



EDUCATION IN ASTRONOMY AND ASTROPHYSICS: THE INDIAN EXPERIENCE

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ABSTRACT

In the context of a vast region with one-sixth of the global population, the Indian subcontinent has a very rich tradition of teaching of astronomy as a science. The so-called modern astronomy has mostly been developed over the past two centuries whereas the subject of astrophysics is barely a hundred years old. This work reviews briefly the current efforts in India in propagating these subjects not only at the research level but all the way down to the level of school children. With the creation of IUCAA, these efforts have been systematized and the response to them has been very rewarding.

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INTRODUCTION

India has a very long and enduring tradition for teaching and research in astronomy. The recent review by Kochhar and Narlikar (1995) summarizes the historical developments. In the Vedic times, dating back more than two and a half millennia, there were works like the *Vedanga Jyotisha* which carried astronomical ideas and speculations. During the golden period of Indian astronomy ranging from Aryabhata (5th Century) to Bhaskara II (12th Century) astronomy had advanced from calendar making to observations of celestial bodies with special instruments called *Yantras* and usage of trigonometric and algebraic manipulations. It is worth noting that Aryabhata had clearly stated that in his view the Earth spins about an axis against the background of fixed stars ... an idea that ran counter to the then prevalent geocentric theory.

Then there was a lull for a few centuries and a revival of astronomy in India came with the colonial era about two hundred years ago, with inputs from the French and the British. Telescopic astronomy came with the Europeans and there were several expeditions from Europe to observe special events like occultations, conjunctions, eclipses, etc. The discovery of the element helium was a by-product of one such expedition in the last century. The usage of spectroscopy in astronomy was a precursor to astrophysics. Here India can claim to have taken the initiative through the work of Meghnad Saha on the ionization equation (de Vorkin, 1993).

The major achievements in astrophysics came through the works of Saha, S.Chandrasekhar and D.S.Kothari in the twenties and the thirties. This was the legacy on which the post independence (post-1947) developments in astronomy and astrophysics (A&A) have been founded. The current scenario in these fields in India will be described next.

THE A&A INFRASTRUCTURE IN INDIA

The present infrastructure in astronomy and astrophysics in the country can be described as a combination of three sectors:

- The research institutes and observatories
- Universities and colleges
- The amateur astronomy movement

We briefly outline these three areas.

The research institutes and observatories:

These include autonomous institutes set up by the Government of India through its Departments of Space, Atomic Energy and Science and Technology. These institutes have been partially or wholly devoted to research in A&A. They train research students for Ph.D. degrees in A&A while most of them also run a few observational facilities. Table 1 gives a brief summary of these institutions:

Table 1. Indian A & A facilities (de Vorkin, 1993)

Institution	Partially (P) or Wholly (W) devoted to A&A	Observing facilities
Tata Institute of Fundamental Research, Mumbai and Pune	P	Balloon Facility Radio Telescopes Gamma ray Detectors
Physical Research Laboratory, Ahmedabad	P	Solar Observatory Radio Array
Indian Institute of astrophysics, Bangalore	W	Optical Telescopes
Raman Research Institute	P	Radio Array, MM-Dish
Uttar Pradesh State Observatory, Naini Tal*	W	Optical Telescopes

* This observatory is managed by the State of Uttar Pradesh

The universities and colleges:

In the pre-independence India the subject of spherical astronomy was taught in the mathematical departments of several universities. This continues even today. However, with the emergence of astrophysics as an important branch of physics several universities now include it as an optional part of the Master's course in physics. Today more than twenty universities have A&A in some form or other as part of their M.Sc. programme in either mathematics or physics. A few colleges affiliated to the universities also run such courses.

There are two universities, Osmania University, Hyderabad, and Punjabi University, Patiala, which have departments wholly devoted to astronomy. These universities have played a major role in training astronomers and astrophysicists, many of whom are active on the Indian scene today. The Osmania University also runs an optical observatory with a 1.2 metre telescope at Japal-Rangapore within an hour's drive of the university.

However, over the years the university-sector was getting neglected in the overall growth and development of A&A. To initiate a revival, the University Grants Commission created in 1988 a new institution at Pune called the Inter-University Centre for Astronomy and Astrophysics (IUCAA in brief) with a mandate to nucleate and promote the teaching, research and development of A&A in the university sector. We outline IUCAA's activities in the following section.

The amateur astronomy movement:

While the first two streams broadly cater to the professional astronomy community, which today is around 300-350 (including graduate students), there has traditionally been a large amateur interest in A&A in India (Kochhar & Narlikar, 1995). The amateurs have either worked individually with optical telescopes in the 8-15 cm class, or in voluntary organizations or clubs.

Till recently, this sector was diffuse and unorganized. Largely through an initiative taken by the IUCAA in 1991, the various amateur organizations have been trying to come together under the joint umbrella of the Confederation of Indian Amateur Astronomers. The Federation organizes an annual meet of the amateur community in which a few professionals also participate. The amateurs play a key role in the Indian society for dissemination of astronomical information and on special astronomical events like solar eclipses, cometary visits and so on.

IUCAA's PEDAGOGICAL ACTIVITIES

We now outline the broad spectrum of activities of IUCAA which are aimed at growing human resources in A&A at all levels. Table 2 summarizes these. We should mention that the IUCAA has freely drawn the resource persons for its pedagogical activities from the research institutes in India and scientists from abroad as well as from universities and the amateur community.

Table 2. Pedagogical Activities of IUCAA

Level of participants	Activity
Post-doctoral, research students	Advanced, state of the art workshops
Introducing new research areas to graduate students	Mini-schools
Preparing graduate students for research in A&A	Inter-university graduate schools
University teachers in A&A	Refresher courses
Undergraduates	Introductory schools in A&A
High School students	Summer projects and also monthly lectures in A&A
School teachers and amateurs	Workshops for training the basics of astronomy, including hands-on training in making sky-globes and small telescopes

The IUCAA has excellent facilities for holding such meetings on its campus and several are held there round the year. However, in keeping with the desire to bring A&A closer to the universities and colleges, many of these meetings are held in their campuses also.

Apart from these institutional activities, several Indian astronomers (including the authors of this paper) also lecture individually on various public forums. The enthusiasm of the general public towards astronomy appears boundless and has not been adequately tapped so far.

CONCLUSION

India is an unusual country in the sense that it presents the sharpest contrast between a highly developed society and a highly primitive one coexisting side by side. The contrast is not merely one of economic development. The lack of scientific temper and adherence to superstitions like astrology are found in the highest strata of society. This is where astronomy education has a major contribution to make.

In this context, there is a strong need to enhance the astronomy part in the science education curricula of Indian schools. Through astronomy one learns to appreciate the vast scope for the application of the laws of science, one realizes the smallness of the Earth in the overall scheme of the cosmos and, last but not the least, one is forced to appreciate the need to make our planet safe and habitable: for as yet it is the only known habitat for life.

REFERENCES

deVorkin, D.H.: Saha's influence in the west in Meghnad Saha Birth Centenary Commemoration volume, Ed.S.B.Karmohapatro, Saha Institute Publication (1993)

Kochhar R.K. and J.V.Narlikar: Astronomy in India: A perspective, Indian National Science Academy, New Delhi (1995)