

## TEACHING OF ASTRONOMY IN INDIA

Astronomy is not only the oldest of all sciences, but it can also be called the mother of all sciences. It was the solution of the problem of planetary motions which laid the foundations of mechanics, the first systematised branch of physics. The growth of spectroscopy through the study of the stellar spectra, the interaction of the theories of stellar structure and thermonuclear reactions, the intimate relation between celestial mechanics and space flights, simultaneous development of radio astronomy and electronic instrumentation, application and testing of the general theory of relativity by astronomical observations of the remotest galaxies and quasars, are some of the branches of science where the astronomers and physicists have been working together. Again, the inception of differential and integral calculus, introduction of the methods of numerical analysis, and the development of computer programmes for long and complicated numerical calculations are representative of the vital interaction between astronomy and mathematics. The relation of astronomy to other branches of science such as chemistry, geophysics, meteorology and now even biology may also be noted.

Astronomy was well developed in India in ancient times culminating in the writing of Surya Siddhanta in the fifth century. But the growth of astronomy and science in general was hindered by the political vicissitudes in the medieval period. Later when the learning and teaching of science was reactivated with the introduction of western education about hundred years ago the subject of astronomy did not receive the same attention and encouragement as other branches of science. This lacuna has become particularly glaring in the current space age when everyone ought to have some familiarity with the universe of planets, stars and galaxies, in which we live and move. It is all the more important for physicists to be acquainted with the vast extra-terrestrial space where their physical theories and hypotheses get really tested for their universal validity under extreme circumstances.

Teaching rudiments of astronomy to all students, including the students of arts as well as science, has now become an integral part of education in all advanced countries. In contrast, the situation in India is none too good as summarised by Trehan (*N.C.S.T. Report on Astronomy and Astrophysics*, 1972) a few years ago. Astronomy is being taught at very few places in the country. It would seem surprising that of about one hundred universities in the country, there is only one (Osmania University) which gives regular instruction in astronomy. It would seem paradoxical that while the country did produce some outstanding astrophysicists, astrophysics has not received the same encouragement as other fields during the development of science in the past two decades.

As far as research institutions in Astronomy, it is gratifying to note that there are now half a dozen places where very serious effort is being made with encouraging results. However, for a healthy growth of the subject we should have a few very strong Centres for Astronomy

and Astrophysics in the universities during the next decade. It is true that normally employment opportunities for astronomers are not as plentiful as for physicists, chemists and engineers. But considering the extensive training, both theoretical and practical, which an Astronomer has, the various research and development organisations in the country would be well advised to hire astronomers for their own benefit. Besides, the existing astronomical institutions and universities would also gain by recruiting trained astronomers instead of relying on physicists only.

Astronomy can be introduced in the curricula of universities at the undergraduate or/and post-graduate level.

(a) **Undergraduate Level** :— A recent survey in the United States of America by Berendzen (*Bull. American Astr. Soc.*, 2, 262, 1970) has shown that about a third of their top astronomers were exposed to astronomy in their high schools, and another third were introduced to astronomy in undergraduate (Bachelor) classes. Only the remaining third drifted to astronomy at post-graduate and post-doctoral level. It is thus imperative for attracting good students to astronomy that the subject should be included in the syllabus of at least the undergraduate (Bachelor) level if not of the high school. It is therefore suggested that a compulsory paper on astrophysics, either full or half, may be introduced in the B.Sc. Physics syllabus of all universities. The standard of the Paper could be that of the introductory book on astronomy by R.H. Baker.

(b) **Post-graduate Level** :— In the beginning it may be advisable to introduce astrophysics as a specialization in the final year of the M.Sc. Physics course, or as a post-M.Sc. diploma course. In either case the syllabus could contain a few papers on some important fundamental topics such as Physics of the Solar System, Atmospheres and Interiors of stars, Milky Way and Galaxies, Astronomical Instruments and Techniques, etc. In suitably located universities, which are close to an astronomical observatory or institute, the theory course may be supplemented by a dissertation based on a limited programme of observations undertaken by the student.

It may also be possible to introduce Astronomy as a specialization in the final year of M.A./M.Sc. Mathematics course by concentrating on mathematical topics such as celestial mechanics, radiative transfer, relativity and cosmology, statistical astronomy, etc.

Finally as a prerequisite to starting astronomy courses in universities one has to think of giving special training to college teachers of physics and mathematics through two or three sequential summer schools with the help of the University Grants Commission.

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