

INTERNATIONAL ASTRONOMICAL UNION

COMMISSION 46 - TEACHING OF ASTRONOMY

NEWSLETTER

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Number 31. April 1991

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ASTRONOMY EDUCATION IN ARGENTINA

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1900 La Plata

Elementary Schools. The basic concepts of Astronomy are given in elementary schools as a part of other subjects, in particular those belonging to natural sciences. The information they receive in schools is very poor. The only way for them to get more knowledge is by visiting some observatories. During all the year the La Plata Observatory has a continuous reception of students during dayhours, in which a description of instruments and talks with slides about celestial bodies are given. In some cases some observations of planets, nebula and clusters are done. About the same programme is given in the Córdoba Observatory.

Many schools also attend during workdays the planetarium of the city of Buenos Aires, where several functions per day are given, each one according to the age and preparation of the students.

At the same time, H. Tignanelli, of the La Plata Observatory prepared several short plays which using a funny presentation describe the most fundamental topics of Physics and Astronomy.

Secondary Schools. In the secondary schools the situation is quite bad. Until some years ago Astronomy was a separate course, but later on it was mixed with other courses, like mathematics, or in some cases it was eliminated. Most of the teachers preferred not to teach it or just give a very superficial view. The La Plata Observatory gives nearly every year a short description of main topics on Astronomy to teachers of the secondary schools, to keep them informed about different topics, and also about recent discoveries.

University Education. Two Universities give degrees in Astronomy: La Plata and Córdoba. In both the studies include about 25 courses and several seminars which correspond to new topics. With a thesis the student gets a title of Doctor in Astronomy. Four specialities are offered in La Plata: Astrophysics, Astrometry, Celestial Mechanics and Radioastronomy. After getting the degree, the young astronomer is encouraged to obtain a fellowship, as for example from the CONICET (National Council of Scientific Research) to work for some time in a foreign institution.

Public Education. The general public gets astronomical information mainly from the planetariums: one in Buenos Aires and another one in Rosario, which every weekend have functions to show different aspects of Astronomy. The observatories of La Plata and Córdoba have once a week an open night to the general public to show through the telescope some celestial objects, which normally are complemented with explanations on modern topics. On the other hand, several main newspapers in Argentina give in a non continuous way information about the new advances in science, and some times also in Astronomy.

ASTRONOMY EDUCATION IN THE COMMONWEALTH OF AUSTRALIA

A.W. RODGERS

MOUNT STROMLO AND SIDING SPRING OBSERVATORIES

WESTON CREEK A.C.T.

General Information. Australian consciousness of astronomical research is very high and extends across all society. Two basic reasons for this are, first, the national education programs and the prominence that astronomy is given therein, and secondly, the high visibility of major astronomical projects in the country. These are well publicised by an interested Media through newspaper articles and television programs. The progress of astronomical research and Australian contributions to it are kept well in the mind of the public. This visibility ensures that the place of astronomy in education and research is well recognised and results in astronomy, unlike many other basic sciences in this country, being well able to withstand the attacks of the bureaucratic pragmatists who temporarily hold sway in Australian politics.

Primary Schools. There has been a continuing development of programs and materials for the acquainting of primary school level children with some of the concepts of astronomy in several Australian states. Quite a few private observatories have this age group of children as their main visitors, as does the Sydney Observatory, which is now an astronomical museum open to the public. A hands-on national science centre in Canberra, Questacon, has a planetarium and uses children of typically 14 years of age to provide the descriptions of the planetarium sessions.

Secondary Schools. Astronomy is now well established as an element in the general science programs in secondary schooling. There is great demand in state libraries for material from observatories to be used for science projects. Many of these are chosen to have an astronomical basis. At the more senior secondary level (senior colleges) in various state capitals and Canberra, tuition in the use of optical telescopes is given to students, allowing an integration between the physics, chemistry and mathematics courses which form the mainstream of the science programs that are taught in preparation for matriculation. Several of the Amateur Astronomical Societies have initiated programs of tuition in practical astronomy but these are generally outside the mainstream school process.

University Education. A basic tenet of the Australian approach to astronomy education at the tertiary level is that the fundamental prerequisite for education towards astronomy-related careers is based on a sound foundation of education in physics and mathematics. Astrophysics is taught in several state universities by lecturers who are themselves practising astronomical scientists, but these courses are generally seen as expressions of the teaching of techniques in physics or applied mathematics. The result is that nationally the able graduate who may wish to pursue a career in astronomy or related topics has an extensive background in general physics, applied mathematics and computing, and may have a

one or two semester experience of, for example, astrophysics or stellar dynamics amongst the various topics which have been taught during the degree course. The student who has not had access to these astronomy-based courses during his/her degree is in no sense penalised. The national post-graduate funding scheme is based almost entirely on merit within the courses undertaken and has little to do with the course topics.

Post-graduate Education. There is continuing strength in the post-graduate education undertaken by Australian universities in astronomy and astrophysics. At least six universities in eastern Australia have post-graduate students working in astronomy for the PhD degree. Mount Stromlo and Siding Spring Observatories have approximately 20 post-graduate students; 70 per cent of these are Australian and the rest are from overseas. Recently introduced initiatives by the Government have encouraged the shortening of the time available for preparation of a PhD thesis from four-and-a-half to three-and-a-half years, and the Government's introduction of full fee payments by overseas students has significantly reduced the potential number of overseas post-graduate students studying in Australia. It is generally seen within the Observatories that this decision will curtail the valuable interactions that are generated by students from many countries working towards their astronomy doctorate in Australia.

Summary. In general terms, the Australian community's perception of astronomy is high and favourable. The value of astronomy as a tool for introducing young students to concepts in physical sciences is well appreciated and the flow of students into post-graduate education is still healthy. Economic forces will strengthen the hand of those who argue that astronomy contributes little to the national wealth, but the intrinsic importance of astronomy as a topic and the international prestige of Australian astronomy maintains a healthy attitude towards pure research and a general acceptance of the subject in educational circles.

Astronomy Education in AUSTRIA

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General Information. There is not too much new since the last report, except for a few improvements that will be dealt with in the following sections.

Elementary Schools. We still did not succeed to incorporate astronomy properly in the curricula of elementary schools ("Volksschulen"). Children aged 6-10 were approached by some special planetarium shows and guided tours at observatories, although with limited success.

Secondary Schools. There is nearly no astronomy in the simple secondary schools (age 10-14) called "Hauptschule", except when a teacher is an astronomy fan. The situation is different for all kinds of gymnasiums (age 10-18) called "Höhere Schulen" (high schools). Here we were able to implement an integrated astronomy teaching: Various branches of astronomy are being taught in physics, mathematics, geography, and history. Most recently the teachers of the uppermost classes (age 16-18) may conduct projects in astronomy ("Projektunterricht"). Pupils of the 7th class will be allowed to write an astronomical text ("Fachbereichsarbeit") based on their own studies or/and observations that will be credited for their final examination ("Matura").

Much effort is directed towards a continued instruction of high school teachers. This is accomplished by nation- or statewide courses given at universities. Also the Astronomische Gesellschaft regularly includes in its annual meetings a day of perfecting their knowledge for high school teachers. These days are generously subsidized by the government.

University Education. Astronomy can be studied in two steps at three universities in Austria (Graz, Innsbruck, Wien): (1) 8 semesters plus a master thesis for a diploma ("Mag.rer.nat.") and (2) 4 more semesters (at least) for a doctoral thesis ("Dr.rer.nat."). Curricula are not identical but nearly uniform all over Austria focusing on solar physics in Graz, on radio and stellar astronomy in Innsbruck, and on optical night astronomy in Vienna. A wide range of courses in all sorts of physics, space sciences, informatics, etc. is also offered to the students.

Public Education is continued and intensified at many local amateur societies all over the country and in three planetaria. A great success was the exhibition in 1990 of "Men and Cosmos" including Imax movies in Linz. The university teachers frequently gave lectures at the meetings of the amateurs.

Astronomy Education in Belgium

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General Information

The interest for astronomy seems to be rising among the general public, partly because of very good television programmes devoted to astronomy and partly due to an increase in the technical facilities offered to people all around Belgium under the form of planetariums, general exhibitions and in a near future, a Euro Space Camp in Redu (Belgian Ardennes), which is planned to permit short visits, conferences, courses, and even space camps. Its opening is scheduled in June 1991. At the same time, the time devoted to the teaching of astronomy is decreasing regularly in the universities, even in the mathematical and physical science sections.

Elementary Schools

The role of astronomy in elementary school education is very reduced and generally limited to a brief glimpse into the solar system and the problem of the seasons, despite the great success of rare special sessions on astronomical phenomena organized at the initiative of the teacher.

Secondary schools

The teaching of astronomy is limited to a few hours in the geography courses and generally depends on the goodwill of the geography teacher. There is an increase in the attractive power of astrology and other related fields, due to a lack of information among young students. With inspectors in geography, mathematics and physics, we have examined the problem and made several suggestions. At the initiative of geography inspectors, a memorandum has been sent to the Education Minister. This proposal includes an increase in the weekly time devoted to geography in the general programme, in which elementary notions of cosmography would be inserted at 2nd and 3rd levels of the secondary curriculum. The Belgian National Committee of Astronomy has brought its full support to this proposal, with a letter from its President, Professor P. Paquet, addressed directly to the Minister.

To increase the interest among the science teachers, a special meeting will take place at the National Planetarium in Brussels, next autumn. It will be followed by specialised 1 or 2 day conferences for smaller groups.

University Education

Astronomy is taught in all Belgian universities to students in mathematics, physics and geography. Optional courses are offered in the senior years of the mathematics and physics sections and in the scientific ingenieurs sections. Although astronomy and astrophysics remain an usual choice for graduation work, there are too few Ph. 'D. students due to the scarcity of new research positions in astronomy.

Since 1987, a "Mastership in Astrophysics and Geophysics" can be obtained at the Liège University. These studies are opened to graduate students in sciences and to scientific ingenieurs. Orientation in astrophysics or in geophysics is given according to the choice of courses made in a large programme and the studies are performed on a one or two year basis. In addition, a personal work in the main field chosen by the student is required.

Graduate studies are organized each year with the financial support of the National Funds for Scientific Research. On these occasions, foreign speakers are invited. The courses are centered on a different subject each year, they last about twenty hours and are opened to students and professional astronomers. Exams can be taken to fulfil part of the requirement for a Ph. D. degree.

Public Education

The activities offered by amateur societies in Belgium are numerous, ranging from sky observing sessions, astronomy courses, book and scientific instrument exhibitions, personal computer programmes, general conferences and excursions. Each year, the National Day for Astronomy attracts more and more visitors and special sessions are organized for very young, young and not so young participants.

The scientific team of the National Planetarium in Brussels offers general programmes and presents, on request, special demonstrations for university students, centered on coordinate systems, precession movement and time. New programmes are being prepared. Each year, one day or 4-5 day sessions are being held in Transinne for newcomers in astronomy and for more advanced amateurs. Conferences and observations or practical exercises share the time table.

ASTRONOMY EDUCATION IN BRAZIL

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General Information - As already stressed by previous reports, the main emphasis regarding astronomy education in Brazil has been placed on the astronomical training at graduate level. In the late sixties and beginning seventies several promising students have been sent abroad to complete their training; later on, such training could be done in the country, although several students still go to the US and Europe for pos-graduate (or even graduate) work. Presently, young PhD's are strongly encouraged to spend at least one year abroad in post-doc work. It is believed that an increased number of qualified professionals is essential not only to develop original astronomical research, but also in the training of new generations of astronomers, who will be able to communicate more efficiently the main aspects of the astronomical science to wider audiences.

Elementary and secondary schools - Some astronomical teaching at these levels is included within more general "Science" or "Physics" courses. In elementary schools, astronomical teaching often faces the double problem of inadequate texts and poorly trained teachers. However, students interest is generally very high in comparison with other sciences, which can be inferred from the large (and interested) audiences of general astronomical lectures delivered by invited astronomers. In secondary schools the astronomical teaching seldom goes further than gravitation and the Solar System. Probably the main contribution to the astronomical teaching at these levels in the past few years is being given by short courses, such as the Summer courses in Astronomy delivered by the Astronomy Department of the Institute of Astronomy and Geophysics of the University of São Paulo. Each course accepts up to 70 students, most of whom are science teachers. During 10 days, they are exposed to all fields of Astronomy, both theoretical and observational, delivered by active researchers in the field. It is believed that such intense, in-depth exposure to both classical and modern astronomy have a definite influence on their teaching.

University education - As a result of the emphasis on graduate astronomical training in the past decade, the total number of qualified astronomers in the country is presently close to a hundred, which is a factor of 10 higher than some 15 years ago. Although this is a very small number for the country's population of 160,000,000, such increase reflects the considerable efforts made by a few institutes and universities, often working in far-from-adequate conditions. Each astronomer is in average associated with 3 students, so that it can be expected that the total number will sharply increase in the next few years. They are linked to 10 institutes in the country, half of which are involved with graduate teaching, and one with undergraduate teaching. Most of these recently qualified astronomers have obtained their degree either at the University of São Paulo (IAG/USP) or at the National Observatory (ON). Both offer MSc and DSc courses, and the IAG/USP also offers several undergraduate courses for students majoring in Physics (cf. W. J. Maciel, in *The Teaching of Astronomy*, ed. J. M. Pasachoff, J. R. Percy, Cambridge University Press, 1990, p. 34).

Public education - Several exhibits have been made in the past few years, especially in the big cities of São Paulo and Rio de Janeiro, where astronomical sessions in public squares have been organized, always with large audiences. As an example, the IAG/USP introduced an "open house" on Friday evenings, and interested people often have to register weeks in advance. Also, astronomical popularization in the press is steadily advancing, particularly with the contribution of professional astronomers. In Rio de Janeiro, the new "Astronomy Museum" (MAST), located in the headquarters of the old National Observatory (ON), is dedicated to organizing public astronomical exhibits, also conducting original research on the History of Astronomy. In São Paulo, the "Science Station", a permanent exhibit formerly linked to the Federal Research Council (CNPq), is now operated by the University of São Paulo (USP), and often organizes astronomical exhibits.

Astronomy Education in Bulgaria

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General Information. The general state of astronomy education in Bulgaria has been presented in the National Reports published by IAU Commition 46. Except in all levels of the school and in the Universities astronomical courses are taught at the Peoples observatories, usually tied with planetaria in ten towns in Bulgaria. The most recent event in astronomy teaching is the Ministry of Education decision to detach astronomy from physics and to fix it as separate obligatory subject at the 11th before the last 12th grade of secondary gymnasium type schools.

Elementary Schools. Ideas and preliminary conceptions about Solar System and Earth as planet, Moon, Sun and stars in 4th grade of Elementary schools proceed to be taught.

Secondary Schools. In 1988 a team from the Astronomical Department of Sofia University and Peoples Observatories astronomers as well as school teachers completed the development a didactic system for astronomy teaching in secondary schools. The project was initiated by the Ministry of Education. A consequence was the decision to detach astronomy from physics as a separate obligatory subject at 11th before the last grade of the natural sciences as well as human specialized gymnasium type secondary schools. As astronomy starts to be taught in 1991/92 school year a new textbook for 30 lessons for the first half of the school year of the 11th grade was compiled. A connected with the textbook teacher-guide book was also prepared. Now some devices for pupils as well as for teachers as stellar maps, slide sets, diagrams etc. are in preparation or in designing.

University Education. A new course entitled "History of astronomy" started in 1990 at Sofia University. Its purpose is on the background of astronomy progression from the ancient to the contemporary time to examine the development of the human concept of the world picture, the

evolution of the notions about the Cosmos from the mythological to the contemporary cosmological ideas paralel to the philosophy concepts of the Humanity. The course now is attended by the students of the physical Faculty but in the future it may be attended by students from Philosophical and other Faculties too.

Public Education. A new Peoples observatory in the town Blagoevgrad was established and began to operate in 1988.

ASTRONOMY EDUCATION IN CANADA

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General Information. During the period 1988-90, many new programs and projects have been initiated which relate to attracting good students, in particular women, into science; to informing and educating the general public about astronomy; to assisting public schools in providing good astronomical education; and, to developing new tools for teaching astronomy in the universities.

In 1990, the National Research Council created a Science and Engineering Training Program for Women. Financial assistance and career-related training will be provided to about 75 women enrolled in undergraduate studies, with priority being given to women studying physics, mathematics and engineering.

The Royal Astronomical Society of Canada (RASC) continues to publish annually the oldest and most widely-known astronomical publication in Canada, the OBSERVER'S HANDBOOK which is used by educators and by amateur and professional astronomers in many countries.

Science Culture Canada is a program of the federal government designed to promote a more science-oriented culture in Canada. The program provides funding for projects which are intended to stimulate greater public interest and awareness, particularly amongst young people, of the role and impact of science and technology in contemporary society; and, to improve communications between scientists and non-scientists. An example of the use of this program was the production by the McLaughlin Planetarium in Toronto of a show about cosmology.

Elementary Schools. Astronomy education is rather limited in the elementary schools but there are some good efforts to encourage such education. In 1988, the Alberta Astronomy Resource Group (AARG) was formed with representatives from the Alberta Science Centre/Centennial Planetarium, Calgary Board of Education, Calgary Separate School Board, Mount Royal College, Calgary Centre of the Royal Astronomical Society of Canada, and, the Department of Physics and Astronomy of the University of Calgary. AARG has developed practical activities and lesson plans in astronomy for teachers at all educational levels. Workshops and conventions have been presented in Alberta.

Secondary Schools. Secondary school programs vary from province to province. There are continual changes being made in the curricula and programs. Problems that have arisen because of these changes include: the dropping of astronomy units from the junior high science curriculum in Alberta; the attempt to introduce "Creationism" into the science curriculum in Ontario high schools; the loss of high school astronomy courses in

some Nova Scotia schools due to a trend to eliminate small enrolment courses and "extra-neous" courses.

In 1989, Pierre Brosseau high school in Brossard, Quebec, a suburb of Montreal, introduced a program called "Young Astronauts" aimed at students in the early years of high school. Four modules including one on Astronomy comprise about 100 hours of the school year. Students in the program spend one week at a Space Camp in Alabama, USA, and visit the NASA Marshall Space Flight Centre.

The Canadian Astronomical Society (CASCA) introduced an Astronomy in Education session at its 1990 meeting at Mount Royal College and the University of Calgary. The RASC and CASCA cooperated in presenting papers and demonstrations for university and high school level astronomy to members of CASCA and to invited high school teachers. Another session is scheduled for the 1991 meeting at York University.

University Education. University education has been responding to the introduction of new technologies in astronomical research and teaching. In particular, universities are acquiring CCD imaging systems, software, and, computer work stations; and are developing computer-assisted instructional software.

York University has developed a number of computer-assisted instructional modules for undergraduate use. The University of Manitoba has developed, for student training, a real-time computer simulation of the operation of their 40-cm telescope and observatory.

Public Education. To celebrate the centenary of its incorporation, The Royal Astronomical Society of Canada held a public symposium on astronomy in Ottawa on June 30, 1990. Entitled "YOU AND THE UNIVERSE", the symposium was presented by five invited speakers who gave a broad view of the place of astronomy in modern society. The talks have subsequently been published in the Society's Journal.

As an example of the ongoing activities of centres of the Royal Astronomical Society, the Calgary Centre participated in public education programs including: public observing sessions and observatory tours; classes for the general public introducing astronomy and telescope making; a monthly radio program "What's Up in the Sky?"; a recorded astronomy information telephone message service.

The Canadian Astronomical Society and the Royal Astronomical Society of Canada continue to sponsor "The Helen Sawyer Hogg Lecture", an annual public lecture on astronomy delivered during the Annual General Meeting of the RASC. These lectures are published in the Society's Journal.

The Dominion Astrophysical Observatory, the Department of Physics and Astronomy at the University of Victoria and the Victoria Centre of the RASC sponsored very successful week-long astronomy programs at the Royal British Columbia Museum in the summers of 1989 and 1990. The programs were titled "Voyager at Neptune" and "Space Project '90".

ASTRONOMY EDUCATION IN TAIWAN, REPUBLIC OF CHINA

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General Information. Taiwan, Republic of China, is undergoing rapid industrialization. Her prosperous economy and increasing technical prowess have been providing great impetus for the advance of astronomy education. This development is evidenced by: (1) a much enhanced astronomy curriculum for elementary and secondary schools, (2) the increasing availability for astronomy courses in universities, and (3) an explosive growth of astronomy education facilities for the public.

Elementary Schools. Basic astronomy concepts are taught in the fifth and sixth grades. The subjects include seasons, the apparent motion of celestial bodies, and man's place in the universe. Some schools, especially those in the metropolitan areas, have built small planetariums, and observatories. In Taipei and Taichung, all elementary schoolers take at least one field trip to visit the large public planetariums.

Secondary Schools. Astronomy is taught as part of the earth sciences. It constitutes about 25% of the material. The first three years (junior high) of the secondary education is compulsory. Ten hours of instruction are given in the third years. Students learn to recognize constellations and important stars. They study the sun and the moon, origin of eclipses, and the schematic structure of the universe. They are also exposed to the question of astrology and the zodiac as well as intelligent life in the cosmos. Those who are going to colleges enter high schools for three more years. Astronomy is taught in the first year. Students learn how astronomers use instruments to measure temperatures and distances. They also learn the basics of stellar evolution and cosmology. These are designed to get them interested in learning more about astronomy later in their life. High school planetarium is becoming a fad in the education circle.

University Education. In teachers' colleges and the Normal University, astronomy courses are available to prepare the teachers for the teaching of earth sciences in schools. Because astronomy was added only recently to the school curriculum, there is a shortage of trained teachers. So these colleges also offer some summer intensive training courses for the teachers already in schools. Most major universities offer some introductory astronomy courses so that the future elite of the society have some understanding of our field. In the three more important physics departments upper division astrophysics courses are offered to prepare interested undergraduate students for careers in public education and to attract students to pursue graduate studies in astronomy. National Central University has the only graduate program in astronomy in its Institute of Physics and Astronomy. On average two to three master degrees are granted per year. Because of the recent doubling of astrophysics faculties in this country there are more students getting into astronomy graduate programs. It is estimated that six to ten students per year have entered Ph. D. programs (some domestic but mostly abroad) for the past three years. A master program in space science has been established in Central University.

Public Education. There have been a tremendous surge of public interest in astronomy in the past few years. Taipei Municipal Observatory has been leading the public education in astronomy for decades. Amateur organizations are mushrooming all over the country. An Omnitheater-Planetarium is the centerpiece of the newly opened National Museum of Natural History at Taichung. In Taipei, the capital city, an astronomy center is being built. It will boast one of the best and the largest projectors ever built by Zeiss and a who array of fascinating interactive exhibition modules. The opening is expected in two years. Many popular science magazines have come into existence frequently featuring astronomy articles. The recent planning of a national space program further focuses public attention onto man's venture into space.

ASTRONOMY EDUCATION IN COLOMBIA

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General Information. No essential change in astronomy education in Colombia has happened in the period reported.

Elementary and Secondary School. In elementary and secondary school some elements of astronomy are introduced in such courses as Geography, Natural Sciences, and Physics. Emphasis is put on description of the movements of the Earth, seasons, time and calendar, and planetary system. No special training for teachers is officially organized.

University Education. At university level some engineering programs include courses in astronomy oriented towards geodesy. A few universities offer an introductory course in astronomy intended for non science students. The Observatorio Nacional offers two general astronomy courses for science students in the Universidad Nacional.

Two young colombian astronomers attended the XVI IAU / UNESCO International School for Young Astronomers that was held in Cuba in 1989.

Public Education. Lectures and educational activities in the field of astronomy for the general public and school children are offered by planetaria in Bogotá and Medellín. The amateurs group are very active in the country. They help in making astronomy reach a larger number of people by means of lectures and open nights.

Astronomy Education in Czechoslovakia

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General Information. At the middle of October 1989 a three-days 6th conference on the teaching and popularization of Astronomy was held at the Komensky University in Bratislava under the auspices of the Czech and Slovak Astronomical Societies. Several participants were from Austria, East Germany, Poland and Soviet Union.

Elementary Schools. The situation in the elementary schools is not very satisfactory. Only a few phenomena are mentioned (for ex. the phases of the Moon, the eclipses of the Sun and Moon) but a systematic presentation of the fundamentals of Astronomy is missing.

Secondary Schools. Astronomy is integrated in the Physics courses. In the last years a new astronomy study program for a grammar schools ("Gymnasium") was prepared. The main topics are : radiation - the source of information about the universe; internal structure, spectra, physical characteristics and evolution of stars; structure and the evolution of the universe (our Galaxy, external galaxies, elements of cosmology). Results of a didactics test from astrophysics, applied to 22 classes of the 4th class of a grammar school in the school-years 1988/89 are described in Acta Universitatis Palackianae Olomucensis, Facultas Rerum Naturalium, Vol. 101, 1991. Statistical processing of results and the analysis of answers shows that the pupil's knowledge is of a good level, which is in favour of compilation of subject matter of astrophysics in a new textbook for grammar schools (Prague-Bratislava, 1988). Textbooks and collection of problems for pupils of secondary schools have been published.

University Education. Professional astronomers are educated at the Charles University in Prague and Komensky University in Bratislava. Other universities (Masaryk Univ. in Brno, Safarik Univ. in Kosice and Palacky Univ. in Olomouc) have introduced astronomy into curriculum of physics teachers. The physical background is emphasized but specific

astronomical methods are also shown, astronomy should not merely merge in physics. Physics teachers at secondary schools have one semester course in astronomy and astrophysics during their study of physics at the university.

Public Education. Czechoslovakia has today a fairly large network of Public Observatories and Zeiss Planetariums. The former - constructed mainly after the World War II - in the number about 60, are uniformly distributed all over the country, the latter are concentrated in larger cities. They serve general astronomical interests and are to supplement the curriculum of secondary schools. Their instrumental facilities permit quite interesting astronomical observations, especially in collaboration with one or the other scientific institute or under the direction of a professional staff member.

Unfortunately during the last 40 years astronomy in our country was influenced by marxistic philosophy and therefore some new problems were suppressed.

ASTRONOMY EDUCATION IN EGYPT

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A short review on teaching of Astronomy in Egypt has been presented in IAU Colloquium 105 July 1988, p. 398. Here we summarize only the new developments.

Elementary Schools. Training of school teachers is being continued in one- or two-week periods by professional astronomers. To help the teachers in giving their students simple, accurate and up-to-date knowledge, an astronomical teacher's guide was published in Arabic by the Egyptian Association for Science Teachers.

Secondary Schools. A reform of the 3rd (last) secondary school year is now taking place. In this context a full year (two lessons per week) astronomy and space science course was suggested. It is postponed until after the graduation of a sufficient number of qualified teachers.

University Education. Astronomy lectures have already started this academic year (1990/1991) in the Alazhar-University. Besides astronomy, the curriculum contains also mathematics, physics and meteorology. The Faculty of Science - Cairo University, to which the Astronomy Department belongs, is reforming its graduation rules. Accordingly, allowance will be made for a general degree in astronomy and physics, or astronomy and mathematics, instead of only special astronomy (since 1972). This seems to suit better the job conditions in Egypt and other Arab countries. Such rules may be applied in the next academic year.

Public Education. The public astronomy education has lost completely the role of the sole planetarium in Egypt. It has in fact been dead for one year. An Arabic translation of the German ABC Astronomie was published by the General Egyptian Book Organisation in 1990.

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General Information. There have been no great changes in school education since 1988. But outside schools, several new developments have taken place. The first Finnish science center with its planetarium was opened in Vantaa, and the role of planetariums in general increased. The first "Space Engineers" completed their studies in the Technical University of Helsinki. The total solar eclipse of July 1990 was one of the most important astronomical events in Finland during the whole century.

Elementary and Secondary Schools. Astronomical subjects continue to be taught in connection of physics and geography. New school books on these subjects contain rather good chapters on astronomy, especially on secondary level (grades 10-12). Planetariums have been used in school education more than before. Hundreds of classes visit the Tampere and Vantaa planetariums each year, and there are three small portable planetariums, operated by astronomical societies, that are brought to several tens of schools yearly.

University Education. Astronomy continues to be taught in Helsinki, Turku and Oulu universities, and the basic course has been lectured in "summer university" in Joensuu. A new Laboratory of Space Technology was founded in the Technical University of Helsinki in 1988. The Laboratory gives courses in space technology in general and more detailed teaching in those areas that are most important in Finland, for example satellite communications and remote sensing. The first "Diploma Engineer" in Space Technology graduated in February 1990, and 5-7 new engineers and a couple of "Licentiate of Technology" will complete their studies yearly.

Public Education. The first Finnish science center, Heureka, was opened in Vantaa just across the border of Helsinki in April 1989. There were nearly half a million visitors during the first year. Heureka houses the largest planetarium in Finland (with 196 seats) and produces programs of its own. The planetarium, called "Verne theater", has a 70 mm Omnifilm film projector and a Carl Zeiss Jena (Jenoptik) Universarium star projector. The Särkänniemi Planetarium in Tampere has modernized its equipment, interior and programs, and continues to produce more strictly astronomical planetarium programs than Heureka. Ursa Astronomical Association has built another small moving planetarium.

Ursa also continues its strong contribution in spreading astronomical information in several books yearly, Tähdet ja Avaruus ("Stars and Space") magazine and press releases. At the end of 1990 Ursa had over 5900 members.

Ursa was the central organizer in the events around the July 22, 1990, total solar eclipse here. For this, it got a substantial grant from the Finnish Culture Foundation. The eclipse developed into a massive media event, although clouds prevented seeing the total phase nearly all over Finland. Astronomy got many many new friends here because of the eclipse.

Astronomy Education in France

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General Information : Important modifications in the whole education curriculum in France, from Elementary school to the University level, are under discussion, related to the principal objective of 80% pupils obtaining the "baccalauréat" degree at the end of secondary school.

Among the main objectives are : (1) a strong reduction of the number of sections in secondary schools to only three : literary, scientific and economics, and (2) the improvement of scientific education, the emphasis being put on experimental sciences.

Astronomy is concerned, in tight relation with Earth Sciences, a new field "Sciences of the Earth and the Universe" being possibly introduced. This involves important modifications in the training of school teachers. Up to now, astronomy is included either in physics or in mathematics and school teachers are specialized either in physics and chemistry, or in geology and biology or in mathematics and none of them in both astronomy and geology...

French astronomers and school teachers which are developing school teachers training activities are members of "Comité de Liaison Enseignants et Astronomes" (CLEA). This association school teachers under the responsibility of 3 different teams located respectively at Marseilles, Paris 11 or Strasbourg Universities. CLEA publishes also the quarterly journal : "Les Cahiers Clairaut" and several pedagogical documents : movable viewgraphs, slide sets and series of pedagogical card indexes. It also organizes a large number of activities in the French educational districts. The Strasbourg team is developing continuously a large activity around Strasbourg planetarium, and there is also an increasing number of transportable planetariums.

Elementary School : The main objectives are : (1) structuring space and time and (2) educating to the environment. Emphasis is put on the observation of the apparent motions of the Sun and the Moon and the calendars.

Secondary School : a) first level (compulsory 4 years) : astronomy is included in optics including Moon and planet phases, telescopes and spectroscopy. The new curriculum at the planning stage is built on the general topic "the Earth in the Universe". b) second level : optional courses are presently given to non-scientific pupils (mainly : stellar evolution and historical points concerning the copernician debate). New ones are under discussion, concerning the scientific section.

University Education : Astronomy is present only as an optional matter in the first (first two years) and second cycles (third and fourth years) and continuous training of school teachers in the main Universities such as Besançon, Bordeaux, Grenoble, Lille, Lyon, Marseille, Montpellier, Nice, Paris 6, Paris 7, Paris 11, Strasbourg and Toulouse, and also at Ecole Polytechnique. Graduate courses are also given in several of these Universities including mainly Paris 6, Paris 7, Paris 11, Paris Observatory, Toulouse, Nice and Grenoble. Moreover, a high level course is given each year at Collège de France.

Public Education : Many activities to popularize astronomy are being developed in most observatories, and Grenoble and Marseille cities are considering the possibility of constructing large planetariums.

Astronomy Education in the Federal Republic of Germany °)

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University

Education in the Federal Republic of Germany is in the responsibility of the federal states. Therefore, the study programs differ from one university to another in several respects. Introductory courses in astronomy are offered regularly by nearly all major universities. In most of these universities, physics or mathematics majors may choose astronomy as second examination subject for their diploma.

For advanced studies leading to the doctor's degree a diploma in physics, mathematics or geophysics is required.

School

Astronomy as an optional subject is still restricted to a minority of federal states. Astronomical topics are, however, taught via courses in physics at secondary school level. Pressure for contact with astronomy very often comes from the pupils. To facilitate this, quite a number of text-books specialised on school astronomy have been published in recent years. The tendency is to strengthen practical work under the often unfavourable middle-European weather conditions.

Advanced training courses for teachers are offered by the educational authorities in collaboration with university institutes or public observatories/planetaria. One-week courses consisting of lectures and practical exercises are arranged at a rate of about one per year and federal state.

Finally, reports on school relevant topics appear in a number of amateur journals headed by the country-wide circulated "Sterne und Weltraum".

While broadcasting and television programs are of little help in this respect, school astronomy benefits from the numerous public observatories and planetaria in our country. These centres of astronomical education offer supplementary courses according to their technical equipment.

Public Education

Some of the continuing activities aimed at astronomy education of the general public are as follows:

°) until October 3, 1990

- (1) Regular programs for visitors of the planetaria in Berlin, Bochum, Bremen, Glücksburg, Hamburg, Hannover, Kiel, Mannheim, München, Nordenham, Nürnberg, Recklinghausen, Reutlingen, Stuttgart und Wolfsburg supplemented by special series of lectures and courses.
- (2) Adult colleges in many cities and towns all over the country offer lectures and courses in astronomy. Most of the observatories organize visits and lectures for the general public.
- (3) Radio and television broadcasts on astronomy and space research with the collaboration of professional astronomers and physicists have increased in number.
- (4) Several excellent new popular books written by professional astronomers have been published during the last years.

In spite of this, a slight but marked increase of astrology - even at university level - has been noted and is of some concern.

ASTRONOMY EDUCATION IN HUNGARY

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General Information. The most important characteristics of the Hungarian educational system were presented and a detailed description of the role of astronomy in elementary and secondary education was given by Szécsényi-Nagy (1990, in The Teaching of Astronomy, eds.: J.M. Pasachoff and J.R. Percy, Cambridge University Press, p.28.). This paper was based on the status quo of 1988 but seeing that the changes of the educational system are much slower than those of the Hungarian political system, practically all of its statements are valid nowadays too. The most important development of the last two years is probably the personal computer boom which did not reach the majority of Hungarian families but almost all of our elementary and secondary schools. Although these flexible devices are generally equipped with monochrome monitors only still they are able to drive Hercules mode graphics displays too for which PC's turned out to be really very effectual in modelling a lot of astronomical problems.

Elementary Schools. Following recent parliamentary changes in Hungary a new law of public education has to be codified which is expected to offer more freedom and independence to every schoolteacher. It is only to be hoped that the new act will result in the comprehensiveness and polyphony of our educational system. In this case the personal ambition of the teacher will be the most important factor and we have to be ready to breathe courage into those colleagues who determined to involve more astronomy into the curriculum. In line with these changes the religious instruction was reintroduced into public schools too and its consequences are unforeseeable. In the 8-12 age bracket of pupils we expect more difficulties in explaining and securing acceptance of the astronomical argumentation in problems of the formation and development of stars, planets, and life.

Secondary Schools. Pupils successfully completing the eighth year of the elementary school follow their studies in the optional secondary school or high 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. Both of them have four grades. Astronomy and astrophysics is taught as a section of physics mainly during the second (grade 10) and fourth (grade 12) years with two weekly hours. The main topics of the first part are the history of astronomy from Eratosthenes to Newton, Kepler's laws of the planetary system, the law of gravitation, angular momentum, proofs of the spherical shape and the rotation of the Earth, kinematics, and dynamics of the solar system. The second part contains some bits of astrophysics such as the color of stars, their inner and surface temperatures, the main characteristics of stellar spectra and their classification, theories of stellar evolution and the chemical constitution of stars, the formation and evolution of planetary system(s), the physics of comets, radioastronomy, and cosmology.

Recent changes in the curriculum of Hungarian 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, high-energy particle physics, etc. but about astronomy and astrophysics 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.

University Education. Courses of introductory astronomy and astrophysics 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 the country with its own Department of Astronomy is the Eötvös Loránd University of Budapest. Introductory courses in the former are given 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 mathematics/physics. At some universities these introductory courses are coupled with practical work in a lab or in a campus observatory.

At the Eötvös University a comprehensive set of astronomy and astrophysics courses is offered to science undergraduate and graduate students. We offer special courses to meteorologists and cartographers too. (For more details of the various curricula see Table 3, 4, and 5 of Szécsényi-Nagy's 1990 paper.) Only minute changes have occurred since 1988. The most important is the insertion of Cosmology and Solar Physics as self-contained subjects into the second cycle of the program of training of astronomers. Another milestone was the publication of an up-to-the-minute textbook. "CSILLAGÁSZAT" (ASTRONOMY) came out in 1989 and contains all major chapters of theoretical astronomy and astrophysics but astronomical instruments and techniques. As far as modern astrophysical methods are concerned we are introducing digital frame-grabbing and image processing into our Astronomical Laboratory and Practical Research Work too.

The triennial postgraduate program aimed at the training of club and amateur society leaders (Szécsényi-Nagy 1990, Table 6) which we offered to active school-teachers, engineers, and others has been completed. More than two thirds of the registered students successfully defended their theses and their postgraduate degrees were awarded. Eötvös is the only university in Hungary entitled to award Ph.D. degrees in astrophysics and awarded six degrees in this discipline in the past three years.

The Council of Ministers of the European Communities adopted in 1990 the Trans-European Mobility Scheme for University Studies (TEMPUS). It forms part of the overall program of EC aid for the restructuring of the countries of Central/Eastern Europe. Within this framework, training has been identified as one of the priority areas for cooperation and we definitely intend to join this program in order to promote the quality of Hungarian higher education. We need the active support of astronomers of universities of EC countries for TEMPUS is available for trans-European activities only. Our participation in the scheme could result in live and productive cooperation for the benefit of future generations. We also intend to join the European Astrophysics Doctoral Network (EADN).

Public Education. For the public education has been supported by the state for decades and the system crashed in 1989/90 we have to expect severe problems in this field in the immediate future.

ASTRONOMY EDUCATION IN INDIA

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General Information. The approach of Birth Centenary of Meghnad Saha in 1993 and the birth centenary of Sir C V Raman in 1989 acted as triggers for the spread of astronomy in various parts of India. The unlimited enthusiasm of the Department of Science and Technology and the University Grants Commission has resulted in some concrete steps being taken for astronomy education, like the establishment of Inter University Centre for Astronomy and Astrophysics (IUCAA) and the starting of astronomy teaching in several universities. The success of Voyager Missions and the spread of Television networks to almost all corners of India with the INSAT series of Satellites of the Department of Space has helped in spreading astronomy education to the General Public. What follows is a brief outline of these attempts.

Elementary Schools. The National Council of Educational Research and Training has incorporated some basic ideas about the solar system and the universe in the geography textbooks of the third and fourth standards. Since the teaching in the elementary schools is influenced, to a large extent by these text books, the spread of astronomy education follows. There is an urgent need to train elementary school science teachers in astronomy so that they will be able to answer the questions and doubts raised by some of the students. At the moment this gap is being filled by the scientists in the neighbourhood. Another important gap in the elementary school-teaching is the enormous rural-urban divide. Though this is common to all teaching, the gap is particularly obvious in the field of astronomy, as in the rural areas, the hold of some superstitious beliefs, directly connected to the influence of the planetary positions, is too much. Unfortunately, multi-lingual nature of India prevents a dedicated assault in this direction.

Secondary Schools. Though a proper introduction to astronomy-similar to mathematics, physics, chemistry and biology- is still a long way off, over the last few years, the syllabus of the secondary schools has been revised to include some introduction to 20th century astronomy. The progress made in understanding the close relationship between other basic sciences and astronomy is being appreciated by the students, because of a proper introduction of the subject in the revised textbooks. The visits by the neighbourhood astronomers have helped in fostering and maintaining the growth of observational astronomy in at least major urban areas.

University Education. Major thrust in astronomy education is concentrated in this sector. This is because of the urgent need for getting bright students to

join the major astronomical facilities, both ground as well as space based. In addition to full-fledged astronomy departments in Osmania University, Hyderabad and Punjabi University, Patiala, Madurai Kamaraj University has started postgraduate teaching in Astronomy. Further, it is proposed to start astronomy teaching in about a dozen more universities. The acquisition of small telescopes- a prototype being made by IIA- and the fabrication by NCERT of an inexpensive dome, will go a long way in generating the enthusiasm for astronomical knowledge among the students. The Joint Astronomy Programme(JAP) of Indian Institute of Science, Bangalore continues to teach astronomy, in collaboration with Research Institutions like Raman Research Institute(RRI), Indian Institute of Astrophysics (IIA), Indian Space Research Organization(ISRO), Tata Institute of Fundamental Research(TIFR) etc.

The establishment of the IUCAA has helped to promote astronomy education in the university sector in all parts of India. It has organized Regional Workshops and Minischools in the North, South, East, West and Central regions. The participating universities in the region are exposed to the latest developments in the field. In addition, the teachers are encouraged to spend extended periods in IUCAA, equipping them to teach better, as well as to take part in active research in the frontier areas, with excellent facilities.

The National Centre for Radioastrophysics, TIFR, Pune Campus is spearheading the organization of summer and winter schools, similar to the ones conducted by JAP and IUCAA, with a view to get students to spend their vacation closer to the active astronomers in their observatories. Regrettably, all the efforts are still devoted to mainly Campuses in big cities. It is hoped that with the spread of public education in Astronomy throughout the country, this will change.

Public Education. More than a dozen planetaria have come up in many parts of the country. This has helped in the spread of astronomy education to the public in a big way. Further Science Museums in the country have astronomical gallery, where the public can operate simple instruments like spectroscope, telescope etc. In addition, the Open University programmes, which are telecast in the national TV network, has helped in creating awareness about astronomy. Further, serious course-work in astronomy is also done by a large number of students of the Open University. Radio talks have played a major role, as leading astronomers have been giving talks on relevant exciting astronomical events. These radio talks have been extremely useful in catering to people knowing only the local language. Amateur Astronomy Associations, in close collaboration with neighbourhood astronomers, have helped in a big way in popularizing astronomy to the general public.

The Voyager mission caught the imagination of the general public with the direct telecast of the fantastic pictures of the Triton and simple explanations of the images. The newspapers as well as the weekly magazines, both in English and many local languages have helped in spreading astronomy education to the public.

ASTRONOMY EDUCATION IN JAPAN

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There have been several activities relating to the astronomical education in Japan. Some of them have good effects to our future activities while some others are starting to produce difficult problems. In this report, I will just show these individual activities, the detailed discussion of which will be given in the other occasion.

Reformation of a course of science education in school from 1992-1993. In Japan, a reformation of a course of science education in school is carried out every 10 years. The new course starting to be used from 1992 was decided in 1989. For example, Life Study is newly settled at the position of Science and Social Study for the pupils at the 1st and 2nd grades at the elementary school, but, this kind of reformation makes difficult for us to have teachers with good astronomical knowledge, because most elementary school teachers who do not like physical science and have few good astronomical knowledge can spend their school hours without teaching astronomy in proper way. Then, the school pupils will lose an interest in astronomy. This reformation is created by a committee under the Ministry of Education, Science, and Culture in Japan, which did not include any representative from our astronomical community. We should start to make jointly our efforts to send our representative to the next committee which will be in charge for the reformation at 2002.

A new course for students without intending to have teachers' license at the teachers' college. At the teachers' colleges in Japan, all the students were expected to be teachers at either elementary or junior high or senior high schools and had to have teachers' license. In recent years, it happened that number of students who got the teachers' license but could not be teachers became large, because of low birth rate in Japan. To solve these difficulties, all the teachers' colleges started a new course for students without intending to have teachers' license in 1989. Because of this reform, the teachers' colleges became to be able to have students with wide variety of abilities and are much activated. However, we are anxious about that number of students having a lecturer(s) relating to astronomy will be small. We should look at what change will follow, for a while.

Establishment of a new society of teaching and popularization of astronomy, Japan. We had two colloquiums of teaching of astronomy, Japan in 1987 and 1988, which were mostly dedicated to the discussions relating to the IAU Colloquium No. 105. During these colloquiums, a proposal to have a new society, teaching and popularization of astronomy was made and it was established on August 7, 1989 after one year preparation. Now, we have 400 members of astronomers, school teachers, staffs at public science centers and planetariums, and amateur astronomers, and those number is still increasing. Continuous activities directed by the working committee will make mutual

exchange of ideas relating to teaching and popularization of astronomy among them possible and effective.

Establishment of section for amateur astronomer education at the National Astronomical Observatory, Japan. The Tokyo Astronomical Observatory was one of institutes of the University of Tokyo and was reorganized on July 1, 1988 into the National Astronomical Observatory, Japan, which is one of the inter-university institutes under the Ministry of Education, Science, and Culture. Following this reorganization, a new section for amateur astronomer education was established in the Observatory in order to popularize astronomy in a proper way. Since the Observatory is a national research institute, there is only a limited support in manpower and in budget from the observatory to the section, but the projects are promoted with much personnel helps from staffs belonging to all the divisions in the Observatory. The undergoing projects are 1) a lecture course to leading amateur astronomers at each year, 2) to help discoverers of new celestial objects to communicate with the Central Bureau for Astronomical Telegrams, 3) to distribute informations of new astronomical discoveries to different organizations in Japan, 4) to provide fundamental astronomical data through the telephone linked computer networks, and 5) to answer questions from public people through telephones and letters. Its activities will gradually become higher and higher with supports of the National Astronomical Observatory, Japan.

Situation at the post-Halley comet. There was a big fever in Japan during a period of approach of the Halley comet in 1986. A large fraction of our people knew its approach through mass-media, and also most of them tried to look at the Halley comet. However, there remained also a big disappointment among those public people because of a reaction of commercialism persuaded during that period. We need a couple of years to recover from the difficulty created at that period. Over 20 Astronomical books every year, and 4 astronomical journals every month for public people have been published.

Others. A number of planetariums is increasing, but there are some problems in their organization. A number of astronomers is also increasing and then a number of colleges which had no astronomers but have now astronomers is increasing. We have now a big problem of light pollution as shown in a photograph "Earth in Night" produced by Dr. Sullivan, but a number of people who are thinking in it is increasing including some number of scientists belonging to the Lighting Association in Japan.

ASTRONOMY EDUCATION IN MEXICO

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General Information. Mexico is a country with 80 million inhabitants with a low level of education. Scattered throughout the country there are altogether 13 active planetaria, they are located in the largest cities. They are being used for the general public and for school programs.

Elementary Schools. This level is for grades 1 to 6 (ages 7 to 12). In the elementary school programs the children are introduced to astronomy in 3rd grade with a discussion of the solar system and in 5th grade with earth's location in the universe. There have been no changes in the program in the period covered in this report.

For elementary school education the planetaria play an important role. In Mexico City, the local planetarium is visited by 500,000 elementary school children each year. The other planetaria, are visited by 300,000 children each year.

Secondary Schools. The secondary school is for grades 7 to 9 (ages 13 to 15). Their programs have not changed for the 1988 - 1990 period. The children are introduced to some of the basic astronomical concepts through the natural sciences subjects; there are no specific astronomical subjects. In Mexico City there are science education programs prepared at the Museo Tecnológico, where 2000 secondary school children visit every day; in these visits some physical and astronomical concepts are strengthened.

University Education. There are several cycles in university education. The lower cycle corresponds to grades 10 to 12 (ages 16 to 18), the professional level (ages 19 to 23), and graduate courses. The lower cycle is the last opportunity for students to be exposed to general topics. Astronomy by itself is not included in the general program, it is part of physical sciences courses.

At the professional level, the students are already given their chosen specialized subjects, and the only students that become acquainted with astronomy are those involved in Physics (and to some extent those involved in Geography). The level of studies are then rather deep, and there is the opportunity of delivering introductory courses to a very interested audience, as well as more advanced astronomical courses. The University of Mexico offers 5 optional astronomy courses for interested physics students.

In 1989 the University of Mexico started its graduate program in Astronomy. This project is directly under the auspices of the Instituto de Astronomía staff and had been maturing for several years; previously the astronomical training had taken place under the Physics program. The basic topics covered are: Radiative Processes in Astronomy, Stellar Constitution and Evolution, Stellar Atmospheres and Spectroscopy, Interstellar Matter, Galactic Structure and Stellar Dynamics, and Extragalactic Astronomy and

Observational Cosmology; in addition there is great emphasis in individual research projects. The program has a modest enrollment, but together with the scholarship programs that support graduate studies in foreign universities, it is expected that it will take care of the growth of the professional astronomers in the country. The lectures are delivered in Spanish, and the enrollment of other students from Latinamerica or other spanish-speaking countries is welcome. There are other graduate programs in physics in the country that also have the opportunity of astronomy specialization.

Public Education. There has been an increased activity and growth in the public education programs for astronomy in Mexico.

In 1984 an editorial program was started to promote professional scientists in Mexico to prepare publications on different scientific topics for the general public, among these topics, astronomy has had a big success. During the 1988 - 1990 period, this activity continued, not only through the already established series of publications, but several other new series were started. In this period 8 new astronomy books were printed.

There are several periodic astronomical publications for the layman and amateur astronomers, Orion (published by the Instituto de Astronomía) and El Universo (by the Sociedad Astronómica Mexicana).

The University of Mexico is presently constructing a science museum where there will be a permanent astronomical exhibit. This exhibit is being supervised by professional astronomers.

Although in very small numbers, (there are about 45 professional astronomers, and 30 students) the astronomers are continuously required to deliver public lectures. Altogether, there are at present being delivered more than 300 public lectures per year, to all possible audiences.

In Mexico City, in one of the more extended subway stations, where there are long distances to cover to change lines, there is a 2 km tunnel that has long range science exhibits (mostly of astronomy); at present there are 'Powers of Ten' and 'Solar System' exhibits shown to the public. Furthermore there are temporary exhibits in other locations, which frequently are on astronomical topics.

As we are all aware, in July 11, 1991 a total solar eclipse will be seen from Mexico, and its totality will cover areas where over 40 million people live. This event has generated an enormous interest. A national committee of different governmental agencies has been established to coordinate activities, educate the population and protect its safety. These activities are being supervised by professional astronomers. Different support materials have been already prepared: 4 books aimed at different age brackets and for different levels of science preparations (one of these books has been translated with a cassette to 11 native indian dialects, other book has been published in serial form in one of the astronomical publications), a basic package of slides and pictures for educators to deliver their lectures, information leaflets regarding eye-safety and filter usage during the event, a stamp book for children, articles in science popularization journals, videos with different aspects of the eclipse (8 by TV UNAM, 5 by National Health Services, 24 by Televisa - a private broadcasting company - 5 by IMEVISION - the public broadcasting company), radio programs (25 by CONACyT, 8 by Radio UNAM, 1 by National Health Services - the latter has been translated to 11 native indian dialects).

Astronomical Education in New Zealand

Dr Edwin Budding

General Information

Three centres for astronomy in New Zealand send annual reports to the national journal "Southern Stars" which include reference to their educational programmes. These are : The Auckland Observatory and Planetarium Trust, The University of Canterbury Physics Department, and Carter Observatory (the National Observatory). Besides these three main centres, located in the cities of Auckland, Christchurch and Wellington, respectively, there are some 24 local societies and groups listed in the "Carter Observatory Handbook" (Annual Publication), distributed throughout the country, who are active in promoting astronomical science at the local community level. These organizations are generally in a state of proactive liason with the Royal Astronomical Society of New Zealand.

Elementary Schools

The observatories of Auckland and Carter have established programmes of visits by school children of the region to see the telescopes and receive talks by government supported education officers. These officers also perform educational visits through schools of the regions. Typically several dozen such two way encounters would occur during a school year : the total number of children involved in these two regions is several thousands annually. The University of Canterbury operates the Townsend Observatory as an educational viewing facility on its Arts Centre campus. Physics students are departmentally supported to work that programme.

Secondary Schools

A similar structure operates at the higher school level in the Auckland and Wellington regions as for the juniors, though more ambitious topics and projects are introduced. "Pipehenge" (a steel-pipe outdoor viewing facility modelled on Stonehenge) is a rather colourful and successful example of such a project developed recently in the Auckland area. At Canterbury there is an annual 'Winter School' in astronomy, which is an intensive one week vacation programme involving all the University's Physics Department staff. Top high school students with astronomical interests or potential, throughout the country, are encouraged to take part. This department also holds an annual 'open day' for students in the region.

University Education

The Auckland observatory welcomes students from the University of Auckland with practical observing interests or instruments to develop.

Carter Observatory shares a graduate and postgraduate programme in astronomy with the Physics Department of the Victoria University of Wellington. Carter has also hosted observing students for the universities of Auckland and Waikato in recent years, the former students being connected with the JANZOS research facility at Carter's Black Birch Observatory. The largest single research group in astronomy is that of the University of Canterbury, who maintain the Mt. John University Observatory at Lake Tekapo in the South Island. There have been typically 4 or 5 students engaged on full time research programmes in astronomy in the last few years, based in Canterbury's Physics Department.

There are also small research groups in the University of Otago (Dunedin) and some branches of the government supported DSIR scientific institutes who have an active interest in astronomy, but student involvement appear to be less formalized in these contexts. The University of Otago's Physics Department runs a first year course - 'The Physical Universe' as a special introduction to astronomical science, however. Similar courses exist at the other three universities which have been mentioned.

Public Education

The facilities for this were indicated in the preceding 'general information'. The observatories of Auckland and Carter, and the University of Canterbury's Townsend observatory all run public viewing evenings throughout (at least) the six months of longer nights. Special weekend courses are also arranged, particularly for groups of school teachers. Astronomers from the three main centres tend to be in popular demand to provide talks at astronomical society meetings and extra-mural courses at their local universities. Visiting professionals are also usually eagerly seized on to give lecture tours.

References

Auckland Observatory and Planetarium Trust Report for the year ended 31 December 1989 'Southern Stars' 34-24, 1990.

Astronomy at the University of Canterbury Physics Department : Annual Report 1989 'Southern Stars' 33, 309 1990.

Carter Observatory Annual Report 1989-90 (Special Carter Observatory Publication)

'New Zealand Astronomy in the 1990's' and 'Tertiary Astronomy Programs in New Zealand' P.L. Cottrell, Proceedings of the 5th Asian-Pacific Regional Meeting of the IAU, Sydney, July 1990.

ASTRONOMY EDUCATION IN NORWAY

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General information. During the triennium the curriculum has changed or is planned to change in elementary schools and high schools. A planetarium has opened in Tromsø. 2 mobile planetaria have been made available for schools and groups. The Solar Observatory at Harestua near Oslo has been closed as an observatory and converted to an educational field station, where courses in astronomy are given for teachers and students on various levels. More than 100 short courses are given each year.

Elementary schools. The curriculum has changed somewhat, introducing descriptive astronomy, mainly the planetary system, approximately every third year in the 9 years of elementary school. The interest among pupils for learning astronomy is increasing, and the demand for teachers training and visits to institutions is growing.

In Southern Norway the Harestua Observatory gives teachers training courses and accepts visits by school classes. In Tromsø in Northern Norway, planetarium visits are offered to all schools. In the North on the North-West coast, mobile planetaria are available for the schools. A course in use of miniplanetarium for teachers has been offered by the Northern Lights planetarium in Tromsø.

Secondary Schools. The curriculum has changed, introducing the planetary system and the Universe as topics in natural science in the first year, and astrophysics as part of physics in the third (and last) year. This has raised the demand for teachers training, which has resulted in short courses given at the Universities, and by scientists visiting the school districts. A major part of this training is given by the Harestua Solar Observatory near Oslo, which in 1989 gave 14 teachers training courses and had 40 classes visiting.

In Tromsø, the Northern Lights Planetarium has given courses for students from local high schools who had astronomy as their "in depth" study.

At Andøya, where the ESA rocket range is located, a special high school program in "Space Technology" has been established. The students are offered a curriculum in Space related activities, concentrated on telemetry and building rocket loads. The students will continue their education in Engineering colleges in Sweden and Norway,

and eventually finish with degrees in Science or Engineering at the University level.

University Education. A full curriculum in Astronomy and Astrophysics is offered at the University of Oslo. Astrophysics as part of a physics degree is offered at the Universities in Trondheim and Tromsø.

The Nordic Council of Ministers has supported 6 courses for doctoral students in the Nordic countries (Denmark, Finland, Island, Norway and Sweden). The topics have been Astrophysical Methods and Techniques, training advanced students in use of modern instruments in space and on the ground. The courses have been held at various installations in the Nordic countries and at the Nordic Optical Telescope and the Swedish Solar Tower at La Palma, Canary Islands. Each course had about 20 participants, and can be formally integrated in the students degree requirement.

Public Education. The first planetarium in Norway, The Northern Lights planetarium in Tromsø, was opened in May 1989. It offers the public a view and explanation of the Northern Lights, captured in a Cinema 360 hemi-spherical movie format and displayed on the planetarium dome. The relation between the Northern Lights and physics of the interplanetary space, is used to connect the local observations of Aurora to the physics of the Universe. The planetarium is privately funded and had 75000 visitors in its first 11/2 years of operation.

A quarterly journal "Astronomi" for astronomy interested has been created by the Norwegian Astronomical Society. Its 700 members are organized in many local astronomy clubs and societies, which organize meetings, astronomy days and evening courses for the general public nationwide. The discovery of a comet (Aarseth-Brewington 1989a1) by a Norwegian amateur astronomer in November 1989 made considerably public interest.

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General Information. Professor Robert Glebocki, theoretical astrophysicist of Gdansk University, President of the Polish Astronomical Society, has been nominated Minister of National Education. The Ministry deals now with educational problems at all levels, from elementary schools till university studies.

Elementary Schools. The current physics programme for grades 7 and 8 comprises a few practical exercises in astronomy. Some physics teachers get more motivated and feel obliged to acquire more knowledge about modern astronomy, or about simple astronomical observations. They can get help at planetariums and university institutes.

Secondary Schools. The new subject "physics with astronomy" with astronomy introduced in the second and fourth year, differentiated according to the various lycée types, is now nearing the end of its first full cycle. New manuals appeared, others are still in press.

The National Astronomical Competition, so-called "Astronomical Olympic games" for secondary school students, organized for 34 years by the Silesian Planetarium in Chorzow, attracts every year about 150-200 persons at the first stage, while about 50 reach the second stage, and about 15-20 persons attend the last stage, when the final 5 winners are chosen. These winners are allowed to enter physical or astronomical studies without entering examinations. The same applies to other "Olympic games", national competitions in other subjects: physics, mathematics, etc. These rules are now being examined once again, since there is a national discussion about the advisability of having still the entering examinations, just a month after the very extensive maturity

University Education. Astronomy and practical training in astronomical observational exercises are now more frequently included in the obligatory curriculum for physics students at universities and higher pedagogical schools. The Cracow Higher Pedagogical School built a small observatory on top of a 1000 m mountain, 70 kms south of the city. Students - future school teachers are introduced to observational work, while the staff collects valuable photometric data, a.o. in collaboration with the "Whole Earth Telescope" programme.

Public Education. The Polish Astronomical Society devoted one day of its bi-annual meeting to discuss various problems of astronomy education. The Society quarterly magazine, "Postepy Astronomii" / = Progress of Astronomy / got a new editorial board of younger generation astronomers. They try to attract younger authors and to modernize the general appearance of the magazine.

The Polish Astronomical Amateurs Society organizes series of popular lectures in larger cities, summer astronomical camps for young people, coordinates astronomical amateur observations of solar activity, of comets. The tremendous interest raised by Comet Halley resulted in the building-up of a group of 20-40 amateurs, who observe visually every possible comet. Reduced data are sent by Torun astronomers to the International Comet Quarterly. There are a dozen planetariums in Poland, but Torun, the native city of Nicolaus Copernicus, still waits for its own. A XIX c. building, old coalgas reservoir, is being adapted for that aim. The dome is already finished on the outside, but the internal arrangement of the old building, situated right in the middle of the old city, will still take some time.

ASTRONOMY EDUCATION IN PORTUGAL

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General Information. The general structure of the Astronomy education in Portugal did not suffer great changes in the period covered by the present report. The first degrees of the new degree - course in Astronomy offered by the University of Porto were awarded in this period, and several of the students are now proceeding to higher degrees.

To celebrate the 25th anniversary of its foundation, the Planetarium Calouste Gulbenkian in Lisbon organized a series of conferences on astronomical subjects all over the year 1990.

Also, within the scope of the arrangements for the adherence of Portugal to the European Southern Observatory (ESO), "ESO Exhibition" was shown for a few weeks in the towns of Porto and Lisbon.

Elementary Schools. Some general topics about the Earth, the Solar System and the Universe are included in the programmes for students with ages between six and twelve years.

Students and teachers go often to astronomical observatories to attend lectures, presentations with movies and slides, demonstrations with telescopes and computers. Also, there are special programmes for them at the Planetarium.

Secondary Schools. Some astronomical topics are taught as included in the regular programmes of other sciences. The teachers go often with their students to astronomical observatories to attend lectures, presentations with movies and slides, demonstrations with telescopes and computers. They also organize often in their Schools special sessions, by inviting astronomers to deliver conferences about the Universe. They go also often for visits to the Planetarium.

University Education. As mentioned in previous reports, a degree - course in Astronomy is offered by the University of Porto. The first degrees were awarded, and several students are now proceeding to higher degrees.

Besides that degree - course, Astronomy is taught in other Universities as included in the curricula for degrees in Physics and Surveying Engineering; also, Astronomy is included in the regular curricula of Military Schools.

Public Education. Amateurs and the public in general make regular visits to the astronomical observatories in the country as well as to the Planetarium Calouste Gulbenkian in Lisbon.

ASTRONOMY EDUCATION IN SOUTH AFRICA

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General Information. The sweeping political changes in the country have again focussed attention on the dismal situation in black education. Whilst very large numbers of black students enter school, only a very small fraction eventually obtain university entrance grades (and the number with higher standard in mathematics is as poor as 1 in 10000 of the original intake). Against this background, it is understandable that extremely few black students are successful in the sciences, let alone astronomy. Various programmes to assist disadvantaged students have been operating in the past, but they are clearly completely insufficient. The situation was discussed during a recent workshop involving educators and astronomers (as part of the Annual Review of Astronomy and Astrophysics) in Cape Town. Although circumstances have been exacerbated by the old apartheid system, the situation is little different in other African countries. It is a complex problem involving social attitudes and standards of teaching. Perhaps there will be some improvement for those black students now admitted to the former "whites only" schools, where teaching standards are clearly higher. South Africa has yet to produce a black Ph.D. in astronomy, though certain "coloured" staff at the S.A. Astronomical Observatory have made important contributions to research.

Elementary Schools. Other than basic relationships between the Earth and Sun being taught in Geography, there is no astronomy currently included in the formal elementary school curricula. However, in Johannesburg and Cape Town, the planetaria provide special programmes for elementary schools. About 80000 children per annum attend these shows. In Cape Town, entrance is free, while special schemes have assisted black students in Johannesburg.

Secondary Schools. In Geography, the formal curriculum includes tides and the planets of the solar system, but goes no further than that. Some schools still visit the planetarium, but a crowded schedule makes such visits less frequent. Astronomy is, however, promoted informally and astronomy clubs flourish at many schools.

University Education. Undergraduate science courses in astronomy are offered at the Universities of Cape Town, Witwatersrand and UNISA (University of South Africa, which offers correspondence courses - throughout South Africa and overseas): Cape Town has courses at 2nd and 3rd year level, Witwatersrand at 1st year level, while UNISA offers 10 "modules" (1st, 2nd and 3rd year levels) providing a major in astronomy. Cape Town and elsewhere use a physics major as the basis for astronomy.

An important role, in identifying and encouraging those students considering astronomy as a career, is carried out by the South African Astronomical Observatory, by providing summer employment. The programme includes lectures, observing at Sutherland etc.

In South Africa, a bachelors degree is followed by a one-year Honours degrees. Honours degrees (in Physics or Applied Mathematics) at the universities of the Witwatersrand, Potchefstroom, the Orange Free State, Natal, and Rhodes University may include units in astrophysics. The University of Cape Town and UNISA offer structured Honours degrees in astrophysics. Honours units in Cape Town include General Relativity and Cosmology.

Masters and Ph.D.s in astrophysics can be taken at Cape Town (the centre for optical astronomy and cosmology), Rhodes (radio astronomy), Potchefstroom (gamma-ray astronomy), UNISA and Free State.

Public Education. About 60000 people per annum attend the public shows of the planetaria in Cape Town and Johannesburg. Extra-mural courses, arranged the university and planetarium in Cape Town typically draw a thousand or more per annum. Various other adult education schemes include astronomy. The centres of the Astronomical Society of Southern Africa hold regular meetings. A number of dedicated professional and amateur astronomers give their time to talking to schools, clubs, scouts etc., or even run short courses. To some extent, astronomy promotes itself, as good dark skies are easily accessible in this country.

Talks by Patrick Moore are featured on the radio, but the community hopes to see increased coverage on television. Johannesburg planetarium is now 30 years old and has seen over 3 million people (schools and public) pass through its doors in that time. A quarter million will soon have passed through the newer Cape Town planetarium (in just over 3 years). It is regretted that South African delegates were asked, at the 11th hour, not to attend the 1990 conference of the International Planetarium Society due to educational-boycott action in the host-country Sweden.

ASTRONOMY EDUCATION IN SPAIN

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General Information. There is a great interest on Astronomy education in Spain at all levels. At present, a new law of educational system is being established in Spain for elementary, secondary and professional schools with the main purpose to increase the level and quality of the education. Astronomy is contemplated like an independent matter, but it is not a basic one. The schools offer a lot of matters according as the preparation of the teachers, and pupils must choose their curriculum.

IVth International Conference on the Teaching of Astronomy was held in Barcelona from 12th to 14th September 1990, under the auspices of the "Institut de Ciències de l'Educació" of the Polytechnic University of Catalonia (UPC), in cooperation with "Departament d'Astronomia i Meteorologia" of the University of Barcelona, "Departament de Matemàtica i Telemàtica Aplicada" of the UPC and "Departament d'Ensenyament" of the "Generalitat de Catalunya" (Local Government). The meeting was attended by about 90 teachers from Belgrade, Bulgaria, France, Germany, Israel, Italy, Poland, Spain and Uruguay. The aim of this meeting was to facilitate interchange of experiences realized or of future plans on Astronomy education, as well as to debate didactical and practical works, with the participation of teachers which are developing these ones. 42 reports were presented and 4 general lectures were given by invited professors.

Elementary Schools. At elementary schools some elements of Astronomy are introduced in natural sciences courses. There is a "working group" (Escola Rosa Sensat), composed of teachers, that prepares experiences and observations which can be carried out in the school, during week-ends or in summer. In order to give the necessary formation to teachers, courses and lectures are run in "Summer Schools". On the other hand, since 1988 under the auspices of the "Fundació Caixa de Pensions" there are three portable planetarium model GOTO-Ex-3 with inflatable cupola of 3 or 4m, which are lending to the elementary schools of all Spain.

Secondary Schools. At secondary schools Astronomy is an independent matter, but there are some Universities in Spain that have not any speciality related to Astronomy. Therefore the teaching of Astronomy at secondary schools has only started in some Communities. During the past

years some courses have been developed in order to form teachers in Astronomy for secondary schools and schools have been furnished with telescopes, books, and astronomical material. A lot of teachers of these Communities attended the IVth International Conference related in General Information. It is very important the effort that the local governments of these Communities are doing in favour of the Astronomy education.

University Education. Every year the Spanish Universities, in which Astronomy is imparted, offer different monographic courses related to Astronomy, Astrophysics and Radioastronomy, and students are able to choose some of them according to their future field of work. There are too seminars in which students and teachers take part.

Some students of the doctorate courses attended the XI European Regional Astronomical Meeting of the IAU "New Windows on the Universe" that was held in Tenerife (Canary Island). Teachers of Astronomy at the University have given numerous courses to teachers of primary and secondary schools.

Public Education. The interest in astronomical problems of the general public has been recently renewed following the results obtained by Voyager 2 from Neptune. A lot of people visit the Planetaria and exhibitions offered on monographic topics, on Saturday or Sunday. Lectures on diverse astronomical subjects have been given at civic centres for old people. There are periodic astronomical publications for the general public and some newspapers publish weekly a separate magazine to divulge scientific subjects and particularly Astronomy. There exist in Spain some Astronomical Societies which organize periodical lectures and courses and annual meetings of amateur astronomers. For example, from 12th to 14th October, 1990, the main Spanish Amateur Astronomy Congress (IX National Astronomy Congress) was held in Murcia organised by the "Agrupación Astronómica de la Región Murciana", and the "Sociedad Astronómica de España y América" organized an homage to the Catalan astronomer Comas i Solà on the occasion of the 50th anniversary of his death. This homage was very popular.

ASTRONOMY EDUCATION IN SWEDEN

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General Information. A general background on astronomy education in Sweden at all levels has been published by Sandqvist (1979, in *Stars and Star Systems*, ed. B. E. Westerlund, Astrophysics and Space Science Library 75, p. 235.) Subsequent developments have been described in the triennial reports in the IAU Commission 46 Newsletters. The highlights of the period 1988 - 1990 are the experimental alternative course of studies in computing and astronomy at the secondary school level, the preparations for infiltration of astronomy into university physics curricula through radio astronomy laboratory exercises, and the beginning of the construction of the Swedish omnitheatre which will open in 1992.

Secondary Schools. An optional alternative course in the natural sciences line at a secondary school near Stockholm Observatory is now in full progress. The course "Computing and Astronomy" begins in Grade 11 with three weekly hours of computer programming, examples taken from astronomy, and is followed in Grade 12 by a course in general astronomy, five hours per week for the whole year. In addition, the student undertakes an astronomy project during Grade 12 which takes two hours per week. It is still too early to see what effect this experimental course will have on the recruiting results at the university level. However, about 25% of the students in a class choose the astronomy version of this alternative. Another notable result is that the halls of Stockholm Observatory seem to swarm with high school students every Friday.

University Education. Gothenburg University is continuing its innovative creation of new courses for the non-science students. In addition to the more common courses such as Structure of the Universe and Life in the Universe, the Institute of Astronomy at Gothenburg now offers courses with imaginative topics such as "Science - Science Fiction - Pseudoscience", "Ethnographic Astronomy", "Ancient Technique", "Astronomy in the History of Art" and "Astrology - Astronomy".

Although we have been quite successful in Sweden in reaching general and non-science students with the lure of astronomy, there has been a growing anticipation that we are not getting our fair share of specialised physics students who plan to go on to graduate studies. There is a suspicion that this may be due to the physics students being underexposed to modern astrophysics at the undergraduate level. In collaboration with Onsala Space Observatory we have designed and are building a prototype of a small modern radio astronomy system which will eventually be distributed to six different astronomy and physics institutes throughout Sweden. Each system will consist of a 2.3-m radio telescope, a 21-cm continuum and neutral hydrogen (H I) 32-channel spectral line receiver, personal computer and

hard-copy unit. One aspiration is that all physics students will be exposed to radio astronomy and the Galaxy using this system in laboratory exercises in subjects such as optics, atomic spectroscopy, or dynamics. Some physics institutes are very enthusiastic about trying it out.

Public Education. Although Sweden still does not have a major planetarium or omnitheatre, these concepts displayed a high profile during the last triennial period. The International Planetarium Society held its tenth biennial conference in Borlänge, Sweden in 1990, just in time for the delegates to follow up with a visit to Finland to observe a total solar eclipse. But the Finnish total eclipse was not the only reason for holding this meeting in Sweden. In 1990, the construction of the Swedish omnitheatre began at the National Museum of Natural History in Stockholm. The omnitheatre has a 23-meter 30° tilted dome and a seating capacity of about 300. Omnimax, Digistar and various video projectors will light the way when this omnitheatre finally opens in 1992.

Astronomy Education in Switzerland

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Various activities in the observatories have been pursued during the last three years. Apart from regular education at University level (Zürich, Basel, Bern, Lausanne, Geneva) we mention the following important developments :

University education . Since 1970 the Saas-Fee courses are organized every year by the Swiss Society of Astronomy and Astrophysics. Hundred participants of Doctoral or post-doctoral level attend these courses given by three lectures. The topics of the last four conferences were :

- 1988 Radiation in moving gaseous media (Prof. M. Frizh, R.P. Kudritzki, H.W. Yorke)
- 1989 The Milky Way as a galaxy (Prof. G. Gilmore, I. King, P. van der Kruit).
- 1990 Active galactic nuclei (R. Blandford, N. Netzer, L. Woltjer)

The lectures are published every year and since 1990 edited by Springer-Verlag.

Public education. The Geneva Observatory participated in the preparation and presentation of a public exhibition organized by CERN and ESO at Geneva on the "Macrocosm and microcosm in the Universe" (March to September 1990).

Weekly visits are organized at the Geneva Observatory (1500 participants per year).

Various models in different astrophysical fields are presented in an exhibition room.

Regular training courses for secondary teachers are organized by the Astronomical Institute of the Lausanne University (Prof. B. Hauck and collaborators).

Unfortunately no regular effort is undertaken in Switzerland in the secondary and primary schools to develop astronomy education at these levels.

ASTRONOMY EDUCATION IN THE UNITED KINGDOM

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General Information: The past three years have seen substantial changes in the whole educational system particularly in England and Wales. The situation is still in a state of flux - some would say confusion - but the changes have allowed the reintroduction of Astronomy teaching in schools in a more formal way after decades of neglect. With the establishment of a National Curriculum (but not Scotland and Northern Ireland) and a Science Programme for pupils from 5 to 16 years, with the aim of providing Attainment Targets for given ages, some knowledge of "The Earth in Space" has become a legal requirement for all pupils to have achieved before leaving school at 16. There is some concern that the proposed syllabus and methods of teaching concentrate too much on Astronomy per se which may produce resistance to its introduction; there are those who would like to see Astronomy teaching more in an interdisciplinary rôle.

Much of the groundwork in promoting the cause for teaching astronomy has come from the Association for Astronomy Education (AAE), an organisation formed just over 10 years ago and which now has a membership (mainly school teachers) of about 300. Vetting of materials proposed for use in schools has been done by various bodies including the Education Committee of the Royal Astronomical Society.

In 1990 a National Essay Competition for young people was organised by the Royal Astronomical Society with sponsorship by American Express. The title "Our Place in the Universe" attracted a wide variety of styles and approaches. The winner, Michael Todd (Manchester Grammar School), was awarded the prize of a holiday of one week in the Canary Islands with a night visit to the telescopes (including the William Herschel) at La Palma.

Primary Schools: Project work undertaken in the early school years depends much on the enthusiasms of individual teachers and, in some cases, on the demands of the children. Support of teachers has gained some ground through the establishment of Resource Centres around the country where information, materials, planetariums might be available - not all of them funded by local government, but run by enthusiastic personnel usually on a "spare time" basis.

In 1988/89 the AAE devoted their main efforts to producing a "Primary Teachers' Pack" following drafting, trialling, feedback and vetting. The material was published by the Association for Science Education (ASE) and its distribution since its availability in early 1990 has exceeded all expectations with sales of over 4000.

Secondary Schools: Mention has already been made of the module "The Earth in Space" as being part of the new National Curriculum and through 1989/90 the AAE have been preparing a Teachers' Pack to help with its presentation. It is hoped that this will be published in 1991, again by the ASE.

Concern is felt that many science teachers are not trained to deal with the reintroduction of Astronomy to schools. In anticipating this problem there have been several enterprises to provide in-service training for teachers by running short courses and workshops. Successful events have been a "Training the Trainers" course at the Royal Greenwich Observatory (Cambridge) in December 1990 and workshops for teachers at Birmingham University early in 1991.

University Education: The last three years have seen the virtual demise of all courses leading to a first degree solely in Astronomy. There is no longer any university that boasts an Astronomy Department offering undergraduate teaching. At the same time many of the classical subjects (e.g. celestial mechanics) are no longer taught to any depth as in previous decades. The current courses given as options within Physics or Mathematics reflect the more exciting developments that are occurring in astrophysics and cosmology.

Partly in response to the changes in the school curriculum and to some dissatisfaction with the way that Physics degree work is so intensive, proposals to reorganise the typical syllabus are currently being explored. A basic subject content has been drafted but there are some concerns that this might preclude Astronomy teaching as only basic cosmology is included. However, even if the proposals are accepted fairly widely, there are establishments that will continue in their own directions offering optional courses with substantially more astronomy content such as solar system studies, stellar structure, etc., according to the expertise of the research in their departments.

The Open University (learning at home via TV broadcasts, etc.) continues to flourish. The course on "Matter in the Universe" (8 TV programmes, a video and text of 700 pages) attracts about 500 enrolments each year.

Public Education: A grass-roots group organised a National Astronomy Week from 17 to 24 November, 1990, the previous one being in 1986. Events were promoted throughout the country with various educational establishments and professional stations acting as hosts for exhibitions, lectures, planetarium shows, views through telescopes, etc. Excellent coverage was given through TV, national and local radio and by newspapers. One of the chief themes of the week was to draw the attention of the public to the problems of "pollution" caused by city street lighting.

On a more regular basis, several amateur astronomical organisations continue to support education on the broad front. Some societies, for example, help schools by providing telescope sessions and special lectures sometimes using facilities provided by the local town. The amateur is also served quite well by regular (monthly) TV programmes and there have been several documentaries screened for the scientific community and the layman.

On 16 October 1990, a set of four postage stamps was issued under the general title "British Astronomy". These commemorated the bicentenary of Armagh Observatory and the centenary of the British Astronomical Association. Their widespread use aroused public interest in the subject.

ASTRONOMY EDUCATION IN URUGUAY

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General Information. The teaching of Astronomy has a long tradition in our country. Astronomy is taught at the different educational levels, going from elementary school to the University.

Elementary Schools. Schoolchildren from Grades 1 to 3 pay regular visits to the Montevideo Planetarium, where they are taught elementary notions of Astronomy and learn how to distinguish the brightest stars and main constellations. Schoolchildren from Grades 4 to 6 attend lectures on some specific topics, such as the cause of the seasons, the solar system, etc. The annual attendance at the Montevideo Planetarium is of about 60,000 - 70,000 schoolchildren from all over the country.

Secondary Schools. Uruguay is one of the few countries in the World where Astronomy is included in the national curriculum of secondary education. There are about 70,000 students attending full-year terms on Astronomy every year. Astronomy is included in the Grade 10; this means students attending this course are 15-16. Throughout the term a special emphasis is given to the methods and procedures currently used in scientific research, accompanied by a wide observational program, seeking the development of a critical and analytical mind in the youth. The curriculum intends to show a global view of Astronomy, including historical aspects and the progress in our understanding of the Universe. There are also topics related with cosmology and life in the Universe, trying to induce young minds in the field of scientific and philosophical speculation.

University Education. There is a career in Astronomy within the recently created Faculty of Sciences. The student is granted the title of Licenciado after completing four years of courses plus a short thesis. Students of the careers of Mathematics and Physics can choose optional courses on Celestial Mechanics or Astrophysics. For observational training, University students will very soon have access to a 14-inch Cassegrain telescope to be installed in the neighborhood of Montevideo.

Public Education. The "Agr. Germán Barbato" Planetarium, located on one of the main streets of Montevideo, plays a decisive role in the programs of public education in Astronomy. It was inaugurated in February 1955, being the oldest one in Latin America. It has a large projection room with 320 seats below a 18-m dome. It also has a conference room with 120 seats, an exhibition room and a library. The programs are structured for the different levels, from elementary and secondary education to public sessions. The annual attendance to these different activities is on the order of 80,000-100,000 spectators. The Planetarium also organizes two annual introductory courses in Astronomy, one for children aged 9-14 and the other one for adults.

ASTRONOMY EDUCATION IN THE UNITED STATES

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General Information. Education initiatives for astronomy are being adopted at several levels, with the recognition especially that science education at early teen-age years is crucial not only for affecting future career choice but also for developing scientific literacy among the general population. The decennial survey of astronomy and astrophysics, led this year by John N. Bahcall (National Academy of Sciences Press, 1991), has discussed astronomical education for the first time, indicating a rise in status of education matters. As part of the survey, a panel convened at the National Academy of Sciences to discuss how Federally funded projects should modify their educational goals. Recommendations include providing education functions in all major scientific projects, such as major observatories and space missions. (See Robert A. Brown, ed., *An Education Initiative in Astronomy*, Space Telescope Science Institute, Baltimore, MD 21218, 1990.)

NASA's Astrophysics Division has recognized the need to increase educational programs. A plan to make a videotaped program describing astronomy in the context of new discoveries with the Hubble Space Telescope was delayed by the added work needed to evaluate HST's problems, but is moving forward with a high-level Headquarters appointment in the Astrophysics Division with major duties related to planning educational functions, with my appointment to the Astrophysics Council, and with the resumption of planning for the videotape.

The American Astronomical Society, long known for its concentration on astronomical research rather than education, is showing its new interest in education with the proposal that a major prize in education be awarded at one of the semiannual meetings.

The budget of the National Science Foundation for educational matters is being substantially increased, even at a time when other astronomical funds are falling further behind needs.

Elementary Schools. Project 2061 of the American Association for the Advancement of Science continues to plan a new school curriculum suitable for the 2061 return of Halley's Comet. The project operates within the AAAS independently of the Astronomy Division and other Divisions and without their supervision. A main precept of Project 2061 is that science has no fixed boundaries between fields, and there is the potential that astronomy will be treated only in passing and as basic concepts, with a resulting drop in the role that astronomy plays in school education and a decreased knowledge of specific new advances in astronomy. Some aspects of Project 2061's curriculum are now being field tested.

Astronomy is finding an increasing role in the existing school textbooks, thus bringing new astronomical findings to millions of schoolchildren each year. The participation of professional astronomers in the preparation of some of the material, such as my coauthorship of *Discover Science* (Scott, Foresman and Co., grades K-6), is increasing the timeliness and accuracy of the astronomy treatment.

Secondary Schools. Project STAR (Science Teaching through its Astronomical Roots) is developing high-school-level hands-on materials. STAR is based at the Harvard-Smithsonian Center for Astrophysics (Cambridge, MA 02138) and funded by the National Science Foundation. An activities book, *Where We Are in Time and Space*, is available for \$9 from Learning Technologies, Inc., 590 Walden Street, Cambridge, MA 02140, and a textbook is in a pilot version. 135 teachers nationwide have been trained to conduct workshops or teacher training, as part of projects STAR (for Project Star's materials), SPICA (for astronomy, grades K-12), or ESTEEM (for earth science, grades 6-12).

The Space Telescope Science Institute (3700 San Martin Drive, Baltimore, MD 21218), in cooperation with the Maryland Department of Education, is explaining astronomy and discoveries with the Hubble Space Telescope with a 30-part video series of 15-minute programs, *StarFinder*, for junior-high and high-school students. An accompanying teacher's guide includes activities and projects. For information write *StarFinder*, Maryland Instructional Technology, 11767 Owings Mills Blvd., Owings Mills, MD 21117.

Most astronomy education on the secondary level continues to be in the Earth Science courses, with some content in the Physical Science courses. These courses are commonly taken on the 8th and 9th grade levels, respectively. New textbooks incorporate recent astronomical studies.

University Education. Most university and college students taking astronomy in the U.S. do so in non-mathematical introductory survey courses, for which new textbooks continue to be produced and updated. The latest versions are usually in full color and incorporate results from the Hubble Space Telescope, Voyager at Neptune, Magellan at Venus, etc.

The National Science Foundation provides support for undergraduate education through such programs as *Research in Undergraduate Institutions* to expose undergraduates to astronomy research. An *Instructional and Laboratory Improvement Program* in the education division provides matching funds for telescopes and other equipment.

A grant from the Keck Foundation to 8 colleges provides CCD's and computer workstations, plus technician and workshop support, to involve students in modern electronic data taking and data reduction. The student papers from the first summer's operation have been published (Keck Northeast Astronomy Consortium Workshop, c/o Whitin Observatory, Wellesley College, Wellesley, MA 02181).

The National Undergraduate Research Observatory (NURO) uses a 0.8-m telescope of the Lowell Observatory for undergraduate projects. (For information contact NURO, Northern Arizona U., Flagstaff, AZ 86011.)

The Consortium for Undergraduate Research and Education in Astronomy (CUREA) is the undergraduate education arm of the Mt. Wilson Observatory. It is holding summer institutes using the Snow solar telescope. (For information contact CUREA, Physics Department, Oberlin Col., Oberlin, OH 44074.) It hopes to use the nighttime telescopes as well.

Public Education. Public interest in planetariums remains high. A new Christa McAuliffe Planetarium opened in Concord, NH, and new projectors were installed at the Franklin Institute in Philadelphia (with an OMNI theatre), at the Griffith Observatory in Los Angeles, and elsewhere.

A public television series, *The Astronomers*, has been completed.

ASTRONOMY EDUCATION IN THE USSR

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General Information. General educational system in the USSR is in the state of great expectations and modifications following the political, economical and psychological changes in the country. In 1988 the two educational ministries (school and university) were closed. Instead the All-Union Committee for Public Education (ACPE) was established. Its advantage is evident: it makes it possible to coordinate all levels of education. Unfortunately this advantage has not been realized as yet. In fact the two old systems were formally combined into a symbiotic institution. But the republic ministries of education obtained much more freedom to organize local educational institutions. Now schools as well as universities can choose their own profile, curricula and programs. All levels of astronomical education are being taken care of by the CTAP - Council for Training of the Astronomical Personnel. Its authority has increased because of direct submitting to the Academy of Sciences Presidium. An other important event is the foundation in 1990 the Astronomical Society of the USSR. In contrast to well known AAGO (All-Union Astronomical Geodesic Society, which is partially amateur) the AS is pure professional. In the frame of this new society there is a Commission on Astronomical Education. The purpose of the Commission is to provide astronomical teaching aid for professors in schools, institutes and universities.

Elementary schools. Astronomical topics are successfully used to stimulate natural curiosity of children of preschool and early school age. A lot of astronomical books for children are written by E. Levitan. Some of them are translated into many foreign languages. The beginnings of Astronomy are still taught in Nature History of 9-10 age. Also in recent years there is a tendency to integrate all natural subjects (including physics, geography and biology) into a large course of Natural Science. A lot of new material is supposed to be involved. That means that the Astronomical sections certainly will be dispersed, shortened and simplified. Only they may be more humanitarian in character (Cf. - E.P. Levitan, *Astronomie in der Schule*, No 3, 1990).

Secondary Schools. Economical and financial difficulties together with the deficiency of good teachers as a rule does not permit to take the advantage of the school system decentralization. To help the situation CTAP initiated the foundation of a special Council of Teaching Science and Methods in Astronomy in the frame of ACPE. We hope this Council will have the opportunity of influencing significantly the whole system of astronomical education. In recent years there occurs a differentiation the secondary schools into gymnasiums, lyceums, specialized schools even in astronomy. Now in the upper, 11 form, astronomy generally is still a separate subject when and where it is possible and found reasonable at all. The innovation is a conversion of some graduation exams into optional astronomy included. A special questionnaire was published in 1990. Some school graduates prefer a compact course of astronomy to others. The exams showed good results. Meanwhile the tendency of integration is going on in spite of its evident disadvantage and even threat for astronomy. The integrated course of physics and astronomy is under development. Also the experimental textbooks mentioned in our previous report are accepted for revised edition. New

teaching aids for school astronomy continue to appear. The last two years the experimental course in Physics of the Cosmos has been carried on in Kaluga. This is an attempt to integrate Physics and Astronomy. This course is supported by two others: Celestial Mechanics and History of Cosmonautics.

Pedagogical Institutes. Education of teachers is the most important point in the whole system of education. The fate of astronomy largely depends upon it. In this respect it should be emphasized that for the time being the ten pedagogical institutes of the country have in their curricula the specialization of a teacher of physics and astronomy. The program incorporates about 500 hours of teaching time for astronomy and a lot of time for cosmonautics.

University Education. The chief item of CTAP activity is the training of professional astronomers. For the time being over ten universities of the country graduate about 100 astronomers (mostly astrophysics) per year. CTAP managed to obtain the right for these universities to improve and adapt their curricula and programs to suit the local needs and interests of a given university. The most important privilege is the earliest possible teaching of astronomy. Special attention is paid to the doctorate. Also very important is the help to the young astronomers in observational programs. Famous Crimean summer schools has become a good tradition. Also winter schools in Kurovka near Sverdlovsk are very popular among students and young astronomers.

Public Education. A new public Astronomical Observatory of Moscow Planetarium was inaugurated in 1990. The planetarium has got new expositions: the 1.5 meter martian globe based on american atlas of the planet (courtesy of Louis Friedman from International Planetarium Society) and the model of Voyager. On February, 5, 1991 the new building of Vilna Planetarium was opened in order to use the advantages of middle size Zeiss apparatus. Kiev Planetarium owns the great Zeiss apparatus and has also got a new house last year. Moscow and Leningrad planetariums participated to Borlang Conference of International Planetarium Society.

Astronomy Education in the Vatican State

M.F. McCarthy

Specola Vaticana, Castelgandolfo

In 1988, the Second Vatican Summer School for young persons ready to begin graduate studies in astronomy and astrophysics was held at Castel Gandolfo. A report on activities is published in "Teaching of Astronomy" IAU Colloquium N° 105 ed. J.M. Pasachoff and J.R. Percy, p. 408-413. In 1990, the Third Vatican Observatory Summer School hosted another 25 young scholars and has been described in Vat. Obs. Publications Vol. 3, N° 1, p. 2, 1991.

In July 1-20 1991, the Vatican Observatory is offering a special educational workshop for Bishops at Castel Gandolfo. This workshop will mark the 100th Anniversary of the Specola's existence as a formal branch of the Vatican and will offer instruction on "Galileo" and on "Galaxies".

The following Professors will assist at the Workshop : E. McMullin, R. Blackwell, O. Pedersen, R. Westfall, F. Sullivan, E. Carreira, W. Stoeger, M. Heller, F. Bertola, J. Casanovas and M. Hoskin. M. McCarthy will be Academic Dean and G. Coyne Director of the Workshop.

ASTRONOMY EDUCATION IN YUGOSLAVIA

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General Information. Astronomy education in Yugoslavia follows pattern of the education in general: it is a subject upon which each republic (6 republics altogether) decides independently.

Elementary schools. Elementary school is a compulsory eight years school. Selected astronomical topics are taught in elementary schools within the course named "Nature and Society" (IV year), within geography (V) and within physics (later than VI). Details can vary from one republic to the other.

Secondary schools. Secondary school is not a compulsory one. There is a large variety of types of secondary schools. Some of them are very specialized, preparing pupils for the work. The reformation of the system of education is on the way in Yugoslavia. Therefore, there exists, at the present time, in majority of republics, two systems: the old one which is applied to pupils registered by the old law and the new one for the new generations. In the new system majority of better pupils is likely to choose "gimnazija". In Serbia, "gimnazija" type schools are 27 percents of the total number of secondary schools. Astronomy will be taught only in "gimnazija" type of schools. It lasts four years.

Astronomy is taught now in secondary schools oriented to natural sciences. Astronomy is not a separate course there; it is incorporated partly in geography and mainly in physics, except in the republic of Serbia where astronomy is taught now as a separate course, in the last year of the secondary schools inclined to natural sciences, with two hours per week. Such a situation in Serbia has been lasting for about two decades.

The law which was passed in Serbia in 1990, introduced "gimnazija" and placed astronomy within "gimnazija" into the last year of physics. Number of lessons depends on a model. There are 2 models:

I model. (General type) *II model.* *a.* Natural sciences and mathematics oriented type, *b.* Social sciences and languages oriented type.

In the type *I* and *IIb* astronomy is included in physics, in the last year, with 10 hours of lessons. In the type *IIa* astronomy is also included in the last year physics but with 35 hours. Both models allow to schools to organize astronomy course as a separate voluntary course, in the last year, with 70 hours. The course is voluntary in the sense that it represents an extra course which, once chosen, has to be followed by a pupil till the end. Astronomy will be taught according to this law starting from 1993.

There are also specialized schools designed for mathematically talented pupils. Astronomy is taught as a separate course with two hours weekly, in "mathe-

matichka gimnazija" in Beograd (Serbia) as a compulsory course, and in the "Mathematical-informatical center" in Zagreb (Croatia) as a voluntary course.

University Education. There are 19 universities in Yugoslavia.

The University of Beograd is the only one which has astronomy as a study group. It has two divisions:

1. Astrophysical department which has a study program containing many courses in physics, two courses in mathematics, some general courses: such as foreign languages, pedagogy etc. and the following astronomical courses: general astrophysics (I year), general astronomy (II), practical astrophysics (III), reduction of astronomical observations (III), theoretical astrophysics (IV), structure and evolution of stars (IV), radio astronomy (IV), stellar astronomy (IV), methods of teaching astronomy and history of astronomy (IV). Graduated astrophysicist has a right to teach astronomy and physics in secondary schools.

2. Astronomical department has a study program which contains a lot of mathematical courses particularly those related to programming, some general courses (as in the astrophysical department) and the following astronomical courses: general astrophysics (II), general astronomy (I), positional astronomy (II), practical astronomy (III), reduction of astronomical data (III), theoretical mechanics (III), ephemerid astronomy (IV), theoretical astronomy (IV), celestial mechanics and the motion of artificial satellites (IV), and stellar systems (IV). Graduated astronomers obtained in 1990 the right to teach mathematics in secondary schools. They have right to teach astronomy too, but by the new education law they will have to be engaged to teach astronomical part in the course of physics.

The undergraduate studies last four years. The average number of graduations is 3-5 per year.

There are 4 divisions on postgraduate studies at the University of Beograd:

1. Positional astronomy, 2. Astronomy and celestial mechanics, 3. Stellar astronomy, 4. Astrophysics.

The average number of the students which finish postgraduate studies is about one per year.

There is also one semester course of basics of astrophysics (III) for students of the teaching branch on the Faculty of Physics and geodetic astronomy (IV) at the Civil Engineering Faculty in Beograd.

There are four universities in Croatia which have a compulsory course of "astronomy and astrophysics" within the teaching branch of mathematics and physics (Zagreb, Osijek, Split and Rijeka). It is one semester course, on the third year of studies. Such a course is taught on the teaching branch of chemistry and physical chemistry as a compulsory course and on the engineering branch of physics as a voluntary course, at the University of Zagreb. There is a two year course of geodetic astronomy (III and IV) at the Geodetic Faculty in Zagreb. Courses of solar physics and stellar physics are taught on the postgraduate studies of atomic and molecular physics in Zagreb.

The University of Ljubljana (Slovenia) has at the Department of Physics

a branch for astronomy and geophysics. There are the following astronomical courses: astronomy (one semester in the II year and two semesters in the III year), astrophysics (IV), introduction to astronomical observations (I), astronomical observations (exercises, IV) and astronomical practicum (one semester, in the II year). There are also: the course of higher geodesy with geodetic astronomy (one semester of lectures and one semester of exercises on the third year) and the course of geodetic astronomy with satellite geodesy (one semester on the fourth year), at the Faculty for Architecture, Civil Engineering and Geodesy, at the University of Ljubljana.

Astronomy is taught at the University of Sarajevo (Bosnia and Hercegovina) through the following courses: one semester astrophysics (IV) at the Department of Physics (III), as a voluntary course, and geodetic astronomy at the Faculty for Civil Engineering (IV).

There is one semester course of astronomy and astrophysics on the third year of studies of physics, teaching branch, at the University of Skopje (Macedonia).

Elements of astronomy are taught within mathematical geography, although not always in a modern way, on the most of universities in Yugoslavia. University of Sarajevo has more astronomy in geography than at others Universities.

Public Education. Public astronomy education in Yugoslavia is done by lectures at Popular Universities, on Radio and TV programs, in popular journals and books, in Planetariums, in Popular Observatories and numerous Amateur Astronomical Societies (almost 20 of them).

A long tradition in organization of lectures on recent discoveries in astronomy has Kolarchev Popular University in Beograd. Particularly active institutions in public education are the Astronomical Society "Rudjer Boshkovich" in Beograd, the Croatian Society for Natural Sciences in Zagreb, the University Astronomical Society in Sarajevo, Amateur Astronomical Society Visnjan in Vishnjan (Croatia) and Astronomical Society Javornik in Ljubljana.

There are four civil planetariums in Yugoslavia (Beograd, Zagreb, Ljubljana and Skopje). The Planetarium in Beograd works mainly with schools while the others work for general public mainly. All planetariums are small Carl Zeiss (Jena) instruments.

An interesting form of astronomical education are courses and summer schools for pupils interested in astronomy. The Youth Research Station in Petnica (Serbia) organizes 4 courses every year. The first course is an introductory one, the second course is introduction into practical work, the third course is devoted to small research projects and in the fourth one the projects are finalized. It starts with 50 candidates, number decreasing later to few best participants. Very good summer school is held by the organization "Nauku mladima" (Science to the Youth) of Croatia on the island Prvich, already for many years. The Union of Astronomical Societies of Croatia organizes thematic astronomical campings while the Astronomical Society "Rudjer Boshkovich" organizes yearly Belgrade Astronomical Weekend, with lectures and observations.

There are also some other forms for teaching of astronomy in Yugoslavia.

One of them is the regular yearly competition of pupils in astronomical projects within the organization "Nauku mladima". The projects are chosen by pupils while the examining committee consists of professional astronomers.