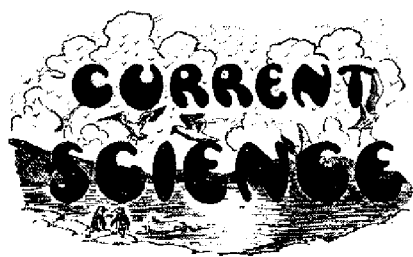
(v) It has been found that even though some universities have departments of geology, geophysics, meteorology, etc., they tend to work as separate entities, with hardly any coordination among them. A mechanism has to be designed to

facilitate the offering of the multi-disciplinary courses by the departments jointly.

(vi) The need for the geoscience courses to have strong linkages with industry cannot be overstated. Experts from the industry should be persuaded to give short-term courses in the universities, which could be made use of by a number of universities in a region.

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Astronomical research in India: I

Astronomy is the oldest of the natural sciences, its beginnings being traceable to the remotest periods of recorded human history. There is ample indication in ancient Sanskrit literature of the interest with which the subject was studied in India from the earliest times, while the later writings of Aryabhata, Varahamihira, Brahmagupta and of Bhaskaracharya, which have come down to us, show that astronomy was actively studied in India at a time when the lamp of learning lighted by the ancient Greeks had burnt out, and Europe was passing through the dark ages. The vicissitudes of Indian history in the later centuries of the present millennium were not favourable to the development and expansion of cultural interests. Some indication that active interest in astronomy nevertheless did not altogether disappear in India is furnished by the astronomical instruments of an earlier era which have been preserved to us, and by the curious structures known as Jaisingh's observatories which are still to be seen at Delhi, Benares and Jaipur.

During the three hundred and odd years which have elapsed since Galileo first directed his little telescope towards the heavens, the progress of astronomical science has been of the most spectacular character. This progress has largely been the result of the success achieved in making bigger and better telescopes. A study of the fascinating autobiography of John A. Brashear—the American who loved the stars and made great telescopes for observing them—may be warmly recommended to any one who is interested in the development of astronomical research in India. It brings home to the reader the extent to which the progress of astronomical science in a country depends on the existence in it of skilled opticians who can grind, polish and figure great lenses and mirrors up to the most exacting requirements. Without telescopes, interest in astronomy must languish, and without an active interest in astronomy, there obviously can be no telescopes in a country. That was the vicious circle, which Brashear sought to break in a spirit of genuine altruism. The immense interest in astronomical science and the generous support accorded to it by wealthy men in the United States of America must, to no small extent, be credited to the influence of Brashear's life and work. The making of great lenses and mirrors is practical optics on an engineering scale, and it is no accident that Brashear was a mechanical engineer before he became a maker of telescopes. The mounting and driving of telescopes is also mechanical engineering of a very

exacting nature. In a modern observatory, the ton-loads of material making the telescope and its accessories move with the same accuracy and smoothness as the hands of a wrist-watch go round its dial. Optics and engineering are the handmaids of observational astronomy without whose services she cannot live and flourish...

As some of the outstanding results of astronomical research which have influenced the orientation of scientific thought, we may mention the discovery of the finite velocity of light by Romer, of aberration by Bradley, of the laws of planetary motion by Kepler, of the dark lines in stellar spectra by Fraunhofer, of helium in the sun by Lockyer, of the magnetic field in sunspots by Hale, and of the recession of the nebulae by Hubble. When we examine the structures of modern physical and chemical thought, we find that they are laid on foundations built out of the results of observational astronomy. *Vice versa*, observational astronomy calls to its aid all the resources of the experimental physicist, while astronomical thought and speculation have as their basis the well-established laws of experimental physics and chemistry.

It will be evident from what has been said that the organization of scientific research in India must be considered radically defective unless and until adequate provision is made for astronomical study and research of the highest grade in the country.

C. V. Raman