

These teachers are many in number, they are scattered throughout the country, and have no resources at hand. The training process thus becomes a mammoth undertaking for what is usually only a handful of dedicated astronomers.

This takes us to the question of whether a developing country needs a greater number of qualified astronomers (as opposed to whether it needs more, for instance, qualified engineers). It is usually appreciated that in order to advance research, a critical number of people is required to carry out and sustain the research effort. The problem highlighted in the previous paragraph, however, indicates to us that if the science education in a country is to progress it must have qualified scientists. Therefore, developing countries need a greater number of qualified astronomers, not only so that research is advanced (which is not normally regarded as a justifiable reason in the developing countries) but especially so that the education base may be broadened and so that a high standard of education is ensured.

Another dire need of the astronomy teacher in the developing nations is to be in contact with the outside world. Isolation leads to stagnation and boredom, which do not make for enhanced teaching standards. Links between astronomy teachers in a region should be established in the form of cheaply produced newsletters, *etc.*

L.F. Rodríguez

Instituto de Astronomía, UNAM, Apdo. Postal 70-264, 04510 México, D.F., México

The astronomy education needs of the developing countries are so many and so varied, that I decided to restrict myself to the two that appear to me as most important.

While listening to the talks of the U.S. participants, one gets the impression that in the U.S., supply and demand are more or less balanced in what refers to astronomy education. If anything, supply may exceed demand. This is, of course, not the case in México where we have about 40 professional astronomers for a population that is above 80 million people. This gives one half an astronomer per million people. In contrast, there are 10 to 20 times more astronomers per million people in the developed countries. This situation is further compounded by the fact that in México a large fraction of the population is young and demanding education.

Then, while in the developed countries the concern is in improving the quality of education, we face a more basic problem of quantity. Any teaching or popularization activity made by one of these very few Mexican astronomers is valuable and is absorbed like a drop of water in the desert. What can we do to increase the number of professional astronomers in México? It is quite interesting to summarize the growth in the number of astronomers in México during the last few decades. In 1960, a few pioneers started sending students abroad to get doctoral degrees in astronomy. By 1970, the number of professional astronomers had grown to 9. An explosive increase marked the period 1970–1980: at the end of this decade we were about 30. The reason for this increase was, I believe, a result of the oil boom of

those years. There was a lot of money around and some was put to good use. Research and education developed in México as never before. It appeared that it was a matter of a few decades to catch up with the developed countries. But the mirage did not last long. Oil prices dropped again and now, very close to 1990, we have gained only a few more astronomers with respect to 1980 and are nowhere near 100, the expected number had the trend of the seventies continued. It turns out that in México the salaries in education and research are tied to the nation's economy and seem to reach reasonable levels only in epochs of bonanza. Some countries have had the good fortune of having visionary leaders who valued and supported education and research even in the worst of circumstances, knowing that this is the only way to build a strong country. We have not shared this fortune.

Nevertheless, even in our limited situation, a lot is being done and the second major need that I see can be satisfied at no cost (that is, money). By the peculiar structure of our universities (research and education are considered as totally separated activities, with institutes and centers doing the first and schools doing the second), teaching is considered as a less "intelligent" activity than research. Popularization does even worse, and can be valued as a negative component in one's *curriculum vitae*. It is true that teaching and popularization can be done disastrously, but the same is true for research. A manifestation of this scale of values was the creation by the government of the program of "scholarships" (actually, a supplement to our meager salaries) that is based mainly on our research publications. We need our scientific community as a whole to recognize education activities as important, as long as they are made seriously and professionally.

Silvia Torres-Peimbert

Instituto de Astronomía, Universidad Nacional Autónoma de México, Apdo. Postal 70-264, 04510 Mexico City, Mexico

A healthy astronomical education system can exist only if there are active research groups in a given country. I will discuss some of the cultural and economic problems that astronomical research groups face in developing countries.

In every country, in general, the higher the level of education, the smaller the group that benefits from it. This pyramid is immensely steeper in poor countries, where elementary education is not even available to all children, and where the higher levels of education are reached by only a very small fraction of the population. In atmospheres where frequently there is a general lack of culture and scant official interest in science, and where the mass media continuously advertise fantasy and escape from reality, it is difficult to promote and supervise science education at any level (including astronomical education). Even in those developing countries with a rich historical background, modern scientific research and science education are only incipient activities.

In underdeveloped countries, most of the scientific research and scientific edu-