into the daytime schedule of the school. Short projects can also be carried out.

**Visiting Lecturers Program.** The travelling telescope will provide the host country with observational facilities over an interval of several months. Local astronomers can obtain hands-on experience with various astronomical techniques and can carry out research projects, perhaps in collaboration with one of the visiting lecturers.

By mutual agreement of the Canadian Commission for UNESCO, the University of Toronto, and the IAU, ownership of the telescope will be vested in the IAU, because of its administrative structure and its long-term commitment to improving the state of astronomy around the world. The specific assignments and itinerary of the telescope will be determined by IAU Commission 46: The Teaching of Astronomy. Countries or institutions wishing to use the travelling telescope should apply to the President of IAU Commission 46[1], who will consult with the Organizing Committee of the Commission and with the co-ordinator of the travelling telescope project. If the application is approved, detailed arrangements for the shipping of the telescope will be made by the co-ordinator, in consultation with the applicant and the IAU Secretariat in Paris.

## 4. Acknowledgments

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# ASTRONOMY EDUCATION: THE NEEDS OF DEVELOPING COUNTRIES

## A Panel Discussion

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It is perhaps somewhat ironical that although astronomy is regarded as the oldest of the sciences, yet the study of astronomy is still to be accepted. In many cases, astronomy appears to be the last of the basic sciences to be accepted as a teaching subject in the educational curricula of most of the developing countries. It is not too difficult for one to fathom the reason for this state of affairs. Taking Nigeria as a country that might be considered typical of the developing countries, one finds

[1]During 1986–1991 the President of IAU Commission 46 is Professor Aage Sandqvist, Stockholm Observatory, Saltsjöbaden S-13300, Sweden.

that the official policy towards science is oriented towards its utility. Thus science teaching is seen as an important prerequisite for the development and acquisition of technical skills needed for technological and industrial development. In this regard, the teaching of such basic science subjects like mathematics, physics, chemistry, and biology in the primary and secondary levels of the educational system is seen as being a prerequisite for future careers in engineering, medicine, agriculture, architecture, *etc.* On the other hand, the relevance of astronomy to the development of a modern national economy is less than apparent and many enlightened officials as well as politicians would in fact regard astronomy as an esoteric subject that is worthy neither of the investment of the lean resources of the developing countries nor of the tuition or time of their pupils.

It would then appear that one of the major needs of the developing countries is for astronomy education itself to be justified, for without this justification it would be next to impossible to secure government support and funding for any meaningful activity in astronomy education. The problem is, in fact, an aspect of the spreading of a scientific culture across the various strata of the citizenry. The name of the game is popularization, of which a lot will, I am sure, be said in other sessions of this colloquium.

For now, it is necessary to make a broad distinction between those developing countries with significant astronomical activity and those that are astronomically deficient or undeveloped. Their needs are obviously not the same. In the one case, the major need is to develop and consolidate existing structures and resources for astronomy education, while in the other, the need is for the initiation of astronomy education programs.

The problem of those developing countries with some astronomical activity is perhaps more straightforward. This revolves around the broad issues of the lack of human and material resources for the prosecution of the laid-down programs in astronomy. These are already addressed directly by such programs as the Visiting Lecturers Program, International Schools for Young Astronomers, and the Traveling Telescope Program; there is a lot of scope here for international activity and assistance. One may add to this list the possibility of establishing a regional or inter-regional center or institute for astronomy and astrophysics located in a third-world country, funded with international money (*e.g.*, from UNESCO, UNDP, *etc.*) and associated with the UN University or a family of first-class universities around the globe. Such a center would help the nucleation of astronomy in the developing countries; provide M.Sc. and Ph.D. programs and refresher courses; conduct basic research as well as advanced research workshops and schools; and run Fellowship, Associateship, Visitor, and Guest Observer programs. Perhaps the newly-established Inter-University Centre for Astronomy and Astrophysics in Poona, India, could be expanded to fulfill these objectives, initially for the Afro-Asian area.

We now turn to the more difficult problem of initiation of astronomy education where none exists in a developing country. There is no easy strategy, but the following strategy appears to have worked in Nigeria. Basically, the strategy involves identifying and developing potential resource persons in astronomy. In the

case of Nigeria, the potential resource person was a fresh physics graduate who was persuaded about twenty-seven years ago by an expatriate astronomer on the staff of the local physics department to do a doctorate degree in radio astronomy at the University of Cambridge, U.K. Three years later, this resource person had returned to Nigeria, equipped with a Ph.D. in radio astronomy, and joined the physics department of his alma mater. It was this same resource person, who some years later had seen to the injection of a good quantity of astronomy topics in the national science curricula at both the primary and secondary levels; the initiation of astronomy programs at the University of Nigeria, Nsukka, with an astronomy option in the B.Sc. (physics) degree, as well as M.Sc. and Ph.D. programs in astronomy and astrophysics; the local production to date of 4 astronomy/astrophysics Ph.D.'s (with another 2 in the pipeline) as well as 10 M.Sc.'s in astronomy/astrophysics; the transformation of the former department of physics into the present department of physics and astronomy; and the recent establishment of a Space Research Centre at the University of Nigeria with a 10-meter parabolic antenna being equipped with a VLBI terminal to provide a long north-south baseline for the European VLBI Network. Other highlights include the formation of a National Committee on Astronomy and Nigeria's joining of the IAU in 1985.

It is proposed that potential resource persons be self-identified through competition for international scholarships and fellowships for doctoral studies abroad. It is also proposed that a package of support incentives be made available to these resource persons on the successful completion of their doctoral programs. These initiatives perhaps may not fit into the purview of IAU Commission 46 on the Teaching of Astronomy. Perhaps the time is ripe to consider upgrading Commission 46 or merging Commissions 38 (The Exchange of Astronomers) and 46 into a new Commission on "The Training of Astronomers," or perhaps an entirely new commission on the training of astronomers should be established. Alternatively, instead of having a Commission just on the Teaching of Astronomy, we might upgrade it to a Commission on Astronomy Education, which is a more comprehensive title.

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The needs of the developing countries pertaining to teaching resource materials — namely, books, audiovisual aids, *etc.* — and understanding of concepts have been dealt with already.

One problem that has not been covered in sufficient detail is the training of school teachers. Most teachers have very little exposure to astronomy and themselves have problems grappling with basic astronomical concepts. While this conundrum also exists in the developed countries, the situation is more severe in the third world, where the media coverage of astronomy is non-existent or at most scant.