Teaching of Astronomy in Asian-Pacific Region

Bulletin No.19

The Special Issue
on Astronomy Education in Europe
carried out
in the European Astronomical Society out
edited by Magda Stavinschi

Mitaka Tokyo Japan
2003.11.15 -- 1,800 --

Contents

JENAM-2003

Budapest, Hungary, 26 August 2003

Special Session

ASTRONOMY EDUCATION IN EUROPE

The European Astronomical Society aimed to contribute to and promote the advancement of astronomy, in its broadest sense, in Europe, by all suitable means and in particular:
a) by providing an independent forum for the discussion of subjects of common interest;
b) by providing means whereby action can be taken on those matters which appear desirable to be handled at the European level.

One of the subjects of common interest is the astronomy education. More and more it becomes a problem in the world, taking into account its absence in most of the curricula of different countries, an unprecedented proliferation of astrology and other pseudosciences, and the stronger role of the mass media and internet in spreading scientific information.

All these determined the IAU to adopt during its last General Assembly at Sydney a special Resolution and the EAS to organize for the first time a special session on the same topic. It was opened by prof. Syuzo Isobe, the former chair of the IAU Commission 46. Many communications (oral or posters) from Bulgaria, Germany, Greece, Hungary, Romania, Russia, Spain, and even from USA were presented. They concern the education at different levels in the primary, secondary schools or university, as well as the role of the planetariums or mass media for the astronomy education.

The Proceedings are published by the kindness support of prof. Syuzo Isobe.

Magda Stavinschi

Scientific Organizing Committee:

Bernhard Mackowiak (ESO)
Magda Stavinschi (Romania)
Gabor Szécsényi-Nagy (Hungary)

Major Topics:

Astronomy before School
Astronomy in the School Curriculum - Where and What?
Astronomy Education of Teachers
Astronomy Education Research
Internet Astronomy Education
Public Astronomy Education
Mass Media and the Astronomy Education

PROGRAM

Tuesday, August 26

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A NOTE OF JAPANESE EDUCATIONAL SYSTEM RERATING TO ASTRONOMY

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Abstract: A short history of the Japanese educational System relating to sciences is shown and what problems should be considered is briefly presented.

1. IAU activities

The international Astronomical Union established the Commission 46, Teaching of Astronomy in 1967 which was reorganized to the Astronomical Education and Development in 2000. Now, it has 9 Program Groups, all of which cover most of the level in astronomical education and cooperate dynamically each other under presidentship shown in table 1.

Table 1. The List of Past Presidents of C46.

1967 —1970	E. Schatzman	France
1970 —1973	E. A. Muller	Switzerland
1973 —1976	D. McNally	UK
1976 —1979	E. Kononovitch	USSR
1979 —1982	D. G. Wentzel	USA
1982 —1985	L. Houziaux	Belgium
1985 —1988	C. Iwanizsewsoka	Poland
1988 —1991	Aa. Sanqvist	Sweden
1991 —1994	L. Gouguenheim	France
1994 —1997	J. Percy	Canada
1997 —2000	J. Fiero	Mexico
2000 —2003	S. Isobe	Japan
2003 —2006	J. Pasachoff	USA

However, there is one field which the Commission 46 does not cover, that is, astronomical education for school pupils. We realize that point and expect some number of active people will try to set a new program group. At the 25th General Assembly held in Sydney, July 2003, we held a symposium and those proceeding of "Effective Teaching and learning of Astronomy" will be published by the Cambridge University Press, where you can find detail description on the commission 46.

2. A short history of Japanese education system related to Science

Japanese public education started in 1872 after 5 years from the date when Tokugawa Shogun's military government was collapsed. Sciences were taught in two categories of physical science and natural science. That system was mostly kept by the time of US occupation after the Second World War. The new system requested by US government was set in 1947 and sciences were taught 4 hours per week for junior high school and 5 hours per week for senior high school. These numbers of school hour were good enough to school pupils. All the school pupils had to study upto the junior high school obligatorily, but only half of pupils could go to the senior high school (figure 1). Sciences were divided into four courses, that are, physics, chemistry, biology, and earth sciences. Originally, it was thought that astronomy would be a part of physical science but it had been within natural sciences, and therefore, finally it belonged to earth sciences.

Meantime by 1968, sciences were well taught. However, over 70 to 80 percents of all the school pupils became to study at the senior high schools and a certain fraction of pupils

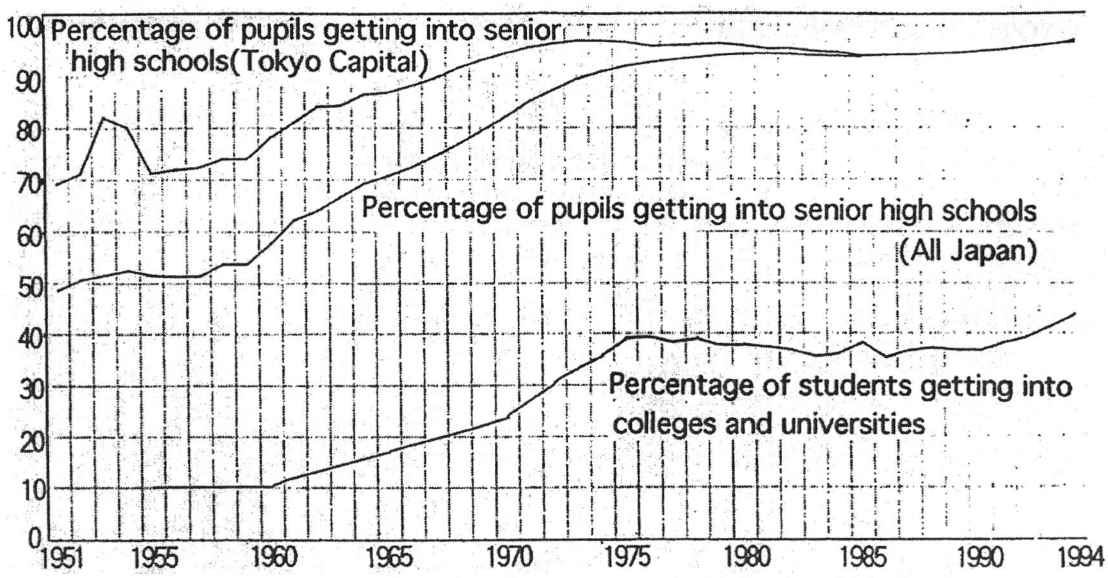

Fig. 1. Percentage number of students to go to the higher level of schools.

could not follow the existing courses and there were re-arrangement of science courses in 1968 and a new course of "fundamental sciences" was created.

Because of Japanese economic development, most of the parents wanted to send their children to the senior high schools and also to universities. In 1974, the percentage went over 90% and the further request to have much easy understandable science courses and in 1987 it was again introduced new science courses of "Science I" and "Science II". However, unfortunatry, although these new courses covered all the science field, but those were not integrated. Therefore, each part of the courses were taught by teachers of physics, chemistry, biology, and earth science, separately. This brought a tendency that teachers just taught without much concern of school pupils' understandings.

This problem was realized soon after a trial in schools and in 1994 a new course was introduced, namely "Integrated science". Although its name has "integrated", there was not much difference of problems for the case before 1994. Moreover, to give much school hours for Japanese language and English study, school hours for science courses were cut down to 3 hours per week for junior high school and 2 hours per week for senior high school as a minimum request.

From 2003, school days per week was cut from 6 days to 5 days and therefore school hours for different courses especially for science courses, had to be shortened again. When this new curriculum was proposed by the Minister of Education (, Culture, Sports, Sciences and Technology which has an ahronium of MEXT and Sciences are one of X categories) they requested to teach the minimum scientific concepts. However, reflecting of much complainment from many parents, the Minister now say that this is the minimum level and school teacher can teach further developed concept depending on ability of school pupils.

Now, we should consider and discuss what points are missing in the governmental educational concepts.

3. Differences of human-ability

It is natural that individual personal has different interest. Isobe (1991) showed a pyramid structure of different levels of Japanese people's interest in science, in particular, astronomy. Only small fractions of people are interesting in astronomy and science.

It is also true that individual personal has different ability as shown in figure 2. One my have a good ability to music while his ability may not good for science. There are cases of different ability pattern for different individuals. After the Second World War people have been given equal right and then it has been thought that all the pupils have a right to teach with same level of textbook. There was no consideration that individual pupil has different ability and then it happened that some pupils could not follow their curriculum. I believe this is a main cause to create pupils' dislike of science (and also the other curriculum).

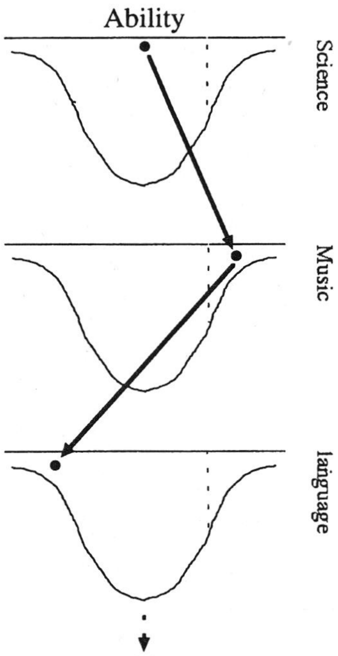

Fig. 2 Each pupil has different ability.

It is clear that if one has a good ability of science and is interested in science he can easily follow. Under that point of view, the current school curriculum are good and make him study extensively. What we should consider is for school pupils who have not good ability for specific course. It is clear that those pupils can not understand what they are taught in class room ever if they are taught with good curriculum for extensive study. That makes them just dislike that curriculum in our case science.

4. Real integrated science

In the far-past, one could live without much knowledge of sciences. However, in these times one's activities are not affect only to local environment but also to global problems. To know what link is there between one's activities and global problems it is essential to have some knowledge of sciences to all the people. And also in these several decades scientific and engineering developments have been extensively carried out and some of them have been brought in school curriculums. This situation is good for teachers and pupils with enough scientific ability, but most of the teachers and pupils have difficulties to understand them and start to escape from those new scientific and engineering items. However, those are sometimes tightly connecting with daily activities, and also are necessary to understand global environmental problems.

Abilities of school pupils are widely scattered, and if one chooses a specific pupil he has a high ability for a curriculum but a low or medium ability for the others. For pupils with a high scientific ability a systematic scientific curriculum should be taught. To understand relations of scientific items with daily activities and global environmental problems, all the pupils should study scientific stories including different scientific fields as well as items of the other curriculum.

If pupils with medium or lower levels of a scientific ability are taught each scientific items individually, they can not obtain any ideas that each item has any relation with the other items, and some years later they totally forget them.

Here, I will show several examples, each of which has different contents of physics, chemistry, biology, and earth sciences in table 2 as for examples. When we apply curriculums with stories, we have to prepare nearly 100 different stories. The contents of table 1 are also applicable for the elementary and secondary school, but levels of those stories should be different.

One may say that some contents of table 2 are not applicable to the elementary school curriculum, for example, "nuclear fusion". However, although the elementary school pupils may not understand its physical processes, the word "nuclear fusion" can be seen in comic books for children, Therefore the pupils can accept the content if one can include its word in a proper story.

Finally, I strongly recommend that scientific items included within stories will be taught not only in the elementary schools but also in the secondary schools.

Table 2. Some examples of stories containing some items of physics, chemistry, biology, and earth science.

		Physics	Chemistry	Biology	Earth Science
quality and amount	Multi-phases of material	Effect of T and P	Chemical reaction	Growth of animal	Phase change of stone
	Feature of earth	Effect of gravity	Compositions of atmosphere	Necessary condition for life	Earth is one of celestial bodies
fundamental	Circulation of atoms	Nuclear fusion	Chemical character of each atom	Circulation of living life	Formation of stars and Sun
	Solar radiation	Light spectrum	Chemical reaction for materials	Light effect to life	Climate change
nature	Water flow	Evaporation	Chemical inclusion	Water for life	Erosion
	Dinosaurs	Areas and volume	Explosion energy	Evolution of life	Asteroid

Reference:

Isobe, S. 1991, Proposed Structure of Education in Astronomy, Proceedings of Astronomical Society of Australia, volume 9, 72-75.

THE IMPORTANT ROLE OF PUBLIC ASTRONOMY EDUCATION FOR SOCIETY AND MASS MEDIA AND THE ASTRONOMY EDUCATION

Bernhard Mackowiak
ESO EPR Department

AND

FUTURE ESO - RELATED PROJECTS - INCLUDING ALMA – AND THEIR ROLE FOR ASTRONOMY EDUCATION

Dr. Richard West
ESO EPR Department

Aims of this talk:

Astronomy has become a part of our life. New telescopes, like VLT, new satellites and discoveries made with these high-tech facilities fascinate most people. But how we are able to bring our knowledge to them? A very important roles are played the planetaria, by the press and the radio stations. The author will speak about his working experience, both at the Berlin planetarium and as an author of broadcast programs and science pages in two widely circulated German newspapers.

VLT is the most fascinating telescope of today, and ALMA is a most fascinating, very ambitious international project of the future. It is very important to stimulate the interest of the public, and especially of the young generation, for such frontline projects and tell them how they function and what are their goals, also because they are the people who finance them. Moreover, it is important to inform young people that they really want and are capable of becoming an astronomer, they have a chance to realize their dreams and to work with these telescopes at the absolute front-line of contemporary science. But which methods, which media, must be used to achieve the best possible communicative effects and really get the message across?

1. Why (modern) astronomy today is a part of our life?

There is no doubt and everybody knows it: astronomy is one of the oldest and at the same time one of the modern and actual sciences. In former times most of the people saw astronomy as an eccentric and useless occupation with things which have nothing to do with the everyday life. The German painter Carl Spitzweg has shown it with his picture the stargazer. On a platform of a castle tower a aristocratic man is fascinating and astonished looking through a telescope in the dark and clear sky, accompanied by an old droll man. In reality astronomy never was a tranquil and for the everyday life useless profession. Calendar and orientation especially navigation are the basics of our culture and civilization and if people want to practice them they must observe the stars.

But since the age of space exploration has started and brought high events like the first landing of men on the moon the automatic unmanned landings on Mars by VIKING or PATHFINDER which has shown exotic landscapes and topographic shapes, like the volcano Olympus Mons or the missions of VOYAGER-space probes and their explorations of the giant planets Jupiter, Saturn, Uranus and Neptun and their fascinating satellite systems the important rule of astronomy has been aware to larger part of the public.

Astronomy and its neighboring sciences are growing more than very explosive today since we have the Hubble space telescope and the VLT and since we have the internet. This global communication system makes it possible for everybody to load down the latest and fascinates pictures to read the latest reports and news about the latest discoveries.

The interconnection of astronomy with neighboring sciences like physics, meteorology, earth sciences and techniques is more and more clear for everyone. Instruments which has been developed to support the work of astronomers like CCDs you can find in commercial cameras. The exploration of the other planets in the solar system - especially Venus and Mars - has shown that our planet Earth is a common member, it had in the beginning the same evolution and history but in later times our blue planet has gone its own way.

A lot of reasons for that we know, but there also a big number of questions exists, which we have to answer in future - for example: how life has come to Earth and how it has evolved? Why planet Venus is a world without life? Has the evolution of life had a chance on planet Mars? Is the Jupiter moon Europa with its oceans below the icy crust a stronghold of life? Does worlds like Earth exsist beyond the solar system? Does extraterrestrial life exsist on their surfaces?

Another reason for our feeling that astronomy has become a part of our modern life is our Sun, the nearest star to us. Already the ancient people know how life depends from the shining of the Sun. In our time we know well a lot of kinds of solar influence, which is founded upon the various forms of activities on or near the solar surface. The most important and visible phenomena are sunspots and flares. If they appear experts know that the Sun emits a high rate of charged particles, which will be attract by the Earth's magnetic field.

Here they not only produce at the polar regions the auroras, they are also able to disturb, to disrupt the work of communication satellites or to damage them. In the electricity network a giant break down can happen produced by GICs (Geomagnetic Inducted Currents) - like 1989 in the Canadian province of Quebec but not two weeks ago in New York. The accidents of these events happened 9 month later. These phenomenon - called *space weather* - will be more and important for our daily life.

Last no least: The science fiction. During the time of the race to the moon this kind of literature and films has experienced an explosive evolution which is not only caused by the real events of space travel and space exploration; it is also caused by the evolution of computerized trick technology: „Star Treck", „A space odyssey" may be only two examples for the numerous films and stories of this genre. They bring a lot of astronomical words to the common people, make them public. Kids easily talk about light-years like kilometers and black holes or supernovae like Tour de France or the races of Michael Schumacher and his Formula 1.

And virtual reality shows in science centers or parks like Disney World also in Imex-cinemas and planetaria are able to present astronomical facts, events in a clear vivic and impressive way.

More and more astronomy institutions have seen these facts and this trend, because they know that without sympathy and support of the broad public, they have a lot of difficulties to get money for their ambitious projects. So a lot of these institutions and administrations have founded PR-departments and special home pages on the web. Scientists give talks and interviews for radiostations, write popular books over astronomical themes or work together with science journalists.

But more and more they see that to write about astronomical facts and phenomena is not sufficient enough. *It is necessary to build up an continuous interest in this field of science which will be constant the whole life. Because young people in future not only shell support astronomy with sympathy and money they also shell work in this field of science.* And this ambitious aim only can be realized by public or general astronomical education!

2. What is astronomical education (a definition)?

A definition in *Oxford Learner's Advance Dictionary* says: „Education is a process of teaching, training and learning, especially in schools or colleges, to improve knowledge and develop skills." I want to add: „and so to influence and change the behavior of a person in a way that I want of which I think that it is the right and the best for the educate person."

But we are talking about a special kind of education namely Public Astronomy Education. That means: *a general education of the mass for all scientific fields and aspects of astronomy!* That is our process of teaching, training and learning.

3. Which are the objectives or intentions or aims of general astronomical education?

The fundamental aim is to arouse a livelong interest in astronomy and its current developments and by this way to show that astronomy is an important part because it is a fundamental thing of our daily live. Astronomy is a section of general education. That means exactly: to teach fundamental/basic knowledge of astronomical facts - for example like:

We are living in a planetary system with one star, nine planets and a lot of moons, our solar system is part of a spiral-shaped galaxy, called the Milky Way with 200 Billion stars, gaseous clouds and clusters of stars.
The Sun is the nearest star to us - a violent, spinning ball of hot, luminous gas. The gases are held together by gravity and the Sun gets its energy by „burning" its gases not like coal, but it is a more efficient reaction called nuclear fusion.
Planets like Earth orbits the Sun and shines only by reflected light.

Astronomy now is not any more a science of the night and a science of optical and radio telescopes. It is a science of all wave lengths of the electromagnetic spectrum and can practiced also during daytime. Its tools are apart from telescopes satellites, computers and CCDs.

The five-meter-mirror of the Mount-Palomar-telescope is not any more the largest telescope of the world. Astronomers are working with other giant telescopes for like the VLT or the Keck-telescopes.

Astronomy is first of all physics and not spherical astronomy.

Which special skills we have to improve?

Everybody should be able to know how to handle potential sources of astronomical informations, for example encyclopedia, mass media - like newspapers, radio, tv, special magazines - and chiefly the web with its numerous homepages of astronomical institutes, like observatories of the universities, planetaria, amateur observatories, astronomical unions and the search machines like google.

Everybody should be able to use a telescope or a binocular for simple astronomical observations and know that sun observation is very dangerous.

Everybody should be able to orientate himself in the sky.

4. How we are able to bring our knowledge to them?

Before we discuss and try to answer this topic, we have to answer the question, who are the persons which have to bring this special knowledge into the public? A simple and general answer is. Everybody who has a special knowledge, because he is a specialist or a hobby astronomer and he has the ability to teach it. That can be a scientist, a teacher, a journalist or another person, who is an amateur astronomer.

The ideal person is a teacher, because he not only disposes of the expertise he also disposes over the special didactical and methodical informations and techniques. And he works at a place where teaching and education is the main task: the school. But schools not only have the task to interest young people and so the following generation in astronomy by laying the foundations the also have to prepare the next steps of preoccupation with this field of science that people can work on it as an amateur or specialist. So it is very important that astronomical education has a special place in the curriculum.

A journalist has the advantage that he is working on a wide field and he can bring his informations to a broad mass of the people by using the different kinds of mass media. His work has a bigger broad effect.

The effect of the educational work of scientist is given by the fact that he is a specialist and so journalists use these persons as source to get correct and authentic informations. Newspapers, journals and publishers often give professional astronomers the chance to write reports, stories or books, tv- and radio stations for creating features. But a high specialist must no be a good didactician - that is the critical point.

And what's about engaged amateur astronomers? General they have little chances the work public for general astronomical education, when we speak about using mass media. They must have great luck to get the chance to write a report, article or feature for a newspaper, magazine, radio or tv-station. The have to be at the right time at the right place if they want to do it. But they don't should hesitate to offer their cooperation to the editors.

And not every amateur astronomer is a writer or want to became a writer. Most of them want to give their enthusiasm and engagement for astronomy by working as lecturer in a planetarium or amateur observatory, which we call in German „Volkssternwarte". These people are the real troops of general astronomical education! And some amateur astronomer has become a professional. One of the famous was William Herschel.

5. Why does new telescopes like VLT new satellites and the discoveries made with them, as well as future astronomical projects like ALMA and OWL fascinate most people? How will ESO endeavor to present these projects to the broad public?

There is a simple answer for this question: New telescopes, new satellites like Hubble or in former times VIKING, PATHFINDER, ROSAT, GALILEO and actual CASSINI or future projects like ALMA and OWL are due to their ambitious aims of their missions spectacular projects.

People hope that these projects are in the position or give the possibility to answer some of the fundamental questions, for example:
Does extraterrestrial life exist?
What is the detailed character of the other planets and moons in our solar system?
What is the detailed process of the birth and future of the Universe, what is its history and evolution?

Everybody knows that these projects can not give a final answer. They are only able to give them stepwise and this is the reason why science is a dramatic, exiting, thrilling thing and that's the reason why scientists hope to get money for this in future. But to get it, they have to make a good PR-work and by this way to give a lot of inputs for the general astronomical education. NASA with Hubble has seen it first and produced interesting fascinating websites, ESA and ESO has followed. They founded not only PR-departments, they also founded education departments. ESO since 2001. On purpose ESO's special department is called „Education and Public Relation Department“. ESO has seen that a good and efficient PR cannot exist without education. Between both fields exist a close interrelation.

What is the character of ALMA and OWL? Which are the Educational Initiatives? I will answer this question with some thoughts of Dr. Richard West, who is really sorry that he cannot be here. But please pay attention, that these are very early thoughts and also that even though the ideas are there, there is still some way to realization:

ALMA and OWL – EDUCATIONAL INITIATIVES

Some provisional thoughts by Dr. Richard West

Introduction

ESO's main project during the past two decades, the Very Large Telescope (VLT) at Paranal, with the associated facilities (VLT Interferometer, VLT Survey Telescope, VISTA) is nearing completion. Observations have been ongoing since 1998 and many new research projects have already been completed, with an extremely rich harvest of new discoveries and much new knowledge.

As is common in astronomy, new projects arise as technology progresses and opens new opportunities. ESO is now involved in two new ventures: the European/Northamerican Atacama Large Millimeter Array (ALMA), for which the construction phase has just started, and the OWL extremely large (possibly 100-m diameter) optical/infrared telescope, still in the study phase. ALMA is expected to be ready in 2011 at the 5-km high Chajnantor site in the Chilean Atacama desert; a decision about OWL may be taken within a few years – no site has yet been selected.

Both of these projects have great educational potential. Both represent the foremost front-line of human exploration and the summit of modern technology. Both can only be realized through a broad international co-operation, involving scientists and engineers from many countries. Both will step into new and unexplored territories and will deliver insights into exciting areas of modern research. Both are concerned with some of the deepest philosophical questions posed by mankind, i.e. our origins and position in the Universe. And both are the results of a continuing quest for knowledge with ever-more sensitive instruments that dates back to Stonehenge and other historical observatories, demonstrating a never-ending, fundamental human urge to learn more about the world in which we live.

Education opportunities

There are thus plenty of basic aspects of these projects that have a great educational potential. Both will be accompanied by suitable public communication as they progress, some of which could be advantageously exploited in school education, especially at the secondary level. However, it is obvious that a much more dedicated educational effort is desirable, indeed necessary. It would be a great pity not to use this opportunity as it now presents itself.

Since some time, all new research facilities launched by NASA have been accompanied by educational initiatives – a quick glance at the corresponding websites will convince that these represent large and highly professional efforts. The advantages are obvious, to convey a message to the young generation of progress, both in technology and science, and to stimulate teachers to introduce more modern material and means into otherwise rather dry curricula. An important effect of this initiative, undertaken with great enthusiasm since 10-15 years, has been to inform the young public and their parents about the ongoing work at NASA and the associated institutions, industries and organizations. Similar efforts are undertaken in many other sectors of American research.

Europe has been slower in grasping the educational opportunities in this direction, as this is also evident from the current lag in the public communication area. However, there is now a growing insight on this continent that new research projects ought to be accompanied by a broad educational effort that transforms the related scientific and technological aspects into suitable teaching materials, modified and shaped to fit into the different curricula.

In what follows, some features of the ALMA and OWL projects will be discussed that seem particular useful in this context.

ALMA

ALMA will consist of 64 12-m antennae with extremely precise surfaces, allowing observations in the submillimeter-to-millimeter wavebands. The signals from the individual antennae will be combined interferometrically, filtered and cleaned to provide direct images and spectra of the observed objects. The location at an extremely dry, high-altitude site is necessary in order to minimize the loss of signal due to absorption by atmospheric water vapor.

ALMA will observe many different objects, but from an educational point of view, three of these seem particularly interesting: exoplanets, extremely distant galaxies and complex molecules in interstellar clouds.

ALMA will search for exoplanets that will be better visible in this waveband where the planet/star signal ratio is much higher than in the visual band. It will work together with other telescopes employing other techniques, improving the chances of detecting even comparatively small objects.

Due to the large redshift of extremely remote galaxies, shifting their most intense radiation into correspondingly longer wavebands, ALMA will be particularly suitable to observe the earliest ones in the Universe. These observations will consist of images to study their shapes (morphology) and also spectra to learn about their content, e.g. of young stars of the first generations.

There are many spectral lines of complex molecules present in this waveband. It is likely that ALMA will find new organic molecules in space, hereby contributing to the rapidly advancing field of bioastronomy.

OWL

With its enormous reflecting surface, OWL will be able to observe the faintest and most remote celestial objects ever seen. If the currently proposed mirror size, 100 meters, is retained, OWL will detect object of 38th magnitude in a 10-hour exposure, nearly 1000 times fainter than anything observed before. With a host of sensitive instruments, all possible types of investigations will be possible.

The ultimate observation, in theory possible with such a telescope, is the spectrum of an Earth-sized exoplanet in orbit around a star within 30 light-years. With OWL we should therefore in principle have a means to investigate the atmospheric composition of such objects, with the associated bioastronomical implications. However, OWL will also have a tremendous impact on cosmological research.

OWL is in an advanced stage of project study. The cost is estimated at about 1000 million EUR. ESO has begun to investigate possibilities for funding. Much interest has been expressed from many sides in participation and it is quite possible that also this project will develop into a multi-partner undertaking. ESO has searched for a suitable site on all continents since some years, but until now no site has been selected.

How to introduce ALMA and OWL into Education?

The following, preliminary ideas may serve a useful discussion base. In any case, it is obvious that the earlier these initiatives begin, the better, and the higher are the chances that their educational potential can be properly exploited.

Both projects represent „current“ front-line technology and research. They provide an opportunity to discuss how such large, international projects are conceived and realized. This includes the scientific considerations (what shall they be able to observe?), technological challenges (how can we provide the necessary sensitivity, stability?), economical limitations (how can such a project be financed – where do we find the money?), as well as political aspects (how do the partners find each other and agree to the realization of the project?). In a nutshell, they illustrate the functioning of other modern large technology projects of a more applied nature, but with the added, very attractive aspects of exploration of the unknown, (unexpected) discoveries and contribution to our current image of the world in which we live. An additional, important consideration is the absence of negative environmental impact, an inhibiting public factor often associated with other large technology and research projects.

Both projects are able to deliver an extremely rich audio-visual material: photos and videos of sites, elements, construction and later of observed objects; short videos illustrating the projects and their realization, hereunder prospective interviews of the people involved. During the construction phase, the engineers can explain the principles of construction and the scientists their expectations. There is a clear line towards the „first light“, stimulating expectations many years ahead and increasing in intensity as the time is nearing. There is room for an honest assessment of the work, progress, but also temporary challenges.

Both projects allow bringing a number of very basic considerations into the teaching of „physics“ or „natural sciences“. The main advantages lie in the possibility to combine the exciting prospects of modern technology and front-line science with insight into basic notions. Instead of illustrating fundamental physical principles with „dusty“ experiments, they can now be demonstrated by means of the capabilities of these instruments. This must obviously be the subject of deep and thorough considerations and demands close interactions between the involved communities of scientists, engineers and educators.

One example is electromagnetic radiation and information theory. ALMA and OWL receive such radiation, generated in different environments (stars, gaseous nebula). How is the signal captured? How is the information extracted from the accompanying noise? What do the photons tell about the objects?

Another example is linked to extremes. Both telescopes will observe extremes in the Universe and the aspect of a „Guinness book“ approach may be useful to overcome disinterest in otherwise dry subjects. There are plenty of possibilities here.

Simple exercises at different levels, illustrating physics in a refreshing way. Just a few first examples in order of increasing complexity: metric size of the antennae (comparing with known objects to understand the enormity), wavelengths (comparative examples from daily life, e.g. microwave oven, electric bulb), Doppler effect and redshif (how can ALMA observe ultraviolet galaxies?), number of photons received (inverse power law, noise), waves and principles of interferometry (a very difficult subject!).

The projects should have their own, dedicated websites. A main element would be a regularly updated record of progress, with new material that can be downloaded. Of particular use will be a series of short lecture notes for teachers on selected, associated subjects, duly illustrated and easy to adapt to local/national circumstances. Depending on the time available, the teachers could then select one or more of these and use them in their teaching. Note that here the language problem may be important.

Teachers' meetings. It would be useful to organize from time to time meetings of active teachers to discuss the use of educational material: how does the available material work?, which new aspects could be taken over for teaching?, which other initiatives (material, lectures, competitions, excursions, etc.) should be considered next?

Documentation of careers. As we saw with the „The Future Astronomers of Europe“ educational project in 1993 (where young people were invited to write essays about future observations with the VLT, at that time still under construction), exceptional opportunities exist to „follow“ young people as they progress towards and into a (scientific) career. For this, however, they must be informed about/confronted with the future facilities at an early stage. Then their early dreams may come true and they later may tell other young people about how they succeeded (the concept of „role models“).

Such personal stories are very powerful examples that may cause young, dedicated people to consider following in the footsteps of those who managed to realize their ambitions. It may be particularly important in the current, fierce „battle“ for the best brains – the earlier the most gifted young people are subjected to this kind of experience, the larger are the chances that they perceive a real chance and decide to move towards a research career. (I know of many colleagues who have had exactly that kind of experience).

To begin with, the ALMA (or OWL) educational project will need an absolute minimum of one full-time person with teaching experience and insight into the projects. This will not be enough, however, to develop and realize much educational material. For this, temporary support (e.g. visiting teachers) is a must. Other components may take the form of specifically funded (e.g. EC) projects of limited duration. It will clearly be an advantage if the educational effort can be embedded into a PR-department that also produces project-related material.

A first meeting about ALMA and education will take place at the time of Physics on Stage 3 at ESTEC on November 9, 2003. Here, the overall educational potential will be discussed in general terms. It is expected that the recommendations emanating from this encounter will then serve as a basis for attempts to establish a dedicated ALMA educational office.

6. Which effective tools exists?

There is no productive and efficient general astronomical education without efficient tools. These are:

planetaria and amateur observatories

Astronomy is a field of science of space and motion. People don’t want only to read about astronomy, they want to have a directly look at the celestial bodies, they want to observe for example the Sun or Mars live. Amateur observatories are the best places for this because the are not involved in research program.

But they give the chance to learn the methods of scientific observation and research and they give the chance only to look for fun. But they cant demonstrate the slowly motions and processes of the celestial bodies or events like eclipses of the Sun or Moon or transits of Mercury and Venus. And the depends form the weather. To observe the sky you must have a fine weather.

Planetaria with their 1923 from Prof. Walter Bauersfeld designed special projector are independent of the time, place and weather. Today in most of the countries numerous amateur observatories and planetaria exist. And some of them in a combination of both.

That is an ideal situation, because things which has been demonstrated or teached to the audience in the planetarium can be observed directly with telescope, for example eclipses or transits, double stars, Galaxies and so on. And this kind of education produces a big effect. These institutes are looking continuously for lecturers and staff members not only for giving talks also to write their monthly program or event newsletters.

science sites in the big newspapers and magazines

Most of the big newspapers and magazines of today bring news about astronomical discoveries and they have special science pages. Here an author for astronomy reports and essays has the best chance and a lot of space to write about latest discoveries, evolutions and to comment on them. The simplest way is to write a report of the monthly sky and its actual events. The size and the layout can be different. I will demonstrate this fact with six examples of a description of the monthly sky in German newspapers.

Such event gives the best chance to an unknown author to become a member of the staff of free lance science journalists. The basic informations and data what will happen in the sky you will find in amateur calendars like the German „Kosmos Himmelsjahr“.

That is a very bad way to present and to wake up interest to the public in the sky and in astronomy. Every overview should contain at least a little chart, which helps to orientate on the sky. If you have become a well-known author, you can try to write articles, reports, stories or essays which will need more space like these, which I have written for the „Berliner Morgenpost“-newspaper.

The last example demonstrate a good science essay to make general astronomical education: A color picture of the described object, a graphic which illustrates the theme, the event or the process, and an interview with a an expert, who gives more and authentic informations to the readers.

science magazines, features or reports in the radio and tv-stations

Science magazines like the German „Sterne und Weltraum“ - „Stars and space“ - or the English/American „Sky and Telescope“ have the pro that they offer space enough for writing about astronomy but they have the cons that they are written for a little circle of experts - that is the general opinion. Some of one try to write popular and to be sold in kiosks and not only as subscription magazine. With that strategy „Sterne und Weltraum“ is very successful and become an important part in general astronomical education. A greater part play radio and tv-stations, because a lot of people are listening or looking their program. Chances and they way to become an author of a report, feature or an interview partner for the different „teachers“ of astronomical general education are the same how I have described under the topic „ideal persons“ and „science sites in the big newspapers and magazines“.

The difference is, that the audience of a radio station and tv -program only get the informations by listening or looking and listening and get no documents, which they can read in later times. Every writer and producer of an astronomical program has to consider this fact. But radio can work with noises and tv with pictures and films. A lot of radio and tv-stations has special science program and are looking for good and competent authors.

the web

Since its birth in the beginning of the 1980th the world wide web has developed into the most used medium of communication and information for the common people. It contains all elements of printmedia, radio and tv. And there is no important institution today which has not its own homepage. You have the possibility to get a lot of information and news about astronomy from all over the world, to chat with experts and to load it down and print it out. But you present these collected informations in a representative stile, you cant put your computer into shelves. That's only possible with a book.

special books for the common people

Last not least special astronomy books for the common people are the traditional medium to collect and to get informations. In the last decades under the influence of the American and English science authors a lot of special astronomy books for the common people a published in Europe. Most of them are translations and so it is very difficult, very hard for native authors to publish.

But if you have a good idea and witty concept, you have a chance like me. In the beginning of the 1990th quizzshows like „Who becomes a millionaire?“ starts and was very successful„ because people like the game of questions and answers. I though it must be a good idea to present astronomy as questions and answers. And so I published a book „Why the stars are shining“ as a paperback. It was very successful and so when ten years were gone my publisher ask me to write a new edition and in March 2003 we published it as bound version:

My aims are to count up 100 general interesting questions of astronomy and to answer them simple but fascinating, for example: Why is the Sun shining? Does water exist on the moon? What are the tides? Huge volcanoes on Mars and Venus? What do we know bout the beginning and the end of the universe and so on.

Take a look at one part of the contents. I developed a special method or way to give the informations to the people. Besides the text we published pictures like these and wrote detailed commentaries and we published impressive graphics and boxes which contains additional informations. It is possible to read every question independent of the others. You can start with reading at every point of this book. You have a reading book and an encyclopaedia.

We launched up this title in the beginning of March with 6000 copies. Now we have sold 3200. It is a great success not only for the author but also for general astronomical education.

7. Detailed examples of my experience of work with these tools or media

The topics which I had described and discussed are actual detailed examples of my experience of work with these tools or media. Born in 1951 my interest in Astronomy started with the start of the first artificially satellite SPUTNIK 1 in 1957. And if you want to understand space exploration you have to understand the basics of astronomy.

So I visited the common high school and became a member of the registered society Wilhelm-Foerster-Observatory where I began to work as lecturer for planetary shows. Also I want to make a carrier as an author. The best way to make such a carrier and to practice your hobby was to become a teacher, because in this profession you have enough time to do both things. Some members of the society Wilhelm-Foerster-Observatory are writing for newspapers and radio stations and they show me the methods, writing techniques and the way and opened the gates.

After a time of fifteen years I leave the school and began to work as a free lance journalist for radio stations, newspapers and give special talks in other German planetaria and as lecturer on cruises like the Norwegian Hurtig Line. When the German and Berlin reunion happened in 1990 I changed form the West-Berlin Wilhelm-Foerster-Observatory to the East-Berlin Archenhold-Observatory, which is the traditional Volkssternwarte of the Capital City.

Because I am not only an author of astronomical themes, I am also writing about geo-sciences, especially polar research. And so I have get the chance to make an expedition with the German research vessel „Polarstern" to the Arctic region including visiting the north pole in 2002 and seven weeks later to visit Antarctica. These journeys were peak of my journalistic carrier. Up to this time I worked in all fields of general astronomical education and I think with big success.

Last year I visited ESO during its 40 year anniversary. There I ask Richard West if there is a chance to work a free lance member in the education department. He was very impressed of my work, especially that I have published a big report in the German army Bundeswehr-magazine "Y." (Why dot)

Since the beginning of March I work a associate in the ESO Education Department, as journalist, teacher and author and I am sailing between two exiting cities in a period of 14 days: Berlin and Munich. But I think, next year I will take a full time job.

8. An overview and description of the work of the ESO Education department

The ESO-Department of education was founded in the year 2002. Its aim is to bring the results of the research at the Southern Sky directly and efficient to the young people in team work with other science institutes and European natural science teachers of EAAE. Both have developed a lot of activities and contests to have an interest in astronomy.

Catch a star

Catch a star is a contest for young people in European schools. They have to look for an interesting astronomical object and write under the leadership of a teacher a report about it. A jury will proof and select the reports by quality and give attractive prizes to the winners, for example a journey to Paranal or a telescope or a home planetarium.

Participation in „Physics on stage"

During this event from the 8 to 15th of November in ESTEC ESO will present the ALMA-Project for the European teachers and give special materials to them.

Development in cooperation with ESA of an Astronomy Exercise Series

The VT-2004-Project

That's one of the ambitious astronomy public education projects of ESO and other European science institutions: European Association for Astronomy Education, Observatoire de Paris, Institut de Mécanique Céleste et de Calcul des Éphémérides and the Astronomical Institute of the Academy of Sciences of the Czech Republic. → For details take a look at the announcement.

All members of the „VT-2004 consortium" create special informations on the web for interested persons which want to be a member of this international network. A kind of „general rehearsal" was the Mercury transit on May 7, 2003. The ESO Education Department has developed special web sites with special background informations about the planet Mercury, the Sun and the event with special informations for students and teachers in ten languages. The event could be observed live by webcam with images obtained at the observatories in the Belgium, the Czech Republic, Hungary, Italy, Spain an others. Public has the possibility to ask questions in „real-time" to astronomers via this page.

ESO-Department created a special observation sheet and a graphic how to observe without risk for your eyes this event.

If you want to get more and detailed informations click the homepage of the ESO Educational Office: www.eso.org/outreach/eduoff where you will find special logos which you can click for the discussed themes.

9. For which results we can hope?

The answer of this question is simple and both difficult. We can hope for a better general knowledge and understanding about the special aims, methods and running questions of astronomical research and sympathy for by most of the people and the will to support it with taxes. But everybody knows common sense is subject to prevailing tasks. And you cant never reach everybody with a good and efficient general astronomical education. In Germany we have a tradition of about fifty years and nevertheless we have some people, who welcome an astronomer as astrologer and ask the lecturer of a planetarium show when the dome will be opened that we can take a look in the sky.

THE NEON SCHOOL

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The NEON school is an astronomical observing school organized by the Network of European Observatories in the North. It is taking place directly at the telescope, in active observatories with forefront equipment. Participating observatories are the Asiago Observatory in Italy, the Calar Alto Observatory in Spain and the Haute-Provence Observatory in France. The school was sponsored by the European Union, and benefits from the scientific and technical support from ESO.

Graduate students from all over Europe gather in one of the observatories for a two-weeks duration school, where they execute, in small groups of three, a regular scientific program proposed by their tutors. This begins with the definition of the scientific objectives, translated into observing requirements (limiting magnitudes, spectral resolution, signal to noise, etc..), then followed by the observations themselves (one night imaging and one night spectroscopy, as a minimum for each group of three), and continued by the data reduction and analysis, with the final aim to present the scientific results at the end of the school, like in a conference.

Some basic lectures are given at the beginning of the school by experts in the field, on topics directly related to the observations: optics of the telescope and control of the image quality, observing procedures in photometry and spectroscopy, image analysis, etc...The essential point is however the work in small groups with direct interaction with their tutor, which is usually a young scientist with already a large observational experience. The relaxed atmosphere of a summer school (not in contradiction with hard work...) favors interactions, also with the lecturers, and experience shows that the learning process is very effective this way.

Modern telescopes and instrumentation are more and more complex, to the extent that the observer is generally not the one who is adjusting the instrument and is often not even the one executing the observations. This is particularly true for space instrumentation, but is also becoming the rule in many large facilities (like the VLT) where service observing is now regularly offered. How to observe at the telescope can therefore not be learned like in the past, by regular trips to the observatory with more experienced seniors, nor can one learn the secrets of a spectrograph by trial and error in the final adjustments before observations. It is however largely accepted that the best use of a given instrument, and in particular the obtention of its limiting performances, is only achievable by those users having an excellent knowledge of the instrument itself and of the appropriate observing technique.

The NEON school intends to help to fulfill these learning requirements by using medium-sized telescopes where the instrument and the telescope is still directly accessible to the observer. It will grow in the future by involving more observatories, most notably the ING and the NOT in the Canarian islands. At the same time, staying in observatories where instrumentation is developed, the participants get also a chance to be interested in that aspect, where needs are also expressed. On the other hand, the development of the Virtual Observatory, with large data archives, puts also emphasis on the use of archival data (instead of acquiring new data at the telescope): what is necessary there is the ability to correctly estimate the quality of the data, and eventually proceed with a new, optimized data reduction. The NEON school will, in the future, run also schools along those lines, where the expertise of ESO and ST/ECF will be of particular help.

In a more general perspective, it starts to be recognized all over the world that astronomy (or, more precisely, astrophysics), being an attractive science for many people, should be more widely used to attract young people to engage into scientific studies in general. Our society, becoming more and more technical, may be confronted to serious problems in the future if the majority of the people is not able to understand a minimum of science. For many students at the secondary level or in the first years at the university, being able to observe, if only for one night, at the telescope would be an exciting and far-reaching experience. This is obviously not possible in view of the large number of potential participants and the few telescopes available. The situation will improve with the advent of some robotic telescopes specially designed for remote observations conducted directly from the classroom. But the missing link is the skill and motivation of the teachers: for those interested, a training session adapted from the NEON experience would probably give the right incentive and training to ensure a successful program later conducted with their students. The partners involved in the NEON school intend to start a study along those lines, to find out possible ways to successfully conduct such a process in Europe, taking also advantage of the already functioning schemes, like those presented during this session.

For more details about the NEON school, please refer to: http://www.iap.fr/eas/schools.html

ASTRONOMICAL CONCEPTS AND DISCOVERIES THE STREAMING OF KNOWLEDGE FROM SCIENCE INTO SOCIETY

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Abstract: In this review paper I present a brief historical discussion of the oldest Hungarian journal of natural science and the famous ROYAL HUNGARIAN ASSOCIATION FOR THE ADVANCEMENT OF NATURAL SCIENCE (RHAftANS) which has been supporting the publication of the monthly since the earliest days of its apparition. The *Table of Contents* of the first one hundred and thirty-three volumes of the journal published under often changeable titles has been scrutinized for papers dealing with „ASTRONOMICAL" topics and the outcome of the work has been pipelined into a worksheet for later statistical investigation. The term „astronomical" has been given a considerably wider meaning than usual and this is explained in detail below. The statistics of the astronomical articles resulted some interesting conclusions. The frequency of these papers has an invariable core and a somewhat irregular modulation on shorter time scales. It is shown that the most important factors of this phenomenon are the productivity and coevality of authors and major political or historical events (like WWI and WWII). A short listing of the most prolific and famous authors is given.

The review ends off with a digest of the most interesting topics discussed from the late fifties until the end of the seventies.

Introduction to the history of the RHAftANS

The ROYAL HUNGARIAN ASSOCIATION FOR THE ADVANCEMENT OF NATURAL SCIENCE (RHAftANS) was founded in 1841. The country or the state at that time was called Kingdom of Hungary and comprised of the whole territory of the Carpathian Basin with an extension to the Adriatic Sea (called Croatia and Slavony). The membership of the RHAftANS came together from this area which tripled the territory of the present day Republic of Hungary. Although the population exceeded twenty million, half of it only was native Hungarian - approximately the same in absolute numbers that today. Most of the members were doctors, teachers, land owners, journalists, writers and officers. And they were men (very few of the members were women). At the time of the Hungarian Millennium (in 1896) the membership reached eight thousand. As a consequence of WWI the country was cut into five parts and from the new Hungarian Kingdom a lower number of applicants joined the association. It took a decade for the RHAftANS to reach an absolute record in membership with 18 000 people.

The consequences of WWII were even more tragic. During the late forties the membership of the RHAftANS - the adjective *Royal* was of course omitted from its name - dropped below 500 (five hundred). Fortunately the fresh social initiatives favored the popularization of science and techniques and the number of members of the new-old association had gradually grown up to tenfold and in the seventies the membership reached five thousand. Onward the late eighties the membership has been eroded and now it stagnates.

Publications of the RHAftANS

In the very first years of its existence the association published only *Annals*, two volumes per decade, Vols. 1 to 4 to be exact. In 1860 the publication of the Bulletin of the RHAftANS was started and normally a volume per year came out, Vols. 1 to 7 until 1867.

The newspaper-like journal: *Hungarian Scientific Bulletin* (in Hungarian: *Természettudományi Közlöny*), a biweekly and later a monthly, first appeared on 10 January 1869. This is the birthday of the journal I intend to deal with. At present it is called *World of Nature* (*Természet Világa*) following many changes between 1946 and 1968. For the record only: Natural Science (*Természettudományi*), *Nature and Techniques* (*Természet és Technika*), Nature and Society (*Természet és Társadalom*), Bulletin of Natural Science (*Természettudományi Közlöny*) followed each other. In this year (2003) the volume CXXXIV is being published which means that it is one of the scientific journals with the longest continuous appearance in the world.

„ASTRONOMICAL" topics in the publications

All of the topics listed here were considered relevant to astronomy:
- Astrology (first of all its criticism)
- Astrometry, Astronomical techniques, Astronomy (general), Astrophysics
- Atmosphere (large scale properties and its effects on ground-based observations)
- Auroras (australis, borealis, halo, rainbow, sundogs etc.)
- Calendar making, rules of Easter and other moving holidays
- Chronology (eclipses, occultations, dating of historical records)
- Earth as a planet
- Gravity and G-waves
- Heliophysics
- Light (velocity, spectroscopy - electromagnetic radiation)
- Neutrino Astrophysics
- Optics (relevant to astronomical observations and instrumentation)
- Philosophy (creation of the world, world models etc.)
- Planetaria (sky theatres)
- Radio Astronomy
- Scientific organizations (COSPAR, EAS, IAU-UAI, ICSU, etc.)
- Search for extraterrestrial(s) ...objects and subjects
- Solar activity and phenomena and related(?) weather changes
- Space biology, geodesy, geology, law, technology, -time
- Theories (origin of life, Titius-Bode law etc.)
- Time-keeping and clocks
- Training of astronauts
- TEACHING OF ASTRONOMY and ASTRONOMY EDUCATION

Statistics of the astronomical papers published during 133 years

The average number of astronomical papers is about 18 publications per year. Using five year averages there are only slight modulations in the data. Of course in the beginnings there were less articles (8 papers p.a.) and the same was repeated following WWI and during WWII too. It is very interesting that there is a prominent peak (with a value of 32 p.p.a.) in the distribution of data around 1900. A more detailed study is needed to certify my speculative explanation: this is the consequence of the excitement and continuous interest that had been generated by the books of C. Flammarion, the world famous amateur astronomer and author. In Hungary his books appeared in translation during this decade and they were absolutely popular.

In order to find the clue for other local deviations or oscillations (there is a very characteristic one with a cycle time of five years) it is essential to have a look at the number of authors active during the given period and of course at the names too.

Some of the most famous authors of the journal

were (for the *amount of their articles* or for the *duration of their collaboration*)
Ágost HELLER Vol. I - Vol. XXXV
László WEINEK Vol. X - Vol. XXIV
Ferenc LAKITS Vol. XV – Vol. LI (37 years!)
Jenõ GOTHARD Vol. XVI - Vol. XXV
Radó KÖVESLIGETHY Vol. XVI – Vol. LXVI (51 years!)

József WODETZKY Vol. XLI – Vol. LXXV(34 years+)
Jenő MENDE Vol. XLII – Vol. LXXIII (32 years)
and are
Iván ALMÁR Vol. LXXXIV -
Béla BALÁZS Vol. LXXXIX -

The most prolific author of the history of the *Bulletin* is most probably J. MENDE with well over hundred contribution in this field and many papers in other disciplines.

Unfortunately world famous scientists are not mushrooming amongst the authors of the monthly. This may be the consequence of financial restrictions or complications raised by copyright rules. At least there were some interesting titles, translations of the works of the following (few) well-known foreign authors :

TODD (United Kingdom)
SEELIGER (Germany)
DE BROGLIE (France)
SCHATZMAN (France)
LOVELL (United Kingdom)
OORT (The Netherlands)
EINSTEIN (Germany/USA)
DIRAC (UK)
TYITOV (Soviet Union)
WEIZSACKER (Germany)

To finish with an optimistic statement, there seems to be a definite tendency: the interest of layman in astronomical topics over many decades is continuous and grows slowly.

On the timeliness of the „ASTRONOMICAL" papers: some examples from the period 1957-1979

1957: Artificial satellites study the cosmic rays - Rockets and rocket engines - Ionospheric research by artificial satellites - Living structure onboard the artificial satellite
1958: 300 years of the pendulum clock - On the Cherenkov-effect - Magnetic phenomena in the Universe - Study trip on planet Mars
1959: On the problematics of the Calendar reform - Artificial satellites and general relativity
1960: Television techniques in Astronomy - Ultra-high precision timekeepers: quartz, atomic and molecular clocks - Hypersonic aerodynamics - Astronomy in Estonia
1961: Ultraviolet radiation of the night sky - Gravity measurements during the February 15 solar eclipse - New giant telescope in the GDR
1964: Galileo Galilei - Earliest data on meteor-impacts on Earth - The high-altitude *(sic!)* observatory of Hungary - Evolution of the physical concepts of the Universe
1968: Cosmic lighthouses: the Quasars
1970: Mapping the Metagalaxy - Maximilian HELL
1972: Galaxies in the computer - The Seyfert-galaxies - Molecular evolution in the cosmos
1973: Copernic - Nuclei of galaxies
1976: Black holes are not lasting for ever - Pulsars and magnetic monopoles - Gravity waves - Life on Jupiter? - Solar activity and the weather - The largest solar oven
1977: 300 years of „c" -measurements - How do I see the Universe (A. EINSTEIN) - Astronomical observatories of the Stone Age -Newton and the universal law of gravity - C.F. Gauss the physicist
1978: Is the radio emission of exploding black holes detectable? - Do we have partners outside? - Red dwarfs and the hidden mass - Astrology and statistics - The first radio echoes from the Moon
1979: The unity of the Universe - Extraterrestrial biogenesis - The birth of the first photomultiplier tube, chat with Zoltán BAY - Tsiolkovsky : the father of cosmonautics

Refernces:

The Table of Contents of Volumes: I - CXXXIII of *The Bulletin of the Hungarian Association for the Advancement of Natural Science*

WHY ASTRONOMY NOW ?

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Paradoxically or not, today, when we realize more then ever how fragile is the planet that shelters us, when the education through astronomy plays a more and more important role, when the cosmic space became an environment in which we freely walk, the teaching of astronomy loses ground in almost all countries.

Perhaps more than other post-Communist countries, **Romania** underwent a dramatic change after 1989. **The teaching of astronomy in secondary schools was eliminated**. This situation is not unique, and in several other countries astronomy teaching is in decline. By contrast, the teaching of *astrology* and other *pseudo-sciences* is *continuously developing*.

The reintroduction of the astronomy in the curricula, as well as a new system of scientific education in agreement with the knowledge and technology of the 21st century, is compulsory in both Romania and other countries.

It is superfluous to explain to the astronomers the role of such an education. But we think that we all must be convinced about the part **everyone** can play in proving this truth in his own country.

Everyone can do this, and especially the **IAU**, which owns the scientific authority to recommend and even to convince the national ministries of education to revive or even to introduce the teaching of astronomy in the school.

An international campaign and new ways for implementing astronomy in education can be carried out after the emission of the ***IAU Resolution***. It could be send to all the governments in the world stating its position on astronomy teaching in schools.

RESOLUTION PROPOSED BY COMMISSION 46

Voted by the XXVth IAU GA
Sydney, July 2003-08-10

The International Astronomical Union,

Considering

that scientific and mathematical literacy and a workforce trained in science and technology are essential to maintain a healthy population, a sustainable environment, and a prosperous economy in any country

that astronomy, when properly taught, nurtures rational, quantitative thinking and an understanding of the history and nature of science, as distinct from reproductive learning and pseudo-science

that astronomy has a proven record of attracting young people to an education in science and technology and, on that basis, to careers in space-related and other sciences as well as industry

that the cultural, historical, philosophical and aesthetic values of astronomy help to establish a better understanding between natural science and the arts and humanities that, nevertheless, in many countries, astronomy is not present in the school curriculum and astronomy teachers are often not adequately trained or supported, but

that many scientific and educational societies and government agencies have produced a variety of well-tested, freely-available educational resource material in astronomy at all levels of education

Recommends

the educational systems include astronomy as an integral part of the school curriculum as both the elementary (primary) and secondary level, either on its own or as part of another science course

that educational systems and national teachers' unions assist elementary and secondary school teachers to obtain better access to existing and future training resources in astronomy in order to enhance effective teaching and learning in the natural sciences,

that the National Representatives in the IAU and in Commission 46 call the attention of their national educational systems to the resources provided by and in astronomy, and

that members of the Union and all other astronomers contribute to the training of the new, scientifically literate generation by assisting local educators at the levels in conveying the excitement of astronomy and of science in general.

WHY ASTRONOMY IS USEFUL NOW?

ARGUMENTS

It is clear that such a resolution has to be sustained with consistent and convincing **arguments**. Which could be these ones?

I tried to emphasize only few out of the huge number of arguments - that we all know very well - in favor of a sustained campaign with two main goals:

The harmful action of the mankind on the Earth proves the fact that we must **better know our planet**, in order to protect it, to create the most propitious conditions to life. One of the most efficient methods to do this is to know as well as possible the similar planets, to learn from the solar system what we have to avoid in order to keep the life on the Earth; the greenhouse effect on Venus is only one of a long series of arguments.

It is obvious, at least for us, the astronomers, that **culture cannot exist without Astronomy**. More evolved a civilization was, and deeper its astronomical knowledge has been. But this is not clear for everyone. Consequently, the contribution of the specialists in the history of astronomy can play just this role, of proving the place of astronomy in culture. It is needless to say that such an information has to be spread especially at the pre-academic level.

Among the scientific revolutions of history, **Astronomy** stands out. In the recent lists of '**the hundred most influential people of the millennium'**, astronomers are always included.

Astronomy has obvious **practical applications** to: timekeeping; calendars; changes in weather; navigation; the effect of solar radiation, tides, impacts of asteroids and comets with the Earth.

Astronomy has advanced the **physical sciences** by providing the **ultimate physical laboratory** – the Universe – in which scientists encounter environments far more extreme than anything on Earth. It has advanced the **geological sciences** by providing examples of planets and moons in a variety of environments, with a variety of properties. The **ecology** needs **Astronomy.**

Astronomy, by introducing students to the size and age of objects in the Universe, gives them **experience in thinking more Abstractly** about scales of time, distance, and size.

Astronomy calculations have spurred the development of branches of **mathematics** such as trigonometry, logarithms, and calculus. Now they drive the development of computers: **Astronomy** uses a large fraction of all the supercomputer time in the world.

Astronomy has led to other **technological advances**, such as low-noise radio receivers, detectors ranging from photographic emulsions to electronic cameras, and image-processing techniques now used routinely in medicine, remote sensing and many other fields.

Another aspect in favor of the intensification of the astronomical education is that today most of the **ground-based technologies are going to be implemented in the cosmic space**, whereas the space navigation and communications experience an unprecedented development and globalization process. This is the reason for which NASA and the ESA recently developed a series of education programs (see, e.g., "Life in the Universe"), based on a minimum of astronomical knowledge, assimilable only within the school.

Astronomy reveals our **cosmic roots**, and our **place in time and space**. It deals with the origins of the Universe, galaxies, stars, planets, and the atoms and molecules of life – perhaps even life itself. It addresses one of the most fundamental questions of all – are we alone in the Universe?

Astronomy reveals a Universe **vast, various, and beautiful** – the beauty of the night sky, the spectacle of an eclipse, the excitement of a black hole. **A** thus illustrates the fact that science has cultural as well as economic value. It has inspired artists and poets throughout the ages.

Astronomy harnesses the **deepest emotions of humanity** – curiosity, imagination, and a sense of shared exploration and discovery.

Astronomy, in **philosophy** and **education**, provides an example of an alternative approach to the scientific method – 'observation, simulation, and theory', in contrast to the usual 'experiment and theory'.

The social troubles and the terrorism that staggers the world lead to an unprecedented proliferation of **Astrology**. Who could better prove the lack of scientific substantiation of astrology and to avoid its harmful effects on the people than an astronomer? The fact that even certain universities intend to introduce astrology as a curriculum discipline constitutes an alarm signal for us. We must intensify our campaign oriented towards the education through astronomy, starting just with the pupils.

If we strictly refer to curricula, we have to consider that **Astronomy** courses build a **bridge between mathematics, physics, chemistry, geography, etc**. But this would not mean that the astronomy lessons can be hidden in the courses intended to teach these disciplines. The astronomy, even related to the above sciences, is, however, a different and independent science.

Astronomy is an **enjoyable, inexpensive hobby** for millions of people – the 'naturalists of the night'.

What to do?

The introduction or re-introduction of Astronomy as a compulsory curriculum discipline, for a half year or a full year, in the last-but-one or last year of the secondary school studies, and

The teaching of astronomy be performed by secondary school teachers trained within a special framework organized by professional astronomers.

The same problems, specific not only to Romania but to Europe, too, were tackled in view of special sessions, as "*Astronomy Education in Europe*", JENAM 2003, and, maybe, in the future meetings of JENAM.

THE TEACHING OF ASTRONOMY IN HIGH SCHOOLS AND UNIVERSITIES IN GREECE

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For many years before 1980 Astronomy was taught to all the pupils in Greek High Schools under the general name "Cosmography" with a syllabus including mainly the mathematical aspects of positional astronomy, the movements of the stars as well as some details about the Sun and the planetary system.

The first change came around 1980 with a new course replacing Cosmography under the name: "Elements of Astronomy and Space Science". The new syllabus included almost the same content of the previous course, but it gave more elements for the physical structure of the Sun and the stars and for the first time the new discoveries from the space missions, as well as some information about the space missions themselves.

The last four years however the High-School program changed again. The Astronomy related course lost its obligatory status and it is offered in the eleventh grade (or the second grade of the Lyceum as the three last grades of the high-schools are called in Greece) as an elective course. So, the pupils who wanted to hear something about Astronomy in these years of intense space explorations had to choose this course as one among other elective courses offered. Many of them had to abandon Astronomy in favor of Informatics, which went into the same with Astronomy group of elective courses. The course is taught by teachers of Physics or Mathematics and the vast majority of them are reluctant to undertake the teaching of Astronomy. Of course, there are some very good teachers of Astronomy with the usual for us love of the sky, who managed to attract in their schools many pupils, more than the seven (7) needed according the rules, to start a class in Astronomy. They organize visits to the Planetarium and the nearest observatory or initiate different astronomical projects.

As an example we give the facts for some High-Schools in two school districts, one around Piraeus, the largest Greek port, and the other in the large island of Evia.

3rd PIRAEUS DISTRICT DURING 2002 – 2003
(Include Perama, Drapetsona, Keratsini and Salamis)

School	Number Of Pupils	Pupils in Grade B'	Pupils Chosen Astronomy	%
1st Lyceum of Perama	362	115	17	14.7
1st Lyceum of Salamina	211	66	6	9.1
2nd Lyceum of Salamina	205	63	20 + 18	60.3
Lyceum of Ampelakia	111	36	25	69.4

We see that only in four out of the eleven (36%) schools belonging to this district the course of Astronomy was chosen by more than 6 pupils. In the last two schools of this Table the teachers of the course were very good as to attract the majority of the students around them.

Similarly, in the District of Evia in seven out of twenty two schools (31.5%) the Astronomy course was chosen by a total of 184 out of the 1450 pupils belonging to the eleventh grade (12,7%) as the following table exhibits.

DISTRICT OF THE ISLAND OF EVIA DURING 2002 – 2003

School	Number Of Pupils	Pupils in Grade B'	Pupils chosen Astronomy	%
1st Lyceum of Chalkis	454	152	18	11.8
2nd Lyceum of Chalkis	347	131	20	15.3
3rd Lyceum of Chalkis	476	140	28	20
Lyceum of Kanithos	342	110	35	31.8
Lyceum of New Artaki	231	72	30	41.6
Lyceum of Psachna	220	75	40	53.3
Lyceum of Mantoudi	165	52	13	25

We see again that only a small percentage of the high-school pupils are taught some elements of Astronomy each year. Many of the young pupils leave high-school and come to the universities confusing Astronomy and astrology. The astronomical community of Greece tries hard to spread the truths of Astronomy among young (and mature) people by publishing popular books and newspaper articles with astronomical interest, delivering lectures in front of usually large audiences, helping the numerous amateur societies to organize, having open nights in the Observatories and, through the Hellenic Astronomical Society (HELAS), the affiliated member of EAS, paying part of the monetary prizes awarded in the very popular among the high-school students of the whole nation "Competition in Astronomy". Still, we feel that young people should have the opportunity to be taught in high-school more about Astronomy.

Teaching of Astronomy and Astrophysics in Greek Universities is in better condition. Astronomy and Astrophysics courses are offered to the students of Physics and Mathematics in all six Greek Universities with a Science program. Four of them, those of Athens, Thessaloniki, Ioannina and Crete have their own Departments of Astronomy and Astrophysics as part of their Faculties of Physics. The two older and larger ones, the University of Athens and the Aristotelian University of Thessaloniki, offer their own Astronomy and Astrophysics honor's program to the students, while some courses of level I Astronomy and/or Astrophysics, are offered to all the students of Physics of the above Universities.

The largest Department of Astrophysics, Astronomy and Mechanics of the University of Athens employs 23 (twenty three) faculty members and offers a honor's program in Astronomy, Astrophysics and Theoretical Mechanics, which goes beyond the elementary courses included in the curriculum of the Faculty of Physics. This program includes three obligatory courses (higher level Astrophysics, Observational Astrophysics, Nonlinear dynamical systems) and eight elective courses in General Relativity, Space Physics, Plasma Physics, Dynamical Astronomy, Cosmology, High Energy Astrophysics, Solar Physics and Applied Optics. Each student who follows this program has to take the three obligatory courses and from three to eight elective courses from the above.

Every year more than forty (40) third-year students of Physics enroll in this program, ranking it third among the seven honor's programs of the Faculty of Physics, behind only the Electronics and Computers program and the Environmental Program. It attracts more students than the Nuclear and Elementary Particle Physics or the Solid State Physics programs.

The second large Department of Astrophysics, Astronomy and Theoretical Mechanics of the University of Thessaloniki employs fifteen (15) faculty members and offers to the students of Physics almost the same courses as the University of Athens does, namely Astrophysics, Stellar Systems, Problems of Near Space, Plasma Physics, Observational Astrophysics, Radioastronomy, Cosmology, Theoretical Mechanics, General Relativity.

Many students of Mathematics choose to take some courses in Astronomy I and II, Cosmology and Dynamical Astronomy offered to them by the Physics Faculties in the University of Athens and Astronomy I and II and Cosmology in the University of Thessaloniki.

The Universities of Athens, Thessaloniki, Ioannina and Patras have their own university observatories with a fair-size telescope, which are very instrumental in giving the undergraduate students their first and lasting view of the night sky.

It looks like a large proportion of Physics and Mathematics students enter the university with a high inclination towards Astronomy. As we stated earlier, we are not satisfied with the erratic astronomy teaching in the high-school level, but it seems that the young people who have an active interest in Astronomy try to fill this need for learning more to the University and to the graduate programs. The Universities of Athens and Thessaloniki have graduate programs towards a Master Degree and they have usually more candidates than they can accommodate.

We try to offer Greek Astronomy students, undergraduate and graduate, the knowledge they desire, but more can be done in the high-school level. Perhaps E.A.S., through E.U. could persuade the Ministers of Education all over Europe to include more Astronomy in their high-school curricula.

PLANETARIA IN PRESENT DAY RUSSIA AND ON THE FORMER SOVIET TERRITORY

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Abstract: Public planetaria creation boom takes place over the world. About 4000 planetaria exist now and about 100 new ones are built every year. It is result of general recognition of planetaria importance for enlightenment and formation broad outlook of population and especially young generation as the unique place which attracts large stratum of young people and where performance combines influence on both cerebral hemispheres responsible for rational and emotional perception. Over all huge geographical territory of the Former Soviet Union (FSU) condition of planetaria contradicts greatly with this worldly wide tendency. Less then 40 planetaria are now opened for public on full FSU space. It is just a half of the number existed in Soviet time when planetaria are intensively worked for public in each of 15 USSR Republics. Presently among 15 new independent states created on the FSU territory public planetaria operate in Russia and Ukraine only. Majority of the USSR planetaria were placed in former churches. Just for four planetaria suited buildings were constructed. The oldest and best Moscow planetarium became a semi-private property and was closed for repairing more than 10 years and don't work yet. There is strong tendency to minimize its educational functions and increase more profitable busyness. Starting from late 1980s under state protection the church buildings are returned to initial functions and a half of USSR planetaria lost place for work and were closed. Many planetaria continue exist under this sword of Damocles. As central as local governments in general don't recognize significance of planetaria for people enlightenment. Activities of Eurasian Astronomical Society (EAAS) and Association of Planetaria of Russia (APR) directed to improve the situation are briefly described. Currently the most important initiative is the project of the state program of development for planetaria in Russia. These two non-profit non-government organizations seek support and help from the world scientific and educational communities to overcome current negative tendencies and to correct the situation.

1. Place of planetaria in education.

It is obvious that planetaria play an important role in astronomical education (see, e.g. Mackowiak, 2003 or earlier book about planetaria issued by UN). It is result of general recognition of active, positive and great influence of these institutions on frame of mind of significant part of population, first of all of school children.

There are two main reasons of so unique influence of planetaria:

a) natural interest to the sky attracts large stratum of young people to planetaria and
b) planetarium performance influents simultaneously on both cerebral hemispheres responsible for rational and emotional perception and therefore creates the most deep impression on audience.

Planetaria are important for people enlightenment and formation broad outlook and especially for young generation minds. They inculcate a taste for knowledge, permit to understand its power, stimulate love to nature beauty and feeling vulnerability of noosphere, wish for clear sky above head, ability to global thinking. Thus planetarium performances directed to clear seeing of own place in the world and responsibility for thoughtless usage natural forces etc.

2. Planetaria round the world.

At the early 2000s the total number of public planeteria in the world was about

$$N_{tot} = about\ 4200.$$

More part of large planetaria

$$N_{ass} = about\ 1800$$

are joint in worldly wide association of planetaria. Below a rough estimation of planetaria world distribution are given: as items of Ntot and Nass:

Part of the world	Ntot	Nass
Japan	2200	400
USA	1100	1000
EC	500	300
FSU	40	0
Other	400	0?

Note: The character "?" marks unchecked numbers.

Time derivative of Ntot is believed to be more then 100 planetaria are created per year:

$$dN_{tot} / dt = \textit{more 100 per year}$$

It suggests world investments into planetaria creation equal roughly

Investments = a few billions Euro per year.

For creation of strong effects the highest technology of projectors is using. It permits to produce close to natural moving images of sky which cover full hemisphere and gives strong effect of presence. Such kind of equipment is very expensive. However wonderful results overpay large expenses for planetarium construction.

3. Planetaria on the former Soviet territory

3.1. Distribution over the FSU territory

Over all huge geographical territory of the Former Soviet Union (FSU) the condition of planetaria contradicts greatly with this worldly wide tendency. Less then 40 planetaria are now opened for public on full FSU space. Numbers of presently working public planetaria on different regions of the former Soviet territory at 2003 are shown in Table below.

Russia	29
Ukraine	About 7
Three Baltic States	0
Belorus and Moldova	0
Three Trans Caucasus States	0
Four Central Asia States	0
Kazakhstan	0

It is just a half of the number existed in Soviet time when planetaria are intensively worked for public in each of 15 USSR Republics. Majority of a little more then 70 the USSR planetaria were placed in former churches. Just for four planetaria suited buildings were constructed. Starting from late 1980s under the state protection the church buildings were returned to initial functions and to 1994 a half of USSR planetaria have lost place for work and were closed. This process was stopped immediately after creation of Association of Planeteria of Russia (see Section 4.1 below). As follows from the Table presently among 15 new independent states (NIS) created on the FSU territory public planetaria operate in Russia and Ukraine only and 13 states have no planetarium at all. Many planetaria continue exist under this sword of Damocles.

3.2. Planetaria in Russia and Ukraine

In Russia 2003: Less then 30 planetaria are now opened for 145 million residents and several million representatives of other NIS on great space of Russia . It is just a half of the number existed in Soviet time when planetaria are intensively worked for public.

Only 3 planetaria are located in specially constructed large buildings, namely planetaria in two megalopolises: Moscow and St.-Petersburg, as well as city Volgograd with more then one million population. Among them the big Moscow planetarium do not work during more then 10 years, that is as long ago as a process of the building privatization was started (see next section for details). At present days only one small planetarium with 40 sitting places is opened for more then 15 mln people living in Moscow and suburbia as well as for about 2 mln guests per day. Only 4 rather small planetaria are operated in huge territory of Siberia covering 8 one-hour time-zones. And 2 among 4 ones located one rather close to another: in cities Barnaul and Bijsk on the territory of Altaj Region (one among 89 territorial units consisting the Russian Federation).

In Ukraine 2003: About 7 planeteria are opened for public. Among them only the planetarium of the country capital Kiev locates in specially constructed large building. In city Odessa where planetarium was closed an astronomical lecture-hall supplied to be multi-media light projector was opened as a part of Odessa National University. This so-called "university planetarium" was created in late 1990s under intensive pressing of Odessa Astronomical Society (EAAS local branch). Other planetaria are continued to work in old small buildings of the former churches.

3.3 Moscow planetarium before and in present time

In the Soviet time: Moscow planetarium is one among the oldest planetaria in the world. It was opened in 1929 and supplied one among the firsts of the planetarium apparatus made by company Carl Ceiss. The building was included in the world list of architectural monuments of constructivism style. Main ("stellar") hall had 400 sitting places. Astronomical square was created around. On the territory of 1.5 hectare were exposed for public celestial and terrestrial globes, opened public observatory, etc.

Moscow planetarium was used also as the methodological center for advanced training of lecturers from other planetaria and for preparation of the slides and other methodical materials for lectures for all Soviet planetaria. First groups of Soviet cosmonauts got here training for stellar orientation. There were astronomical circles for young amateur astronomers with 3 academic year program of studying of trainings in astronomy. Many professional astronomers started from such groups. Among them are N.Kardashev, I.Novikov, V.Kurt, Yu.Efremov, A.Zasov, N.Bochkarev, etc). About 1 mln visitors per year attended lectures for adults and high school students as well as performances for youngest guests. Almost 90% callers consisted senior pupils for studying of school course of astronomy.

In present time: Course of astronomy lost status of the mandatory discipline in high school. Now it is a facultative course and is rather seldom. To the moment the only exceptions in the FSU are Ukraine and St. Petersburg were astronomy was returned, but it is the subject of many-sided pressing for removing.

The oldest and best Moscow planetarium became a semi-private property and was closed for repairing more than 10 years and don't work yet. It is an enterprise created by a representative of show business and the government of Moscow as a compromise after about 8 years of litigation for enjoyment of property. There is strong tendency to minimize its educational functions and increase more profitable business.

In this year Moscow government financed a half of price of an ambitious project of lifting all astronomical square together with the building on 6 meters with creation of three levels under surface. Total price of the project exceeds 32 mln US$. New constructions are under erection now but it isn't clear future orientation of the building usage. There is no money for finishing the project and purchases of a set of projectors. The only exclusion is 400,000 US$ which promises some UN structure under condition that Scientific Council will be formed and keep the enterprise activity in proper frame. The only organizing meeting took place in April 11, 2003. In contradiction with its schedule no decision about the Council was arrived at. Nevertheless a protocol claiming its creation and activity was distributed.

4. APR and EAAS initiatives

Eurasian Astronomical Society (EAAS) and Association of Planetaria of Russia (APR) are non-profit non-government organizations. EAAS joint professional astronomers of the FSU and other countries. EAAS was created in April 1990 and joint more than 800 members from 35 countries. EAAS is affiliated to EAS. APR joint lecturers of planetaria of Russia and in present time of Ukraine too. APR was created in 1994 and affiliated to EAAS.

Project of a program for planetaria development in Russia is the most significant purpose in both APR and EAAS, which is in developing stage of preparation. The project is almost ready for submission to government of Russia. It includes 3 stages: for nearby 2-3 year, up to 2010 and up to 2020.The project suggests cooperative work both the country government and local administrations for parities contributions into renewal working and creation new planetaria. Namely: replacement of the old central projector to the modern one at 10 cities; capital construction/reconstruction in cities lost planetaria (16 places); in 3 cities were using churches as planetaria exasperate believers; in 9 cities-millionaires (e.g. Kazan', Nizhny Novgorod (former Gorky), Ekaterinburg, Chelyainsk, Novosibirsk, Samara, Rostov-on-Don); in 11 cities with far North and far East localizations (e.g. Murmansk, Blagoveshchensk, Tumen', Vladivostok, Yakutsk, Irkutsk, Magadan, Ulan-Ude); resort and tourism centers.

The other not so expensive but an important part of the program includes juridical supplying (preparing draft bills, lows bodies, legal roles, etc.), creation an information center and infrastructure for supplying lecturer by modern information (now a part of planetaria has not e-mail and Internet is available in seldom cases only); support of experience exchange between lecturers and between lecturers and scientists and improving lecturer qualification; financial support of production and distribution of materials for demonstrations, and so on.

Process of creation of Scientific Council at Moscow Planetarium. Taking into account all above mentioned and first of all the last paragraph of the Section 3.3 one among current EAAS purposes is to make really working Scientific Council and to disavow its untimely claiming or pretended existing and sham activity.

5. Request to help

Two non-profit non-government organizations EAAS and APR seek support and help from the world scientific and educational communities to overcome above-described very poor state of planetaria over all space of the FSU and present negative tendencies of destruction of planetaria. It consists important element of education, science and culture degradation in all NIS. There are power forces as inside FSU as outside it which interests include such situation and tendencies. We seek not only in advises but also in help for embedding in minds of highest level local, science, and state administrations significance of planetaria for solving of global problems of ecology, stable development of mankind, etc. via formation of broad outlook and global frame of mind of new generation of people (Section 1). It is necessary to recognizing that the countries without broad (global) outlook of population cannot be in full measure adopted in "elite club" of countries, which will solve vital global problems of mankind. An indirect way to reach the purpose could probably be widespread discussion in multi media of influence planetaria on formation citizenry of XXI century with enlightening situation in NIS.

Reference:

Mackowiak B. 2003, *Final statement/thesis of the rule and objectives of astronomy education*, Text distributed among JENAM-2003 participants, Budapest, Hungary, August 26-30, 2003.

THE SOUTH-EASTERN EUROPEAN SUMMER SCHOOL "ASTRONOMY WITH SMALL TELESCOPES" AT BELOGRADCHIK OBSERVATORY, BULGARIA

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Abstract: The Summer school "Astronomy with small telescopes" was organized in the frames of the cooperation between the astronomers from the south-eastern European countries. The school was directed to Ph.D. students, university students and advanced amateurs. The topic and activities during the school were with special emphasize on the methods of photometry and database work. Lecturers from Bulgaria, Greece, Romania, Serbia and Montenegro, and Turkey were invited. Besides lectures and practical demonstrations, a new element for such a school was the observational projects competition with a grant of one week of observational time at the 60 cm telescope and another telescopes of Belogradchik observatory. Most of the participants submitted own projects, which were evaluated by an international jury. The winners received the possibility to perform their observational programs with the equipment available at the observatory. The aim of the school was obtaining of practical and theoretical knowledge, as well as developing of creative skills with preparation of projects for the competition. More information about the Belogradchik school can be found at http://www.astro.bas.bg/~aobel.

The decision for organizing of the Summer school in the Belogradchik observatory was taken in a cold winter day in the end of 2002, when astronomers from Bulgaria, Romania and Serbia and Montenegro gathered at Belogradchik to discuss on further enhancement of the collaboration among the astronomers in the Balkan region. "Astronomy with small telescopes" was determined as a topic of the school with a special emphasis on the photometry methods and database work.

The school was organized by the Institute of Astronomy, Bulgarian Academy of Sciences (BAS), with the help of the Department of Astronomy, Faculty of Physics of the Sofia University, as well as the Space Research Institute, BAS. The school was addressed to students, beginning Ph.D. students and advanced amateurs. The aims of the school were:

1. To develop creative skills of the participants with a preparation of projects for observations on a selected scientific topic.
2. To obtain knowledge on the principles and methods of photometry.
3. To gain experience how to observe with small professional telescopes.
4. To encourage the contacts among the young people involved in astronomy, who can be the future professionals in the Balkan region.

For these purposes well-known professionals were invited to give lectures at the school. Among them are M. Stavinschi from Romania, O. Demircan, E. Budding, M. E. Ozel from Turkey, P. Niarchos, H. Rovithis-Livaniou, M. Contadakis from Greece, M. Dimitrijevic, L. Popovic, V. Celebonovic from Serbia and Montenegro, M. Tsvetkov, V. Golev, L. Iliev from Bulgaria, R. Budell from Germany. Two types of lectures were scheduled: the main course lectures on small telescopes, methods of photometry and database, and also lectures on interest with different topics of astronomy like "Observing variable stars", "Astronomical time", "The present of the astronomy in Turkey", "Contribution of amateur astronomers to the science" and many others. The participants expressed a great interest to these lectures and the lecture room was always full.

A competition for submitting of observational projects which could be performed during the school was organized too. One week of observational time at the 60 cm telescope and another telescopes at Belogradchik observatory was granted. An international jury had evaluated the projects and recognized the 4 most successful ones to be performed during the school. The projects-winners were: "Strong wind effect on the photometric observations of massive binary systems V444 Cep and V1898 Cyg" by V. Bakis (Turkey), "Fast rotating asteroids" by V. Krumov (Bulgaria), "Photometric observation of short-period eclipsing binary stars" by V. Nenezic, A. Otasevic and G. Pavicic (Serbia and Montenegro) and "Observation of possible targets for Rosseta Mission" by V. Tudose, A. Sonka and A. Nedelcu (Romania).

Apart from the lectures and observations there was enough time for establishment of new contacts and strengthening the old ones among the young people.

18 young participants and 15 lecturers from Greece, Hungary, Romania, Serbia and Montenegro, Turkey, Bulgaria and Germany took part in the school. The young people had also the opportunity to present results of their own research work as posters and short oral presentations. For some of them this was the first presentation in a scientific meeting. In a free and friendly atmosphere they discovered that giving a talk is not the worst thing in the life!

At the end of the school special certificates were given to all participants. The authors of the 4 projects-winners were rewarded with diplomas.

The common conclusion accepted at the end of the school was that really the school was a good training for students and young astronomers at the beginning of their scientific carrier. The school proved also that the collaboration among the Balkan astronomers includes this time a new event: cooperation in the education of young astronomers.

The main organizing work was done by the Local Organizing Committee with the strong support of astronomers from Serbia and Montenegro, Romania, Greece and Turkey, who took part in the discussion on the topics and schedule of the school, as being members of the international jury for evaluation of the projects, as well as giving lectures during the school.

A large interest to the school was expressed. Such a kind of school was found as a very useful one. It deserves to be mentioned that even young people from very distant parts of the world like India, Nigeria, Ukraine, etc. interested in. We hope that the Belogradchik school will become a traditional one and to will be held every 2 years.

REVIEW OF ISYA-24, July 26-August 14, 1999 IN BUCHAREST, ROMANIA

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Several rounds of e-mail to participants led to a current e-mail address for 38 of the 41 participants. The review request asked for academic and job progress and ISYA influence thereupon; specific memorable subjects, lecturers, practical activities including eclipse; whether ISYA provided a broader outlook on science and useful English practice; quality of living and educational conditions and resulting later contacts with other participants; suggestions for improvements. We received a good response: Ten out of 18 foreign participants and ten out of 23 Romanian participants responded during March 2003. All the respondents valued the ISYA very highly. A high proportion is still active in astronomy/astrophysics.

PROGRESS of Foreign participants

Nine of the ten are still active in astronomy/astrophysics.

1) One Algerian, who already had a Ph.D. (signal processing) used ISYA for professional development to turn to astronomy. "I learn about helioseismology from students of Uzbekistan and I initiated later this project in my institute." (Alger Observatory) "I have an optimistic view of the development of astronomy in Algeria ... I want to participate actively in this project and ...the ISYA has brought a great contribution in this attitude."

2) Seven of the ten expect Ph.D.'s (six of them in astronomy): The two Turkish participants will soon receive a Ph.D. related to stellar spectra, having visited Saul Adelman in the USA for six months. The Uzbeki student expects a Ph.D. on helioseismology within a year. The three Egyptians each expect to receive a Ph.D. within a year. One Algerian is pursuing a Ph.D. in seismology in France.

3) The two Vietnamese are still teaching university-level physics and astronomy, now with greater authority.

PROGRESS of Romanian participants:

Seven of the ten are still active in astronomy / astrophysics.

1) Seven of the ten had ten-month visits at the University and Observatory of Turin, Italy or the University and MPI Radioastronomie, Bonn, Germany. (Three of them credit the Erasmus program). Of these seven, five are now seeking the Ph.D. in: USA (two at University of Alabama, advisor J. Sulentic, one at Northeastern University, astrophysics), Holland (one officially at Nijmegen, actually working at Fermilab USA), Germany (one at MPI Aeronomie, solar). One is seeking the M.Sc. in Osaka, Japan (x-ray astronomy), and one is researcher at the Astronomical Institute, Bucharest (gamma ray bursts, etc.).

2) In addition, one teaches mathematics and informatics in highschool in Bucharest and is registered for a binary-star Ph.D. topic in the Faculty of Mathematics, Bucharest University; one is starting a Ph.D. thesis on statistical physics in Paris; one seeks a Ph.D. at the Bucharest Institute for Physics and Nuclear Engineering (nuclear spectroscopy).

COMMUNICATION:

Many of the Romanians (and even some foreigners) are still in e-mail communication with each other, in part due to four having been in Turin and three in Bonn. Noticeably they keep in contact with Bucharest University, apparently thanks to Prof. Rusu having created a real astronomical community within the Faculty of Physics of the University of Bucharest (Association of Amateur Astronomers), supported by the international activities activated by Magda Stavinschi (Bucharest Astronomical Institute)

TEACHING:

Several participants praised the teaching (unasked): "Experience new pedagogical methods"; "Teaching methodology was effective"; "Our teachers have presented their courses with great devotion and passion"; "I am impressed by Dr. Gerbaldi....".

Several praised the role of the participants' presentations.

Only two mentioned the lecture notes as needed to compensate for slow English comprehension.

PRACTICAL ACTIVITIES:

There was a large range of opinions of the practical activities, from complaints: "It was not well balanced between theory and practice"; "I think that the experimental work, even at the level of processing existing data, was the weak point of that summer school."; and "It would have been interesting to have a connection to some teams doing "real" eclipse experiments." to praise: "The practical activities were particularly helpful, ... my first contact with the kind of work an astronomer does"; "The great benefit was the outlook on the experiments"; and "I believe that some of the student experiments led by Prof. Rusu during the solar eclipse yielded much more valuable results than some "professional experiments". (He praises Prof. Rusu for preparing teaching experiments using ordinary things which anyone can find.)

INTERESTING REMARKS:

1) The broadening experience of ISYA was expressed in terms of "The school put me in contact for the first time with "research-oriented people"; "...a closer look at the real world of science".

2) "Mr. Guinan's course determined me to make extrasolar planets the topic of my diploma paper." For another student also, Guinan's lectures led to his B.Sc. thesis. After ISYA, Guinan wrote a letter of recommendation for a student to participate at an Erice winter school, where she met her current German thesis advisor (P. Biermann). She wrote: ISYA "completely shaped my life". ISYA was "the first time I heard about the dynamo mechanism in stars, now I have a paper on the large scale magnetic fields in the galaxy."

3) Gerbaldi's spectroscopy course ultimately led to a student's working in nuclear spectroscopy. And it was the practical activities (including those that summer organized by Prof. Rusu) which led this student to decide to do some experimental physics.

4) One student wrote that "the Eclipse was the main event" as the experimental light curve figured in her Diploma thesis.

5) There were numerous comments similar to "ISYA is an important experience in my scientific life"; "will never forget the eclipse".

ASTRONOMY EDUCATION IN USA

Donat G. Wentzel

University of Maryland, USA

I try to explain why I think US and European astronomy educators can benefit from independent development.

The science of astronomy is, of course, the same to be taught on all the continents. But the fraction of population to be reached is different in the USA and Europe, and therefore the most useful teaching methods are somewhat different.

Certainly the two groups can learn from each other, but I see the differences as an opportunity to enlarge the entire concept of astronomy education.

At the university level, the US system emphasizes the large introductory astronomy courses for "non-science" students, students who will take at most three science courses in college and only one of those in the physical sciences.

The assumed science and math background of the students is minimal.

The newly developing emphasis is on participatory learning - in contrast to passive listening in lectures - by small-group activities and discussions, and on research how to focus teaching successfully on the many misunderstandings of science that students bring into the astronomy course and, as we now learn far too often, still harbor after the course ends.

In Europe, the open universities (such as London) address this same population of students, but they have in fact developed their methods largely independently of the USA, quite successfully, and that may well provide some topics for your education meeting.

In contrast, as far as I know, most European universities' astronomy courses address university students with a stronger science background and with stronger intent to learn science.

These provide significantly different challenges.

At the school level, US education is regulated by thousands of regional school boards with a general curriculum decided upon independently by fifty state legislatures.

Some hundreds of schools have planetariums. But only the well-funded schools attract teachers with the initiative to learn and teach astronomy, generally outside the standard curriculum.

From US experience in the 1960's, it is clear that a diluted university-level course will not work because even the best teachers cannot absorb this material well enough to teach it.

Therefore, the current astronomy education efforts, mainly by NASA and the Astronomical Society of the Pacific, have focused on providing astronomy activities that can be adopted by (and paid for by) a relatively few (maybe a few hundred?) school systems, with the teachers participating in multi-week training sessions and, very importantly, receiving further support once they actually start teaching. (A group of 30 teachers met at my university for three consecutive summers even though they were teaching the material already after the first summer. Regarded as very successful.)

Regarding NASA data, I should emphasize that the difficulty is not the number of computers needed for looking at data but the selection of the data such that they can be made intelligible at the (high-)school level.

This has taken some fifteen years to develop and is finally becoming reasonably successful! Surely, this is of interest to European astronomy educators, but so far it is such an elitist system that I cannot see it working in European nations with a well-defined national curriculum, even though European teachers may be educated better than the average US teacher.

Michèle Gerbaldi offers training courses to French teachers, and probably some of the US initiatives could be adapted for European needs, but I suspect that will need a great deal of imagination and time.

As always there is the question whether one should promote whole astronomy courses or settle for portions of astronomy in other science courses. I think the latter is preferable because a smaller quantum of effort is needed to prepare teaching materials and train teachers and provide support for them once they teach.

But the politics involved in any educational system dominate the answer to that question.

PERSPECTIVE OF TEACHING OF ASTRONOMY IN ROMANIA

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There is no education, but personal example!
ª erban Þiþeica

Abstract: The astronomical education is an inseparable part of the scientific literacy of the population. So the Resolution of Commission 46 of IAU that astronomy should be an integral part of the school curriculum is welcome. We review the promising part of our achievements in this direction till now, but we want to stress the problems behind attaining this goal, at least in Romania. Analyzing the difficulties we face, we emphasize the main aspects that we shall try to solve in the next future, and the way we want to do it. We consider that the whole European astronomical and physical community should cooperate in a coherent way for this goal.

Introduction

Teaching of astronomy has a long tradition in Romania, at both undergraduate and graduate levels (beginning from the first years of the 20th century) [1]. Academic centers from various cities, like Cluj-Napoca, Ia°i, Timi°oara, continued to teach astronomy, mainly as a traditional Celestial Mechanics topics. A bit of interest in teaching of astronomy was steadily present from 1980 till now, and became almost extinct in school in the last 10 years, astronomy being removed from the high school curriculum. At the beginning of the 90's it was clear that the impact of this "politics" on education and research in astronomy was disastrous: astronomy literacy dropped down and there are no more young astronomers to enter research.

Teaching of astrophysics in a modern way in the Faculty of Physics of the University of Bucharest started in the 90's with some difficulties.

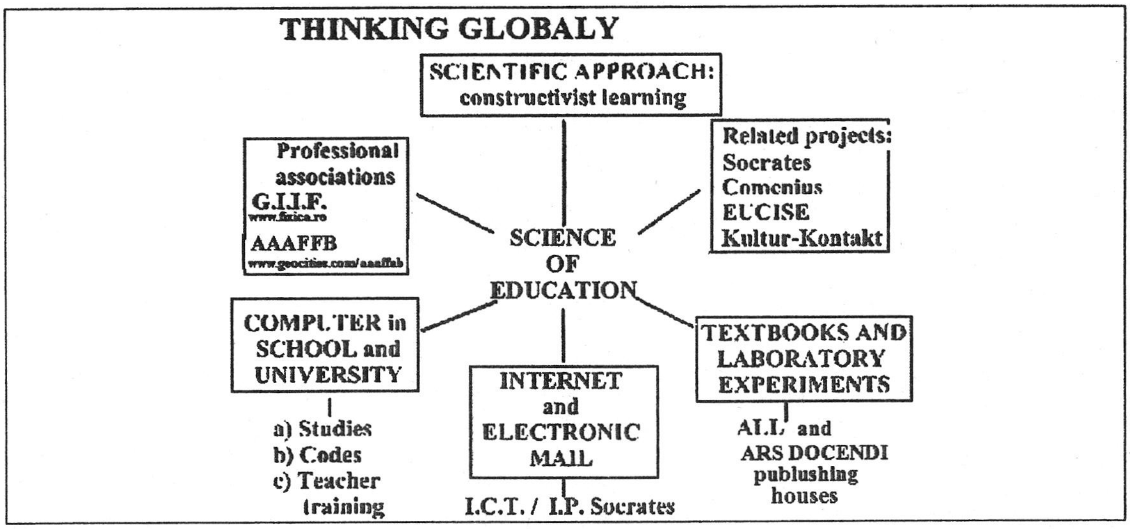
At the academic level, at least at the Faculty of Physics, we tried to attract the students to astrophysics, and we diversified the topics in astrophysics in order to take the advantage of the new opportunities of exchange and the European Community programs (Tempus, Socrates/Erasmus). As a result, step by step, the astrophysics increased in popularity and a lot of students took specific courses. Each year, at our faculty 20–30 students are interested in this field, and about a half of them choose a diploma thesis in astrophysics. About 10 of them are interested to obtain the M. Sc. degree in astrophysics, and are involved in student exchange programs (Erasmus OMS) at various European universities (Bonn – Germany, Turin – Italy, Paris-Meudon – France). Each year about a half of them are starting Ph.D. training at different universities from Europe, USA or Canada [2].

Strategies for success

Here are some of the ideas that guided our activities.

1. *Thinking globally*: not just pointlike activities (our duties and curricula), but in interconnection with other activities and aims.
2. *Thinking in the future*: not just for the near future, but thinking a long range strategy.
3. *Knowing in advance the sites students will study*; establish the agenda, and the living expenses for them, teachers strongly acting as coaches and tutors.
4. *Helping the students to coope with the teaching materials;* we are always training the students for the knowledge they need in training themselves.
5. *Combining introduction to scientific knowledge with ideas from science of education* (constructivist learning [3]).
6. *Trying to improve the didactic means available to students* (literature, computers and internet, laboratory devices).

All of these points are under continuous effort to be improved. We work incredibly hard to find funds and understanding from the authorities.



Conclusions from Socrates (Erasmus and Comenius) activities

We activated in all form of Erasmus projects: students mobility scheme (OMS), teacher exchange (TS), intensive projects (IP), common high school projects, and so on. Our conclusions (also presented and discussed at the international meeting in Frankfurt on Oder [2]) are the following ones:

1. It was the first extensive opportunity to know people, teachers, students from abroad.

2. It is the best way for European integration, in science and education. Romania is in Europe by a long time [1], but this allowed us to build bridges, to make friends, and to be known as a potential partner.

3. It is a real connection to and exchange with the European science and culture.

The main starting means for developing a solid astronomy education in our faculty (and in others too) are:

1- Producing a collection of astronomy and astrophysics problems.

2- Collecting a minimal base of the essential literature.

3- Setting a minimal laboratory for basic physical effects needed to understand astrophysics.

4- Obtaining a minimal astronomical observational instruments.

5- Establishing a good computing laboratory.

We started from the very beginning on these directions, but we have to continue hardly. We encouraged and started an astronomical association for students; the activity of this group could be find on the site: http://geocities.com/aaaffub.

The students participated in different astronomy schools, conferences and lectures at different European universities. They grow up quickly, and we are using their experience for the next generation of students.

In the field of Science of Education we managed to do a lot of fruitful things:

1. We managed to simulate the pre-academic teaching: a) to use computers in the school; b) to use Internet and e-mail; c) to be connected to the new methods of education; d) to face the new challenge of the changing world.

2. We started by writing textbooks for undergraduate schools and used new ideas (experiments, current phenomena, creative tasks, interdisciplinary thinking, etc.).

3. We managed to gather together teachers and scientists in the educational field all over the Romania (GIIF establishment, Group of Initiative for Physics Learning) and made them to think about education.

4. We helped teachers to made their own Socrates project: Comenius, and another one in: EUCISE program (*European Cooperation for Integrated Science Education*, Comenius 3.1 project, coordinated by Kiel University and Pedagogical Institute from Vienna and University N. Copernicus from Torun, Poland). To this end the PING concept was developed (***Praxis Integrierter** Naturwissenschaftlicher **Grundbildung***, teacher training using integrated science approach, in which astronomy is important).

5. We managed to make other connections with universities on other basis than Socrates, like *Kultur Kontact* from Austria (for high school programs) or French Embassy on the *Francophony* context and other countries and universities like Bonn, Turin, Paris-Meudon or Athens Universities.

Socrates remains essentially a great help for us, but we like that Socrates must be more elastic, to be able to accommodate different projected needs with the real, practical, situations.

Other activities that created conditions for boosting the astrophysics learning are the following:

Learning extepriment on web: *Astronomy On-Line*

The *Astronomy On-Line* was considered the biggest world's astronomy event on the WWW and it started in July 1996 under the EAAE/ESO program for the European Week for Scientific and Technological Culture, 1996. Romania was also present at that experiment with a National Steering Committee (NSC), and we have done a first step in such an European action.

Total Solar Eclipse of 11 August 1999 seen from Romania

At the Faculty of Physics of the University of Bucharest, we ensured the conditions for observing, measuring and doing a seminar dedicated the physics of eclipse (ISYA – 24th *International School for Young Astronomers*). We invited some 25 students from abroad and 25 students from Romania to attend the school with teachers from France, USA, Germany, Italy and Romania.

6th ESA student parabolic flight campaign, July 2003

"Skywalkers" team: *Florin Mingireanu, Mugurel Bălan, Istvan Lorand, Marius Tru°culescu,* students at the Faculty of Physics of the University of Bucharest, and *coordinator: Professor Mircea Rusu*, with the research experiment: "Electrolysis in g-zero field". Being among the teams accepted by ESA, as a valuable idea and, at the end, a serious research made another good point for our students to study astrophysics.

If the things will go well, we would like to be able to connect our laboratories to the facilities of the international observatories like in the following excerpt from internet:

"UK students use research telescope in Hawaii over Internet

http://www.canet3.net/news/news.html

The Faulkes Telescope Project will allow students in schools and colleges in the United Kingdom, Hawaii and Australia to make astronomical observations with research class telescopes, direct from the classroom via the Internet."

New ideas:

The very quick changes of the society need a new approach for the future man, which will be necessarily a sensitive man and better adapted to a quickly changing world. Hence we have at least two reasons for improving the educational system: first, to adapt it to the world in continuous change (for us, to rebuild the damages), and, second, to make use of the ideas from the new sciences [4].

For the first reason we must do such things like:

- to restore the confidence of the pupils in teacher and vice versa;
- *there is a strong need to reverse the method of finding the educational needs: from the pupils needs to the bureaucratic system that must find the means of solving the needs;*
- to complement the skill formation with the deep understanding of the phenomenon;
- to improve the methods of education using the new techniques: computers, multimedia systems, virtual reality, and direct observation of the phenomena (experiment);

- to make use of games for a deep understanding of the subject;

- we must bring the physics closer to nature, to the bear reality, to natural phenomena; we can do that now because of the knowledge we have.

For the second reason we must understand that:

- the pupils and the classes are "complex systems" and they could be dragged to the chaos, or to a good stability;

- a quick feedback between pupils and teachers is absolutely necessary for a good education;

- for many such goals the computer-aided education is a very important method.

We did and continue, in cooperation with the Bonn University, the following program (this project started already in August 2001):

A) lecture series project, with the students working it out in several steps:

a) producing a list of possible topics, and the initial literature

b) project for the student himself: the task would be to collect all the relevant literature for the lecture series project; the result would be a work-book;

c) each topic in the book would be the start of a small article, with computer programs attached, with graphics attached, and this work would be done by all students interested in. If there are several such segments from different students, then the students themselves should combine it into one article. Once a final segment is done, then one would still be able to iterate it;

d) we would begin to build a common tool to learn and teach, and do research;

e) there would never be an end, but a growing tree of topics, each of a certain length so as to make it possible to learn it. Occasionally, we would have to regroup topics, so as to rearrange the tree of learning;

f) we could also extend the tree to simpler levels, exciting students in both high school and other fields;

g) a lot of original research can be started from such a tree.

B) At some stage one could think of this as a several weeks school.

C) Some of the best students will start M. Sc. and Ph. D. stages.

D) Teachers, professors and students will be engaged in scientific research, attending conference and meetings.

E) Build a data base (computers, internet facilities), and an experimental base also (powerful computers for simulations and modeling phenomena) in the incoming University (Faculty of Physics, Bucharest, Romania).

F) At the end we can build small groups inviting Romanian people (scientists) back, but with a research and work environment matching that elsewhere in the world, and maybe better.

Conclusions:

- new knowledge can improve and boost the educational system;

- the necessity of knowing and practicing the new ideas; research in this field is needed;

- the necessity of having a forum of such discussions, with a large audience;

- internet and also face-to-face discussions are both important;

- difficult to find funds, not just for pointlike activities, but for the long term (range) of improving education;

- the most important is to educate young people in competitive science. They have then a choice to go wherever their talents and capabilities lead them. The entire pyramid of education, from kindergarten to top-level scientists and educators needs to be competitive with an international view.

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UKRAINIAN ASSOCIATION OF VARIABLE STARS OBSERVERS
U A V S O

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On August 4, 2003, the Ukrainian Association of Variable Stars Observers has been established. The aim of this association is to inform the amateurs in Ukraine and hopefully other countries on the different scientific programs of observations of variable stars.

The current projects which are being carried out are:

– Long-period variables (LPVs)

– Eclipsing binary stars

– Blazhko effect in RR Lyr-type pulsators

– Observations of suspected variable stars from the Hipparcos-Tycho and other giga-object surveys.

The UAVSO will work within the frame of the Ukrainian Association of Amateur Astronomers (UAAA, the President - Prof. Klim I. Churyumov, Astronomical Observatory of the Kiev National University) with a close collaboration with the section of amateur astronomy (head Prof. I. Duma) of the Ukrainian Astronomical Association (the President - Professor Yaroslav S. Yatskiv, director of the Main Astronomical Observatory of the National Academy of Sciences of Ukraine).

The results of observations of variable stars by Ukrainian amateurs are being submitted to the international databases in AAVSO (USA), AFOEV (France) and VSOLJ (Japan). The UAVSO will collaborate of the sections of Astroimages, Computer Astronomy and others from the UAAA. Results will be shown at our WWW page http://uavso.pochta.ru

TWENTY FIVE YEARS ODESSA CORRESPONDENCE ASTRONOMICAL COURSES (OCAC)

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Abstract: The aims and brief history of activity of the Odessa Correspondence Astronomical Courses (OCAC, Russian abbreviation ZASh) have been presented.

Odessa Correspondence Astronomical Courses are the public non-profit organization without any special funding neither from the state, nor from the pupils - members of these courses. OCAC have been initiated by the famous astronomer, organizer and popularizer of science Prof. Vladimir P. Tsessevich (1907-1983) with an initial aim of mail remote consultations of pupils and amateurs, who live at a large distance from astronomical centers. Prof. V. P. Tsessevich was an eminent person, the author of more than 700 publications and a dozen of monographs and books for amateur astronomers.

The first director of this school was Elena V. Menchenkova (1956-2000), who actively worked herself, initiating students and young collaborators of the observatory to participate. Under her supervision, few hundred answers to letters had been prepared and sent. During the first decade of the existence of ACAC, also actively worked M. Kosmykina-Yasinskaya, A. V. Yushschenko, V. F. Gopka, M. I. Myalkovskiy, I. L. Andronov. Since 1988, the directors were I. L. Andronov, L. L. Chinarova and L. S. Kudashkina.

The OCAC has started its work, when the number of correspondents was around a couple of dozens. However, OCAC became very popular in the former Soviet Union, and in mid-80s the annual number of letters had exceed 3200! For each form of the school, special sets of exercises have been developed. Each of them contained 3 exercises in mathematics, 3 in physics, and 4 in astronomy. During a year, 5 such lists of exercises are being sent to the pupil. The answers are being checked, and the initial letters are being returned with comments, if any, or with correct solutions, if the exercise was done wrongly.

Special individual tasks include visual and photographic observations of the Sun, Moon, planets, satellites, variable stars, eclipses, occultations, comets and other interesting phenomena. During recent years, an interest to computations has been increased, thus many of the works are devoted to elaboration of computer programs in modern languages. Some themes of such programs: the distribution of characteristics of stars of different types using databases (e.g. General Catalogue of Variable Stars), visualization and preliminary reduction of multi-channel observations, astronomic small dictionary/encyclopedia, models of plasma motion in binary stars, eclipsing binaries, reduction of photographic plates from the Odessa Sky Patrol, periodogram analysis of variable signals. The talks to the conferences are usually being prepared at the computer using the sequence of figures or Power Point presentations. Thus the pupils learn not only astronomy, but also mathematics and computer science.

There are no special funding from any of the state structures, but the mail expenses had been covered by the Odessa National University and, later on, by the Odessa region Station for Young Technicians (Russian abbreviation OblSUT). Moreover, in 1994-1995 the courses had been supplied by OblSUT as an astronomical group in addition to the "Small Academy of Sciences" (Russian abbreviation MAN) "Prometheus". Recently, OblSUT has joined the Odessa Regional Center for out-of-school Education and Teaching, thus OCAC returned to be an organization supplied only by enthusiasm of its leaders, as it was at the beginning a quarter of century ago.

THE ROLE OF KYIV PLANETARIUM AND THE JOURNAL "OUR SKY" FOR ASTRONOMICAL EDUCATION IN UKRAINE

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Abstract: The main task of the Kyiv Republican Planetarium, side by side with lecturing on astronomy and space physics for population, is also active support of teaching astronomy in secondary and high schools. In the Planetarium educational astronomical programs are made so as to be closely connected with school teachers of Kyiv and intended at introducing certain additions to the traditional school programs and therefore their expansion. They allow to better understand and to study deeper numerous astronomical phenomena and physical mechanisms of cosmic processes. In the Planetarium's educational programs up-to-date scientific information about new discoveries in astronomy obtained with the help of the world largest telescopes, the Hubble Space telescope and space vehicles.

Kyiv planetarium is one of the leading cultural and educational centers of Ukraine for propagation of astronomical knowledge (of astronomical sciences).

In 2002 Kyiv planetarium celebrated its 50^{th} anniversary.

The main direction of the Planetarium activities is to provide lectures and scientific and cultural programs devoted to astronomy, cosmonautics, geography and natural sciences. Every year the Planetarium is visited by hundreds of thousands of attendances.

A prominent place in the Planetarium's activity is given to educational programs. They are worked out in accordance with educational plans and are aimed at supplying educational material to school lessons. The planetarium's possibilities allow, using visual aids, rich demonstration material to interpret the laws of nature and feel those things which neither class nor books or TV could give. Besides educational lectures traditional are children programs which in the form of fairy tails or interesting narration acquaint little listeners with mysterious riddles of the Universe.

Programs for a wide circle of viewers are demonstrated mainly on weekends. Attendants are proposed a wide circle of topics: this is a traditional "alive" lecture about the starry sky of tonight, a story about the newest scientific discoveries and audiovisual programs with the help of special video-effects and systems of computer graphics which allow viewers to feel themselves participants in space events.

During such lectures the newest information which has been obtained from the most powerful telescopes, space stations and observatories around the world is used.

Numerous light effects of the apparatus "Planetarium" are: the starry sky, the Sun, the planets, comets, meteor showers, solar and moon eclipses, all giving an opportunity to get acquainted with the rare natural phenomena. Picturesque slides, fragments of videos make programs much more demonstrative and informative. Though the Planetarium can be considered as a place of impressive star performances.

The scientific creational potential of the Planetarium fruitfully works at perfecting forms and methods of delivering lectures, modernizing demonstration devices, visual materials.

Lectures provide tight connection with methodological societies of teachers. Of great importance is a permanently working seminar for teachers of astronomy original sources. Where leading lecturers of the observatories read practical classes. The Kyiv Planetarium is constantly developing tight contacts with other planetariums of Ukraine and Russia.

During festivals of planetarium's programs, which are periodically held in Kyiv, lecturers from all Ukrainian planetariums and numerous Russian ones take part with great pleasure.

On the basis of Planetarium, the school of astronomy in which education is delivered on 3 levels is functioning. On the first level which involves pupils of the primary school children are getting acquainted with the fundamentals of astronomy through games. They learn how to find constellations, they watch thematic videos and cartoons.

The second level, made for pupils of the intermediate stage, supposes more deep study of general astronomy, the ability to work with star maps, carry out astronomical observations. On the third level pupils of senior classes and other amateurs of astronomy study in detail individual topics, attend observatories, participate in scientific researches.

The staff of the Planetarium is planning further expansion of opportunities of this unique establishment on the basis of the exposition in the hall to create the museum of the Universe; to organize an educational and scientific center, equipped with TV and other projection devices, modern electronics, a library with special scientific and popular literature; to build an astronomical area equipped with various astronomical devices, models, instruments for delivering classes and excursions; to make a hall for space attractions.

Earlier people were dreaming about space travels. Today everyone may become a space tourist. But it is a pity that the price of such a tour is quite great for ordinary citizen. We also propose to have no less bright impressions for anyone who will visit Kyiv planetarium – a miniature model of the Universe. The staff of the Planetarium is constantly working in order to make new more perfect lectures in astronomy using modern devices to demonstrate the newest achievement in Astronomy and Astrophysics.

The first popular astronomical journal "Our Sky" ("Nashe Nebo" in Ukrainian, founded in 1998) to wider the horizon school children who study astronomy in secondary school [1]. It helps teachers to get fresh information about new discoveries in astronomy and to get their pupils acquainted with them.

At the end we would like to cite Poincaré's words from his book "Treasures of Science":
"...Astronomy is useful because it makes us feel more perfect; it is useful because it is great; it is useful because it is beautiful. Namely it shows us how weak is the man's body and how great is his spirit. Because his mind can reach the mysterious depths, where his body is only a dark point which can get pleasure from their harmony. In such a way we come to understanding our power... And here no price can be too expensive, because understanding this makes us stronger".

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V. I. VERNADSKY: THE ASTRONOMICAL KNOWLEDGE IN NATURAL SCIENCES

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There are many reasons of necessity and advantage of mastering by astronomical knowledge for any person and especially for the naturalist. By the example of works of V. I. Vernadsky we can see, how the wide and deep knowledge of astronomy and astrophysics enabled him to achieve essentially new results in his researches and to lay new directions in geology and biology. He has set up such new sciences as biogeochemistry and cosmochemistry. Astronomical knowledge lays also in a basis of the main work of Vernadsky - the doctrines of living matter.

It is known that the interest in celestial bodies and processes has appeared at the beginning of existence of Homo sapiens. People from ancient times established connections between the astronomical phenomena and change of seasons, which determined all the life of an ancient man. The repeatability of the majority of astronomical events enabled to predict appropriate terrestrial processes and phenomena with a high accuracy. Such a first science – astronomy had appeared, and then other sciences appeared too. But for a long time the astronomy remained a leading science, which had not been only applied to navigation or agriculture, but also had determined bases of world outlook of people. Achievements in the field of astronomy more than once principally changed a scientific picture of the world as in the cases of transition from geocentric model of the world to heliocentric one, or a repudiation of the concept of hard sky and an acceptance of infinity of the universe and multiplicity of the worlds in it. In the second half of the XIX-th century, the youngest science – physics has got out on leading positions among natural sciences. Revolutionary discoveries of physics at the end of XIX-th – the beginning of XX-th century underlay a new picture of the world, and in a science the opinion was developed that all the laws necessary for an explanation of any phenomena, including astronomical ones, are already opened by "terrestrial" physics, or laid in its field of research. For the astronomy a role of a passive observing science, which only puts theoretical tasks before physics was destined. However, successes of astronomy of last years again leaded it to advanced frontiers of scientific knowledge. Flights of automatic vehicles, which became possible due to such an area of astronomy, as astrometry, have enabled the mankind to step out in its empirical knowledge to the limits of Solar system. The photographic reviews of whole sky and the subsequent measurements of stars and galaxies coordinates in a combination with other methods of observation, have let scientists to make a model of large-scale structure of the universe. Successes in other area of astronomy – astrophysics – have brought the knowledge about chemical composition, structure and evolution of other worlds – stars and galaxies. New tools and methods of observations have allowed to answer a question for a long time tormenting the man of the Earth – whether our Sun only has a system of planets. And just the astronomy of last years has discovered the facts which are capable to turn a picture of the world around again. Data received as a result of the newest astronomical experiments and accounts, based on them, require perception from other world view positions, induce to look for new approaches in developments of experiments, to apply new methods and means of observations. The obvious example to be convinced of it is a rough progress in the study of so-called "missing mass" of the universe and of "black holes".

As well as all essentially new, the idea of existence of missing mass in the universe strengthened itself in a science with large difficulties. In the early forties of last century the great scientist and philosopher V. I. Vernadsky wrote: "Now we face a solution of "empty" world space – vacuum. It is laboratory for most grandiose matter-power processes" (Vernadsky, 1965, ð.19). The scientist has predicted also forms of existence of matter-energy of this space, putting forward as a working scientific hypothesis the following thesis: " ... the less material bodies are in it, the higher its "temperature" is, which will express us as though accumulation of free energy for these open wide spaces – the field of forces" (Vernadsky, 1965, ð.19). This hypothesis of the scientist was out of attention of an experimental science for a long time and only now, more than half a century after, proves to be true by advanced achievements of astronomy. Vernadsky was an expert in the field of Earth sciences. But his deep astronomical knowledge and wide complex approach to subjects and phenomena under investigation resulted in the development of new methods of research in these sciences, that brought essentially new results. He was the founder of such new scientific directions in natural sciences, as geochemistry, biogeochemistry, radiogeology, spacechemistry. Basing on knowledge of the universe, the Solar system, processes occurring in the space, Vernadsky made the conclusions, how the Earth, its crust, rocks and soils were formed. He showed, what role the constant influence of space in the form of space substance – meteorites and dust, and in the form of "matter-energy", as he named them, – penetrating space radiations, plays in these processes. Due to his knowledge of astronomy, Vernadsky studied the Earth as though "from outside", contrary to study "from inside" – traditional for his time, when there were no spaceflights yet. The same principle of interaction of substance of the Earth with matter-energy of space formed the basis of Vernadsky's doctrine of living matter – the biosphere. The scientist emphasized the special importance of radiant energy of the Sun in formation of life on the Earth. Basing on astronomical knowledge, Vernadsky comprehended the scientific facts of a history of biosphere in a new fashion. He considered a terrestrial surface as the phenomenon of a space nature, where traces of space events occurs, influenced upon terrestrial objects and processes, where a transformation of radiant energy of the Sun into chemical energy of living matter takes place. Studying the biosphere from these grounds, Vernadsky has described, how our planet looks like from space forty years prior to the launch of the first artificial Earth satellite (Vernadsky, 1967, ð.225). But not only the astronomy has helped to Vernadsky in studying the Earth, but also the Earth sciences have brought their contribution to the development of astronomy. Now it does not cause a surprise, but in first half of ÕÕ century, when Vernadsky considered the Earth as an experimental platform for studying and checking cosmogonic hypotheses, it was truly revolutionary approach. He wrote in the early forties: "Conclusions of the geology are not less important for planetary astronomy, than conclusions of this one for the geology, for the Earth is a single planet, which we can study armed by all means with that huge capacity which a technique of modern natural sciences possesses" (Vernadsky, 1965, ð.77).

Thus an example of scientific creativity of Vernadsky convinces us, that the knowledge of astronomy can be radically reflected in achievements of other sciences, bringing new ideas, new approaches and methods of researches.

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ASTRONOMY EDUCATION IN UKRAINE: STATUS, PERSPECTIVES, AND ACTIVITY OF THE UKRAINIAN ASTRONOMICAL ASSOCIATION

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In 1991 the Ukrainian Astronomical Association was organized as the National Committee of Astronomers. Among the principal objectives of the UAA activity the promotion for astronomical education in Ukraine has been put as the important one. At the same time the first monitoring has shown that a situation as concerns with astroeducation in schools has became worse in comparison with the Soviet type education (it's known that the subject "Astronomy" was the basic discipline at the Soviet type schools being the course of 34 academic hours at the 10 last grade).

In 1996, the UAA initiated the next such a monitoring in the 5 large cities of Ukraine (Kyiv, Odessa, Kharkiv, L'viv, Uzhgorod). Analysis of trends was as follows. a) "Astronomy" subject as the basic discipline has been lectured in 20 % of schools, and as the facultative course in 15 % of schools. b) The qualification of teachers, who lectured astronomy, was the following: 3 % of them were lecturers in astronomy, 53 % of them were in physics, 15 % of them were in math, 7 % of then were in geography, and 22 % of them were in human sciences. c) Only 15 % of schools had telescopes, and 16 % of schools had another astronomical equipment; only 43 % of schools had various training aids, and 11 % of schools had sky atlases. It has become obviously that a radical attention is claimed to improve this current situation.

By this reason, in 1996 – 1998 the UAA developed and recommended some proposals to the Ministry of Education and Science of Ukraine, among them were to input the astronomy discipline as the basic one at the faculties of natural sciences at the pedagogical universities, to increase a number of academic hours for student practice in observatories during the summer vacations, to input the "Astronomy" discipline inside the "Astrophysics" discipline in bachelor programs in universities. The numerous letters both to this Ministry and to the Special Committee on Education and Science of the Supreme Rada of Ukraine have been also directed with explanation of importance of astronomical education for youth and with recommendations to input the Astronomy discipline as the basic one for the general not specialized schools. Our appeals have been heard at last.

Moreover, in 1998 – 1999 this Ministry, which has began to develop new programs of school education in Ukraine, proposed to the UAA be helping them in decision of some items. Above all, the stumbling block was the absence of schoolbooks in Astronomy written in Ukrainian. And the UAA decided to prepare such books for all the types of schools. Among others we note also participation of the UAA members in the planetarium's activity, in the organization of summer schools for young astronomers and students, in the holding of various astronomical school olympiads, in the renewal of educational programs in pedagogical institutions, in the holding of training courses for teachers in astronomy.

In 2001, the new system of education in Ukraine was adopted at the state level. Namely, the scholar level education (12 years) is divided on 3 categories: General not specialized schools (i.e. with in-depth education in specialized courses during the last three years of training); Specialized Lyceums of the natural sciences; Specialized Gymnasiums of the human sciences. In 2000, the first "Astronomy" manual for the general not specialized schools was published (authors I. A. Klymyshyn, I. P. Kryachko) as well as a number of school sky atlases, books of problems.

As concerns with the input of the "Astronomy" discipline as the basic one for school programs, the situation has changed strongly when the one of the authors of this paper has took the position of the First Deputy-Minister of Education and Science of Ukraine in 2000-2001. The "Astronomy" was included as the basic discipline in the school standard of education in Ukraine.

Now the subject "Astronomy" is the obligated course (basic discipline) in general not specialized schools (at the 12-th year of education, 17 academic hours per year) and in specialized lyceums of the natural sciences. The State Standard of School Education in Ukraine envisages also the facultative course of Astronomy in specialized gymnasiums of the human sciences. Some aspects of the astronomical education are included in courses of natural history and physics for the 6 – 11 grades of schools.

The following Universities train students in astronomy (Classic courses of astronomy, astrophysics and space physics; Holding the bachelor, specialist and master degrees): Kyiv Shevchenko National University (15 students per year), Odessa Mechnikov National University (15 students per year), Kharkiv Karazin National University (10 students per year), L'viv Franko National University (20 students per year). The Taurian Vernadsky National University, Dnipropetrovsk National University, and Uzhgorod National University and some pedagogical universities have the astronomical chairs. About of 80 % of the entered students finish their education through 5 years. About of 50 % of students, who finished their education, follow to work in astronomy. About of 30 % of holders of specialist/master degree defend thesis during the 3-7 years after the finishing high education

Saying about the amatory activity, it should be noted that in august 2003 the formation of the Ukrainian society of amateurs (USA) of astronomy was initiated during the ASTROFEST-2003 congress of amateurs held in Kerch. The Officers of the USA were elected (the well-known astronomers, Prof. Churyumov K.I. (President) and Prof. Andronov I. L. (Vice-President)) as well as coordinators of sections of amateurs of astronomy. Several amateur societies work in Odessa, Vinnytsya, and Kyiv. Such journals as the "Nashe Nebo" ("Our Sky") and "Suzir'ya" ("Constellation") are very popular among amateurs.

Among the unsettled tasks, which demand of a rapt attention of the UAA, are to prepare and publish a number of courses in astronomy for schools, pedagogical institutions, and first of all for universities; to train school teachers in astronomy through the Institutes of post-diploma education or through teacher seminars;

The status and perspectives of astronomical education will be discussed at the VI UAA Meeting (October 8, 2003).

ASTRONOMICAL EDUCATION AT THE UNIVERSITY OF SZEGED

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Students in astronomy have been educated at the University of Szeged since 1999. We have 5-15 new students each year. Beside the theoretical subjects, the education concentrates on practical applications in observational astronomy, with special emphasis on CCD photometry and digital image processing. We make observations with instruments in the Szeged Observatory (40 cm Cassegrain and 28 cm Schmidt-Cassegrain) and have regularly telescope times scheduled on telescopes of the Konkoly Observatory and other institutions abroad.

The main research fields are the pulsating, eclipsing and cataclysmic variable stars, time-series analysis, star clusters, and astrometry and spectrophotometry of asteroids and comets.

Staff of the astronomical group: 4 lecturers, 5 Ph.D. students.

The illustration is especially important in the education of astronomy. We continuously collect pictures, figures, simulations and animations from the Internet and order them by its content. There are several thousand elements in this database (6 full CD-ROMs). We compile and edit the material for our actual lectures from this database. Short video films are used too.

Our poster has also presented the overview of our recent results, the curriculum and some images of the telescopes. The interested reader can find these details on our webpage at *http://astro.u-szeged.hu*. As an example, we list below the brief content of the course "Introduction to Astronomy". The traditional sequence of subjects is changed because the Solar system perhaps is more interesting and motivate better as the classical spherical astronomy.

Introduction to Astronomy
4 semesters (for students of astronomy, facultative for others)

1st semester (3 hours lecture + 2 hours practice weekly)
Solar system, space research
1. Origin and short history of astronomy. Astronomy and other sciences. Fields of astronomy. Main methods of studies. Important steps in space research.
2. Discovery of the solar system. Main properties, structure. Modern instruments in space and on the ground.
3. The Sun: global character, structure, energy production, energy transfer. Magnetic fields. Solar activity: sunspots, faculae, prominences, flares, CMEs. SOHO, TRACE.
4. Earth-like planets: Mercury, Venus, Earth, Mars. Origin of satellites.
5. Giant planets: Jupiter, Saturn, Uranus, Neptune. Atmospheres and inner structure.
6. Rings and satellite systems. Planetology.
7. Minor planets. Asteroid belt, distributions, families, forms, types. Trojans, Lagrange-points.
8. Comets, meteors, interplanetary matter, zodiacal light. Outer parts: Kuiper-belt, Oort-cloud.
9. Cosmic impacts, craters. PHAs, NEOs. Spaceguard. Evolutionary effects.
10. Origin of solar system.
11. Exobiology, life in the solar system.
12. Exoplanets: methods of discovery, results.

2nd semester (3 hours lecture + 2 hours practice weekly)
Spherical astronomy, astrometry, celestial mechanics, instruments
1. Celestial sphere. Magnitude scale. Constellations. Maps, charts. Criticism of astrology.
2. Coordinate systems (horizontal, equatorial I., II., ecliptical, galactic).
3. Transformations between coordinate systems. Fundamental astrometry. Hipparcos, GAIA.

4. Motions of the Sun and Moon. Eclipses and transits.
5. Definition of orbital elements. Time units (day, month, year). Sidereal time, solar time, UT, UTC. Polar motions, rotation of the Earth.
6. Calendar, Julian Date. Geographical position determination, GPS, Galileo.
7. Refraction, aberration, parallax, precession, nutation. Proper motion of the stars. Evidence for rotation and orbital motion of the Earth.
8. Changes of orbital elements. Glacial periods, ice-ages, Milankovic-Bacsák theory. Climatic changes.
9. Celestial mechanics. N-body problem. Two-body problem, planetary orbits. Kepler-laws.
10. Three-body problem, libration points. Stability of Troians. Transit orbits between planets. Paradox in celestial mechanics. Orbits of satellites. Orbits of exoplanets.
11. Astronomical telescopes, instruments. Optical systems, aberrations. Observatories, giant telescopes. VLBI. Space telescopes in all wavelengths.
12. Photometry, spectroscopy, astrometry. Detectors, PMT, CCD. Digital image processing.

3rd semester (2 hours lecture + 2 hours practice weekly)

Stars

1. Basic parameters of the stars (mass, radius, surface temperature, luminosity).
2. Basic parameters of the stars (absolute and apparent magnitudes, chemical composition, age, magnetic field, rotation, stellar wind).
3. Stellar spectra (continuum and spectral lines, emission, absorption).
4. Vogt-Russell theorem. Stellar models.
5. Hertzsprung-Russell diagram.
6. Evolution of stars: birth, life cycle, final stages.
7. Nuclear reactions in stars, creation of chemical elements.
8. Double and binary stars (visual, astrometric, spectroscopic, eclipsing binaries).
9. Variable stars (pulsating, eclipsing, spotted, eruptive, cataclysmic variables).
10. Analysis of the light curves. Spectral characteristics.
11. Period determination (O-C diagram, Fourier-analysis, wavelet, time-frequency methods).
12. Solar physics. Solar activity and oscillations.

4th semester (2 hours lecture + 2 hours practice weekly)

Galactic astronomy, cosmology

1. Interstellar matter. Gas-, dust- and molecular clouds. Star formation.
2. Star clusters (associations, globular and open clusters).
3. Structure of the Milky Way (nucleus, bulge, disk, halo, corona, spiral pattern).
4. Galaxies, clusters of galaxies. Active Galactic Nuclei, quasars.
5. Interaction between galaxies. Simulations.
6. Redshift of spectral lines, Hubble-law, distance determination.
7. Observational pieces of evidence of hot Universe model (CMB, H-He ratio).
8. Evolution of the Universe, models, cosmology.
9. Gravitational waves (origin, detectors).
10. Gravitational lenses (micro- and macrolensing). Problem of dark matter.
11. Astronomical implications of the theory of general relativity.
12. Neutrino astronomy, neutrino detectors.

TEN YEARS OF DIDACTIC ACTIVITIES OF THE "*CÍRCULO ASTRONÓMICO DEL MEDITERRÁNEO*"

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Abstract: Among the Astronomical teaching activities that ***the Circulo Astronómico del Mediterráneo*** (CAM) organize we should highlight the Astronomy and Astrophysics Summer School. Next year it will be their 10th edition.

1. Introduction

The introduction of Astronomy in Spanish school programs has been gradual and has required a great effort, amongst other reasons because the majority of the teaching staff has not received astronomical training. Aware of this fact, the CAM has been organizing the Astronomy and Astrophysics Summer School for the last ten years. The main aim of this course can be summed up by saying that the conditions and means available are exploited to the maximum in an appropriate environment in order to provide the teachers taking part with the theoretical, practical and methodological preparation required to give an Astronomy Workshop in Secondary Schools.

2. Organization and Structure

The Summer School is organized by the CAM and the CEFIRE (In-service Teachers Training Center) in Benidorm, with the participation of professional astronomers and astronomical teaching specialists. A maximum of 40 secondary school teachers are chosen from 100 applicants, valuing their degree of involvement in activities related to teaching Astronomy, or the intention to become involved (the possibility of giving the Astronomy Workshop in Secondary Schools).

The School is held in the Environmental Education Center "*Los Molinos*" built in the Sierra de Crevillente (Alicante) and owned by the **Caja de Ahorros del Mediterráneo,** the promoter of the initiative that funds its premises and activities. The Center is equipped with an Astronomy Classroom holding up to 50, equipped with a wide range of teaching materials such as, binoculars, telescopes, sundials, etc., a small planetarium holding up to 20, an audiovisual room, an "astronomical balcony".

The activities take place from Monday to Friday, accounting 40 teaching hours. The school begins with a welcome ceremony during which the participants receive information on logistics and session schedules. They are also offered the chance of choosing which workshops they wish to attend each day.

3. Description of the Activities

The **Astronomy Didactics** classes consist of presenting and discussing teaching material for the in-depth study of teaching the earth-sun-moon-star system and for introducing planetary motion. These materials are the result of an iterative process of innovation-research, so they have been modified bearing in mind the students' results. The main aims are: to update teachers knowledge, to make them aware of the alternative ideas in their students' mind and to provide tools to overcome the problems raised by the teaching/learning of Astronomy.

The **Basic Astrophysics** classes aim to teach basic Astrophysical concepts: light (OEM) as a source of information in Astrophysics. Basic concepts of radiation theory and its applications in determining stellar parameters (magnitudes, distances, luminosities, temperatures...). Furthermore, it is also considered a good idea to deal with knowledge concerning stellar evolution which will thus allow us to study "exotic" objects such as neutron stars, black holes... We end with an introductory view to Cosmology. It seems a lot in such a short time, but we must remember that the participants already have a certain level and that this intensive program is complemented with the spectroscopy, astrophysics, and H-R diagram, etc. workshops.

There are parallel free-choice activities organized in workshops or practical classes that are repeated on successive days, depending on the demand. Examples of some workshops are listed below:

The Sundial and Coordinates and Time Workshops are aimed to help teachers to acquire skills when dealing with different coordinate systems and in the measurement of time.

The **Spectroscopy Workshop** involved the observation and identification of the emission lines of different elements using discharge tubes, observation and study of the solar spectrum, using for all this a cost-effective "Project Star Spectrometer".

Astrophysics Workshop, in which a simple economical spectroscope was built using a matchbox and the 1/8 of a CD (compact-disc)

As the participants are teachers from different Spanish centers, we make the most of the opportunity to **exchange experiences** concerning activities associated with the teaching of Astronomy in their respective centers. Finally, the activities that take place throughout the day are magnificently complemented by the nocturnal observations using the **Astronomical Observatory** equipped with a 400 mm Newton telescope, a 160 mm apochromatic refracting telescope, cameras for astrophotography, a photoelectric photometer, two CCD cameras, solar filter, Strömgren and Johnson filters and all the accessories needed to take maximum advantage of the excellent equipment.

4. Conclusions

The organization of the Summer School has allowed us to draw some conclusions. The number of applicants remains reasonably constant, leading us to believe that the School plays an important role in training Primary and Secondary school teachers. Some teachers who have already attended the courses reapply. The excellent overall rating of the School by the participants allows us to be reasonably optimistic in relation to the aims we have set ourselves.

ASTRONOMICAL EDUCATION IN ODESSA (UKRAINE)

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Abstract: Main directions of activity in popularization of astronomy and education of amateurs are briefly described.

Odessa is the largest cultural and scientific center at the southern part of Ukraine. There are many professional and amateur groups working for popularization of astronomy and astronomical education. The professional astronomers are being educated at the Department of Astronomy of the Faculty of Physics of the Odessa National University (DA ONU, head Prof. V. G. Karetnikov).

The popularization of astronomy is one of important tasks. The Odessa Astronomical Society (OAS, chairman Dr. M. I. Ryabov) joins Odessa astronomers from the National University, Radioastronomical institute of the National Academy of Sciences of Ukraine and other scientific centers. The members of this society present monthly reviews in the Odessa Palace of Scientists, as well as "Astronomical Seasons" four times per year. These series of public lectures cover a variety of astronomical problems without duplicates. Much more often public lectures are presented in the Planetarium of DA ONU. There are also excursions to the Astronomical Observatory of the Odessa National University, regular TV interviews, articles and news in regional newspapers, a TV program "Space weather forecast".

There is a state organization called the "Odessa regional humanitary center for out-of-school education and training" which makes a huge work on organization of more than forty different sections, one of them is astronomy (supervisor Prof. I. L. Andronov). The "Small Academy of Science" (SAS) has been created, within which there are summer schools, mini-conferences for teachers and section supervisors. Every year a regional conference-competition takes place, and best participants are awarded by diploma and trips to other all-country and international conferences and schools for young astronomers. Some SAS members take part in the work of the Sunday Astronomical School (head Dr. V. I. Marsakova) and of the Odessa Astronomical Correspondence Courses (heads Dr. L. S. Kudashkina and L. L. Chinarova).

An important part of education is literature. The "Odessa Astronomical Calendar" (editor-in-chief Prof. V. G. Karetnikov) contains not only ephemeredes, but also short reviews and news of the previous year). A series of booklets has been published. Recently a CD version of the textbook "Astronomy at school" (I. L. Andronov, V. I. Marsakova, L. S. Kudashkina, L. L. Chinarova, L. L. Shakun) has been prepared with materials for scholars and teachers.

We also take part in national astronomical educational projects: the popular journal "Nashe Nebo" ("Our Sky"), the Ukrainian Association of Amateur Astronomers (UAAA), annual conferences for amateurs and teachers "Astrofest" (head of them Prof. K. I. Churyumov), Ukrainian Association of Variable Stars Observers (UAVSO, http://uavso.pochta.ru, head Prof. Ivan L. Andronov). In the Ukrainian Astronomical Society (President Prof. Yu. S. Yatskiv), there is the section for amateur astronomy (head Prof. K. I. Churyumov).