

The University of Porto's Center for Astrophysics is also involved in other very interesting and important actions in education in astronomy. However, they are still in a negotiation stage.

#### 4. Conclusions

For those of you who read the report "1987 — The Year of Astronomy in Portugal?" published in the January issue of the *IAU Commission 46 Newsletter*, I would like to conclude that 1988 seems to be as important for astronomy in Portugal as 1987. Most of our proposals have been approved and already partially financed; others seem well on their way. And I will finish with the same sentence as in that report:

*"Years of low profile and little activity will take time and effort to be replaced. Mentalities probably will take even longer to change. But the times are of optimism and strong hopes in a brighter future."*

#### 5. Acknowledgments

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## ASTRONOMY EDUCATION IN HUNGARY

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### 1. Introduction: The Hungarian Educational System

Our educational system, like that of any other country, has grown up to meet the needs of the environment in which it developed. Perhaps its most distinctive feature is its emphasis on education of the masses rather than on education of the intellectuals.

The philosophy of the Hungarian educational system is that a democracy depends upon a well-informed electorate, and that therefore each citizen should receive the best education possible. As a result, in our country most children in the same community attend school together from kindergarten through secondary school practically regardless of differences in intellectual ability or in family background.

Educational policies and curricula are set up by the state organizations established by the government, and consequently the general plan varies only slightly from school to school. The school year is nine months in length, beginning in early September and continuing until about the tenth of June, with a vacation of a week or two at Christmas and a shorter one in the spring.

## 2. Astronomy in Elementary Education

There are eight years of elementary schooling not including kindergarten, which is an optional part of the public-school system. Only the last grade of kindergarten is now compulsory. Schoolchildren enter first grade at the age of six (or seven) and attendance is compulsory until the age of sixteen or until the student has finished the eighth grade. All elementary schools in Hungary are divided into two sections. The first, second, third, and fourth grades form the junior section while the other four grades represent the senior section.

Pupils of the junior section learn about the shape of the Earth, the Moon, the planets, the Sun, and their apparent motions. In the higher grades, the planetary orbits, inclination of the axes, relative positions, eclipses and phases, geometry of the seasons, tides, celestial and geographical coordinates, solar and sidereal time, and calendars are discussed mainly during lessons of geography and physics.

Many pupils attend special performances at the Budapest Planetarium (the best in Hungary), which can be visited during one-day excursions from about forty to fifty per cent of the country. Others may attend presentations at some smaller planetariums in the provinces or visit observatories (local and "Urania" observing stations).

Astronomical subjects are often demonstrated and explained making use of the smallest personal (so called school-) computers.

For the time being, approximately eighty per cent of Hungarian citizens complete their elementary school studies. The others can continue and finish at evening adult schools, which are very popular in Hungary.

## 3. Astronomy in Secondary Education

Elementary school is followed by four years of optional secondary school or high school. Admission to the Hungarian grammar and other secondary schools is automatic on completion of elementary school. The two kinds of secondary schools providing academic courses in Hungary are the so-called *gimnázium* (or grammar-school) and the special secondary school that provides technical courses as well. Their students are between fourteen and eighteen. Astronomy is taught as a section of physics mainly during the second (level 10) and fourth (level 12) years. The first part contains a bit of history of astronomy from Eratosthenes to Newton, Kepler's laws, the law of gravitation, angular momentum, proofs of the rotation of the Earth, kinematics, and dynamics of the solar system. The second part contains some

Table 1. Astronomy in Compulsory Education in Hungary

Age groups (years)	Level	Educational Institutions	Astronomy Taught as Part of ...
3 –	—	Kindergarten	—
4 –	—	Kindergarten	—
5 –	0	Infant-school	Our World
6 –	1	Primary-school	Elements of Natural History
7 –	2	(Junior	Elements of Natural History
8 –	3		Introduction to Natural
9 –	4	Section)	Philosophy
10 –	5	Primary-school	
11 –	6	(Senior	Geography
12 –	7		Geography
13 – 14	8	Section)	Physics
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.			
16		(Repeaters)	

astrophysics (stellar colors and temperatures), spectroscopy (classification of stellar spectra, Doppler-shift *etc.*), theories of planetary and stellar evolution, radioastronomy, and cosmology. Unfortunately, all of these subjects are scheduled for the last semester of the secondary school's curriculum and they only seldom get the necessary emphasis because in that period both schoolchildren and teachers are concentrating upon the final examinations.

Recent changes in the curriculum of our secondary schools made it possible to increase a bit the number of lessons dealing with astronomical subjects. Teachers are allowed to choose from different units to be taught (which can be about atomic physics, biophysics, *etc.*, but about astronomy as well) although they may omit these extra units and use the surplus lessons to prepare schoolchildren for the final examinations and university entrance exams — both of which are indispensable to admission to the Hungarian universities.

In order to support secondary-school teachers in their efforts and to give them up-to-date information, a national meeting was organized in 1987. Professors of Eötvös University and research fellows of other institutes and observatories contributed to the success of the conference held under the title: "The Teaching of Astronomy and Space Research in Secondary Schools." Secondary-school teachers and Urania observatory staff led laboratory practices and workshops, which were very popular.

Both elementary and secondary schools are completely free.

Table 2. Astronomy in Secondary Education in Hungary

Age groups (years)	Level	Educational Institutions	Astronomy Taught as Part of ...
14 –	I(9)	Comprehensive	Geography
15 –	II(10)	or Grammar	Physics
16 –	III(11)	School	Introduction to Philosophy
17 – 18	IV(12)	(Gimnázium)	Physics
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18 –	Compulsory military service (12–18 months), but for males only		

#### 4. The Teaching of Astronomy at the Universities

Some courses of astronomy (in the first place, introductory astronomy and astrophysics or general astronomy and astronomical geography) are offered in all Hungarian universities to students in mathematics/physics and geography/geophysics, but the only institution of higher education in our country with its own Department of Astronomy is the Eötvös University of Budapest. At this institution, a comprehensive set of astronomy courses is offered to science undergraduate and graduate students, while at any other Hungarian university only the above-mentioned introductory courses are offered. The introductory courses are given as a rule by a professor of geography or physics and never exceed one semester. Astronomical geography is taught to students of geography during the first cycle whereas introductory astronomy or astrophysics is given during the second cycle for students of math/physics. A textbook is available for learning astronomical geography and one is in press for general astronomy.

At some universities, these introductory courses are coupled with practical work in a lab or dome.

#### 5. Astronomy at the Eötvös University

The Eötvös University is the oldest Hungarian university; it was founded in 1635 (more than 350 years ago!) in Nagyszombat (which is now in Czechoslovakia and is called Trnava) by the archbishop of Hungary, Cardinal Péter Pázmány — who taught Johannes Kepler at Graz University — and was moved to Buda in the eighteenth century. For a very long period it was the only scientific institution that employed astronomers. After World War II, according to Stalin's ideas higher education and research institutes were split from each other in Hungary too and now there are at least ten different facilities where astronomers also work. Hungarian universities, colleges, secondary schools, observatories, and planetariums employ about one hundred astronomers. Consequently, the country needs at least two or three recent astronomy graduates per year to replace those who resign or retire.

Table 3. Astronomy in Hungarian Universities other than the Eötvös University (Courses available for science students)

Cycle/ <i>Semester</i>	Courses	Lessons
First Cycle		
<i>First</i>	Intro. to Astronomical Geography	42
<i>Second</i>	Astronomical Geography	26
<i>Third</i>	—	
<i>Fourth</i>	—	
Second Cycle		
<i>Fifth</i>	—	
<i>Sixth</i>	—	
<i>Seventh</i>	Intro. to Astronomy and Astrophysics	28
<i>Eighth</i>	—	
Third Cycle		
<i>Ninth</i>	—	
<i>Tenth</i>	—	

Since some people change careers or leave the country, our quota was fixed at four graduating astronomers a year. But quite recently a more substantial and important need arose. As astronomy became so popular in Hungary that every thousandth citizen learns astronomy at home, makes telescopes, or observes celestial objects in his spare time, many communities need an educated person trained in these fields to run local astronomy clubs or amateur societies. To satisfy these needs, Eötvös University and the Society for the Dissemination of Knowledge (TIT) initiated a new program two years ago.

Table 4. Teaching of Astronomy at the Eötvös University of Budapest (Courses suggested to science students)

Cycle/ <i>Semester</i>	Courses	Lessons
First Cycle		
<i>First</i>	Introduction to Astronomy	42
	Introductory Planetology	28
	Introduction to Astronomical Geography	42
<i>Second</i>	Introduction to Astrophysics	39
	The Solar System	26
	Astronomical Geography	39
<i>Third</i>	Introductory Astronomy	42
	Solar Physics	28
	Astronomy for Meteorologists	28
<i>Fourth</i>	Introductory Astrophysics	39

Accordingly, the university offers astronomy courses at three different levels. In the same way as other universities and colleges, the Department of Astronomy provides many introductory courses to freshmen and sophomores.

Those science students who wish to specialize in astronomy have to accomplish a complete set of introductory courses as well as six semesters of mathematics and eight semesters of physics. After finishing the first cycle, they apply for specialization, and during the second and third cycles they learn as would-be astronomers. They have to follow at least seven astronomy courses and pass the exams. After the seventh semester, everyone selects a topic and works it out. In order to get their degrees, they have to write and defend a thesis too. An Astronomy degree can be earned after five years of university studies or more.

Table 5. The Training of Astronomers at the Eötvös University of Budapest (Compulsory Courses)

Subject	Semester:	5th	6th	7th	8th	9th	10th
Celestial Mechanics		+	+	+	+	-	+
General Astrophysics		+	+	+	+	+	+
General Astronomy		+	+	+	+	+	+
Astronomical Instruments		+	+	-	-	-	-
Astronomical Laboratory		+	+	-	-	-	-
Astronomical Techniques		-	-	+	+	+	+
Recent Results of Astronomy		+	+	+	+	+	+
Galactic Astronomy		-	-	+	+	+	+
Extragalactic Astronomy		-	-	-	+	-	-
Extraterrestrial Astronomy		-	-	-	-	+	-
History of Astronomy		+	+	+	+	-	-
Practical Research Work		-	-	-	+	+	-
Computational Astronomy		-	-	+	-	-	+

Eötvös is the only university in Hungary entitled to award Ph.D. degrees in astrophysics. It awards about two degrees a year in this discipline.

Our latest activity in the teaching of astronomy is the training of club and amateur society leaders. This is a triennial postgraduate program. Our freshmen are active school-teachers, engineers, and economists who study the set of compulsory subjects at a correspondence course. They have to attend tutorial classes regularly, pass the exams, and defend their theses. When all of these are done, their postgraduate degrees are awarded.

Table 6. The Training of Astronomy Club Leaders at the Eötvös University of Budapest (Compulsory Courses)

Subject	Semesters:	1st	2nd	3th	4th	5th	6th
General Astronomy		+	+	+	+	-	-
General Astrophysics		+	+	+	+	-	-
History of Astronomy		+	+	+	+	+	+
Celestial Mechanics		-	-	+	+	-	-
Mathematics		+	+	-	-	-	-
Physics		+	+	-	-	-	-
Computers in Astronomy		-	-	+	+	-	-
Astronomical Telescopes		-	-	+	+	-	-
Astronomical Photography		-	-	-	-	+	+
Astronomical Measurements		-	-	-	+	+	-
Methods of Popularization of Astronomy		-	-	-	-	+	+
The Use of Visual Aids		-	-	-	-	-	+

## GRADUATE ASTRONOMY STUDIES AT THE UNIVERSITY OF SÃO PAULO, BRAZIL

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### 1. Introduction

The University of São Paulo (USP), founded in 1934, is the largest university in Brazil, having about 50,000 students and 5,000 teachers/researchers distributed among 33 institutes and 184 departments.

Astronomical work was already developed at the older São Paulo Observatory (founded 1912), which was later attached to the university. The observatory has been renamed as Instituto Astronômico e Geofísico (IAG), and presently houses the departments of Astronomy, Geophysics, and Meteorology. Graduate astronomy courses, intended to provide Master (M.Sc.) and Doctor (D.Sc.) degrees, started in 1973.

### 2. Astronomical Research at the USP

The astronomical research at the USP is basically conducted by the IAG. The main fields of research include theoretical and observational projects in the following areas: Fundamental Astronomy, Mathematical and Dynamical Astronomy, and As-