Chapter 13

Developing Countries

With the widespread international representation at the conference, much attention was paid to astronomy in developing countries — a particular concern of the International Astronomical Union. The papers that follow discuss first case studies about India, Egypt, and Thailand. (Some related papers appear in the Curriculum section.) A paper from Uruguay relates the teaching of astronomy to economic development. The existing International Schools for Young Astronomers and the Visiting Lecturers Program of the International Astronomical Union, the experience with the latter program in Peru, and the Vatican Observatory's summer schools for students from a wide variety of countries are next discussed. Finally, two papers deal with new projects to contribute surplus texts and journals and to provide a well-equipped small telescope for developing countries.

A panel discussion organized by Silvia Torres-Peimbert considered the astronomical needs of developing countries from the points of view of astronomers from Nigeria, Malaysia, Mexico, and Paraguay. A paper about textbooks in developing countries is included in chapter 6. Interest in textbooks for developing countries was so high that a special impromptu session was organized on the topic, of which a summary is included here.

TEACHING OF ASTRONOMY IN INDIA

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1. Historical Perspective

Studies of the skies have dominated intellectual activities since ancient man. In this respect, India has a very long tradition of such recorded activity, covering the observations of celestial bodies both as a science and as mythology (Gurm, 1980). The first half of the Christian era witnessed the evolution of spherical astronomy as a part of the study of mathematics (algebra and trigonometry) and its application to astrology. The evolution of spherical astronomy culminated in the concrete

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manifestation in the northern parts of India in the form of Jantar-Mantars by Raja Jai Singh (Mayer, 1979) in the early eighteenth century. Interestingly, spherical astronomy remained one of the most important activities in the study of astronomy during the British period too. Some of the older treatises on this subject during the nineteenth century were written in the Offices of the Survey of India.

Even today spherical astronomy is taught all over the country in colleges and in some universities as a part of the mathematics curriculum. Somehow, it does not generate a feel of present day astronomy. It reminds one more of spherical trigonometry.

A meterological *cum* astronomical observatory was started in Madras in 1786 and is known as "Madras Observatory" in records (Kochar, 1985). It was shifted to Kodaikanal in 1899, where the Evershed effect was first observed in 1909. It is now a part of the Indian Institute of Astrophysics. A few research centers were formed during the post independence period. Practically all astronomy is covered (Daniel, 1983; Bhattacharyya, 1986). The Astronomical Society of India (established in 1978) has about 300 members.

For any evaluation of the teaching of astronomy in India, we need to have a look at the system of education. It fits the "traditional pattern" of Wentzel (1989). Five years of primary schooling, five years (three and two) of secondary schooling, two years of intermediate level, two years of undergraduate, and two years of masters course is the teaching pattern. One year is being added to the undergraduate course as part of a new education policy (Ministry of Education, 1985). Doctorate work can extend from two to any number of years. The education in India is supposed to cater to a population of 800 million. Presently there are about 150 full-fledged universities with 6000 colleges affiliated to these universities where the bulk of undergraduate teaching is done. There are 40,000 high schools and at least five times as many primary schools.

2. Teaching of Astronomy

Positional astronomy based on texts like Todhunter (1952) and Smart (1931) as a part of the mathematics curriculum has been taught for the last hundred years and is still being taught in a large number of colleges and universities. A large number of small telescopes were purchased by some of the Maharajas in the 1930's and donated to some of the colleges. These are under the control of the departments of mathematics. Over the years, interest has faded in their use for the teaching of astronomy, particularly with the introduction of new mathematics in the 1950's.

Astronomy in small capsules is being taught in about 20 universities as a part of physics at the masters level. It is taught as an independent subject at the undergraduate level at only two places: Lucknow University and Shivalik College at Naya Nangal, affiliated to the Punjabi University. The number of students so involved is less than one hundred.

Two independent departments of astronomy exist, at Osmania University and at Punjabi University, where two-year masters-degree courses in astronomy are

taught. The total number of students spread over two years is about 40. Delhi University taught such a course as a one-time exception in 1960-62.

There is a lot of activity at the amateur level, with about twenty planetariums and with coverage in newspapers and on TV as a consequence to the space program. Recently, primary-school books have a nice introduction of the solar system and related topics. But beyond this, there is a complete blackout up to the first degree. A few centers with about 100 students, in an estimated population of 800 million, is all that India has in colleges and universities.

3. Recent Efforts

Representatives of various research establishments and from the universities evaluated the manpower requirements at Osmania University in a Round Table Discussion on Training Requirements of Astronomers in India in 1977 (Abhyankar and Sanwal, 1978). Research centers prefer physics graduates and, as such, no independent teaching of astronomy. There was a difference of opinion over these estimates and over the contents of courses to be taught.

The University Grants Commission (UGC), Government of India, under the guidance of two of its successive vice-chairmen (B.R. Rao and Rais Ahmed) set up two working groups in 1982 and 1985, respectively, to evolve teaching and research in astronomy in the Indian universities. The first group got involved with the day-to-day affairs of the Advanced Centre of Astronomy in Osmania University. However, the second did formulate wide-ranging recommendations to initiate teaching of astronomy in the Indian universities. The recommendations were accepted by the UGC (1987) for implementation. Some of the recommendations are as follows:

- A few independent departments of astronomy to be established in the universities during the coming 5 to 10 years.
- Five colleges of the Punjabi University to teach astronomy as an independent subject at the undergraduate level.
- The teaching of astronomy to be supported as part of physics at the undergraduate and graduate level, depending upon the availability of staff.
- Some of the existing astronomy infrastructure in the universities to be supported.
- A center of research to be established around the 122-cm telescope of Osmania University for the use of astronomers in the universities.

The Indian Space Research Organization (ISRO) initiated and funded the manufacture of 7.5-cm and 40-cm telescopes in the country. This was based upon the recommendations of the ISRO-UGC Panel for Telescopes in 1981. One thousand 7.5-cm telescopes were manufactured and distributed among the universities and schools all over the country for Comet Halley. The prototype of a 40-cm telescope is proposed, with some focal-plane instrumentation. New departments of astronomy may develop their teaching program around these telescopes. The colleges and uni-

versities have about a hundred telescopes larger than the 7.5-cm of the ISRO. These were mostly purchased in the 1930's. There are about 20 of 15-cm Cassegrain systems of Carl Zeiss and of Celestron. Two medium-sized telescopes are in Osmania and Punjabi Universities.

A joint astronomy program leading to a Ph.D degree in astronomy has been initiated by the Indian Institute of Science, Bangalore, in collaboration with the Indian Institute of Astrophysics, the Raman Research Institute, the Tata Institute of Fundamental Research, and the Physical Research Laboratory. The Inter-University Centre for Astronomy and Astrophysics (IUCAA) has been set up at Pune very recently (July 1988). It is supposed to cater to the needs of the astronomers in the Indian universities and is funded by the UGC.

There are a very few astronomers in the Indian universities, and this presents one of the serious problems in the teaching of astronomy. It leads to a vicious circle: no teaching, no teachers. At one stage, we at Patiala were asked to close down the teaching of astronomy, as teachers of astronomy were not available in other universities who could act as external examiners! Further, locally manufactured small- or medium-sized telescopes with focal plane instrumentation are not available. The import of such instruments is a long and cumbersome process. Similar problems regarding reference material, textbooks, and journals exist.

A concerted effort is required to make the teaching of astronomy popular. For India, the UGC working group recommendations of 1987 is the best way to start.

Recognizing the teaching of astronomy as an independent discipline and having professional astronomers to work in it is the issue facing the astronomy community.

4. Astronomy Teaching at Punjabi University

The Department of Astronomy and Space Sciences was established in 1978. We run a two-year M.Sc. course in astronomy and space physics, with ten students admitted every year. The Ph.D. program has led to six doctorates and five are in progress. Astronomy is also taught as an independent subject in one of the colleges and is to be introduced in five more colleges to be supported by the UGC. The department provides a basic infrastructure for training and research. One 60-cm Cassegrain is operational. A CCD system and a spectrograph are being added.

The two-year course leading to the M.Sc. degree is for those candidates who have a B.Sc. degree with mathematics, physics, and chemistry. The courses have a 40 per cent content of mathematics and physics. The practical training is oriented around basic electronics, spectroscopy, numerical analysis, data handling, and observational programs on stellar and solar physics. Some exercises are based on the plates of solar and stellar spectra acquired from other observatories. Experiments to evaluate site selection and seeing conditions have also been set up. Seminars and projects are an essential part of training. Laboratory training is along the same lines as at the University College London (Dworetsky, 1989; Gurm, 1983). There is a powerful support of meteorological observatories at the campus for weather parameters.

The department has organized two summer schools of six weeks each for college teachers of physics. It has generated short programs for local school teachers and TV programs in the local language (Punjabi). It caters to various enquiries on astronomy, meteorology, and allied fields. A number of amateurs have used the optics workshop of the department to make small telescopes.

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