

## DEVELOPMENT OF ASTRONOMY EDUCATION IN INDIA\*

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### ABSTRACT

Education in astronomy starts early in India. Science texts at primary, middle and secondary levels have units on astronomy. However, these units are generally skipped because the schools lack appropriate manpower and material. Very few universities have courses in astronomy at undergraduate/postgraduate levels. If they exist at all, they are of theoretical nature. If students could be trained in observational astronomy, they could provide the manpower required for school and higher education as well as for observatories and other institutions on which the nation is pledging scarce resources. A concerted program for education in astronomy involving all institutions engaged in research and teaching of astronomy is therefore needed. I discuss a plan which could make astronomy education in universities and colleges more meaningful, so that the twin objectives outlined above could be met. The proposal could interest other developing countries interested in the development in astronomy education.

### I. HISTORY OF ASTRONOMY IN INDIA

The tradition of astronomy in India is very old. It can be traced back to more than three thousand years. The ancient astronomers were more preoccupied with calculations of equinoxes, solstices, and eclipses, because these play an important part in the life of Indians. The vast majority of Indians observe calendars which are based on the motion of the sun and the moon.

Most ceremonies are performed on auspicious days, determined by the positions of the planets, Nakshatras, the stars that delineate the path of the moon, and Rashis, the constellations of the zodiac. A lot of attention was devoted to perfecting algorithms for calculating positions of planets and times of eclipses. Observations were not important, and if any were made, there is no record. This is another curious aspect of Indian tradition: nothing was ever recorded. The knowledge gathered was passed on orally from one generation to the next.

During the medieval period there were a few kings who encouraged astronomical observations. Some instruments were fabricated. But since there was hardly any tradition of systematic observations, many of these instruments were inferior to those in Europe. So, there was virtually no astronomical activity in India until about 1950.

Since independence in 1947, largely due to eminent scientists like M.N. Saha and Homi Bhabha and the visionary first prime minister of India Jawahar Lal Nehru, the Indian government is taking considerable interest in astronomy. On the one hand,

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several institutes and observatories have been established, and on the other, it has been given due importance in education, particularly at the school stage. However, there are several shortcomings in the system of education in astronomy. These are discussed below along with the suggestions to set things right.

## II. PROBLEMS IN ASTRONOMY EDUCATION

Chapters on astronomy are found in textbooks of science at primary, middle, high and secondary school levels. At lower levels, they deal with elementary ideas on the motion of the moon and the sun, occurrence of eclipses, etc. At the secondary level there is a rather comprehensive chapter dealing with the solar system, stars, galaxies and the universe at large. The ideas expressed are quite simple. However, astronomy is mostly neglected throughout the school stage because there are no audio-visual aids available to most teachers, and also because they are not adequately trained to teach this subject. At the secondary stage, there is an additional reason. The Central Board of Secondary Education (CBSE), which conducts the public examination at the secondary stage, has assigned a very low weight to astronomy. This discourages students and teachers to do this chapter with the seriousness that it deserves.

From personal experience I can say that there is no lack of interest in astronomy among school children. I have been to several schools in Delhi and elsewhere to talk about astronomy in general and the chapter in the senior secondary book in particular, and I have found that children show tremendous interest in astronomy. So, the lack of interest among teachers can only be due to their own inadequate training and the non-availability of suitable audio visual material.

The teachers for the schools (and for higher education), and manpower trained in astronomy, are produced by the universities. Very few universities, however, offer courses in astronomy at undergraduate/postgraduate levels. If at all, the courses are mostly of theoretical nature; observational instructions are nonexistent. This results in severe shortage of teachers of astronomy. Equally seriously, it could lead to, if it is already not doing so, a shortage of trained manpower for the many observatories and institutions of research in astronomy in the country.

More resources are being pledged by India to give a boost to astronomy in the country. The Giant Meter-wave Radio Telescope (GMRT) is fast coming up. The Government has announced recently a grant of Rs 400 million (approximately \$11 million) for setting up an observatory in Ladakh and support for the study of solar maximum during the years 2000 - 2002. In addition, a few medium sized telescopes are planned and various experimental facilities are being set up for astronomical work. For all this trained manpower will be required.

## III. WHAT IS NEEDED

In order to augment the trained manpower, obviously more universities should provide instructions in astronomy, and observational astronomy should be an important part of this instruction. However, the universities in India are in no position to carry out such a program. First, they are crippled by shortages of funds. Second, even if they had funds, they have no infrastructure to install small/medium telescopes and run them successfully. The telescopes would have to be located necessarily some

distance away from the universities to ensure good 'seeing'. Most universities, as structured today, would not be able to provide transport to teachers and students to commute to the location of the telescopes.

Maintenance would be another problem. Maintenance of even ordinary apparatus in the universities is a big headache. How would they be able to maintain telescopes located away from their campuses? A university is a large body and has to look after several departments. Most departments would resent allocation of large funds required for astronomical work to one single department. A few departments in some universities did try to erect small telescopes, but faced insurmountable problems.

Some universities experimented with the departments devoted only to astronomy. But they could not attract many good students because a degree in astronomy alone is not sufficient in the job market. Even for a teaching or research career in astronomy, a thorough background in physics is desirable. So, astronomy may be taught better as part of physics.

In a country as large and as short of resources as India, one solution to the problem may be to have regional centers of astronomy catering to the universities of the region. These centers should be funded by the government, and not out of funds earmarked for the universities. Each could have a few small and medium telescopes and necessary maintenance staff. It could fund periodic visits of students and teachers from the universities attached to it. It could have a small hostel for students to stay for a few days to take up and complete some small projects using telescopes. It could be computer-linked with the universities, so that some of the data processing work could be done in the universities without having to visit the center. In time all these centers could be linked with one another as well as with the national centers and institutes so that the students could benefit from the best advice available in the country.

If resources permit, some centers could also create facilities for research so that some of the persons stationed there could advance their own careers. In my view, these centers would not only help universities produce trained manpower for research and teaching but could also become the hubs of astronomical activities in their regions. They could organize workshops, training and demonstrations camps for school children, to strengthen astronomy education in schools. They could hold lectures and demonstrations for general public, and organize such other activities which would help in popularizing astronomy in the country. This model may not be new or original but it is an economical and practical way to generate a culture of astronomy in the country.

To produce teachers of science who would also be able to teach astronomy in the primary and middle classes, at least some universities should be persuaded to offer astronomy as an optional course at the undergraduate level. Alternatively, the teacher training institutes could give a course in astronomy to those opting teaching science in schools. These teachers would then be able to generate interest in astronomy among young school children, leading to healthy development of astronomy in the country.

Some other developing countries, which are large in geographical size like India, could also be facing similar problems, particularly the lack of resources for the universities and consequent lack of quality manpower for furthering the cause of astronomy. They could also look for solutions along similar lines.