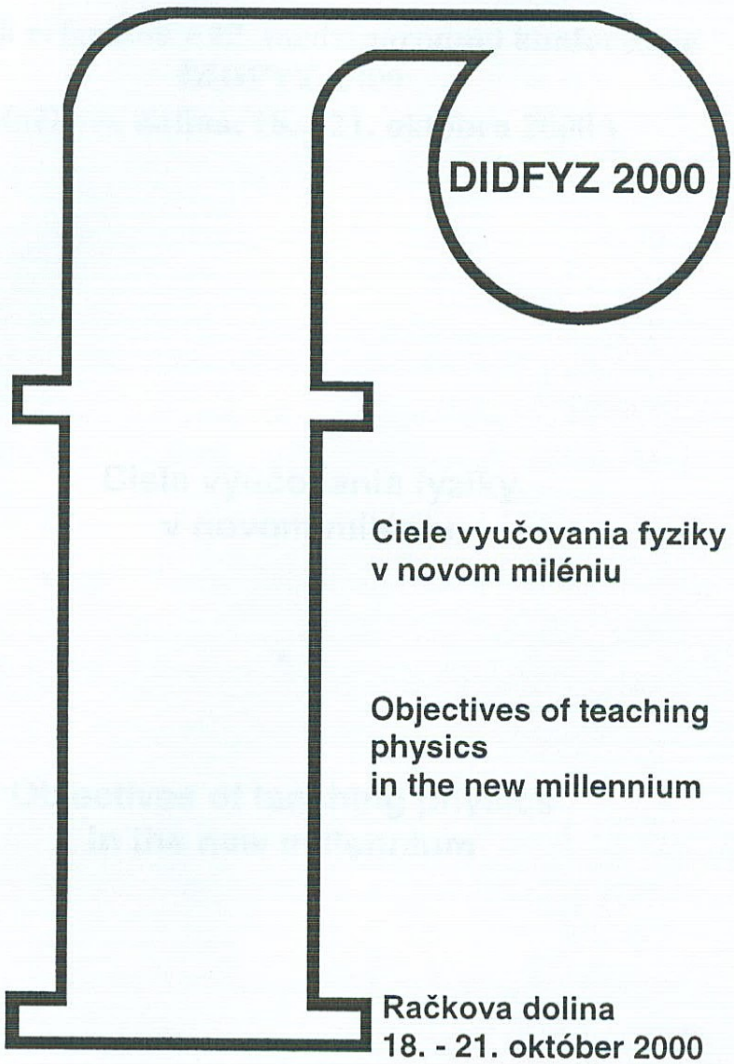

Ciele vyučovania fyziky v novom miléniu

Objectives of teaching physics in the new millennium

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Nitra 2001

SOCIAL IMPORTANCE OF TEACHING ASTRONOMY

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At the time of political and economic transformations, in difficult situations for many people, there is observed escape from rational thinking, from naturalistic outlook and analysis of the phenomena occurring in the nature.

Moreover, activity of individuals and institutions aiming at making money from credulity and ignorance of many members of society is observed. The invasion of delusive and irrational radio and television programs takes place.

At present Poland experiences the period of educational reforms.

In the seventies when there was great progress of world technologies, space travels, inventions and discoveries made by physicists, stimulating development of electronics, miniaturization of electronic elements and at the time of sensational achievements in chemistry (new compounds, alloys), a very ambitions and at the same time difficult curriculum of teaching physics was elaborated. Many good though difficult physics handbooks were produced.

The present reform, in the face of world-wide trends to diminish the role of physics, leads to formation of "easy, simple and pleasant curricula". In the face of reduction of physics lessons number, subject-matter reduction had to take place. In my opinion, modeling on some western handbooks is wrong and even harmful. As the co-author of some physics and astronomy handbooks, I had to force introducing some elementary equations describing the phenomenon or the law of nature. I can quote the pupils` statements, who seeing the equations in the text, say "it is clear, I understand it, the quantity on the right of the equation increases (e.g. acceleration), that on the left must increase too (e.g. force)".

Simple mathematical dependencies, which are so important, describe nature and the laws operating in it being a tool for the teacher in solving cute tasks and problems.

In my opinion, Polish educational system enjoys high standard thanks to a great effort of teachers who must overcome some difficulties: large classes during experimental lessons in laboratories, small number of teaching hours, financial troubles of schools difficult financial situation of teachers. I know some cases of university graduates in physics who were average students but

working in the industrial and scientific laboratories in the West they achieve both scientific and financial successes.

Another problem is invasion of astrological contents and knowledge in mass media (newspapers, magazines, TV).

My personal defeat was removal of short fragments in the handbook as suggested by the reviewers, concerning critical remarks about astrological subjects ("the handbook author should not express his personal views").

In the group of physicists and biophysicists we discussed the problem of actual effect of astronomical bodies on the Earth inhabitants. We came to the conclusion that the Sun affects organisms probably due to varying magnetic field under the effect of corpuscular and ultraviolet radiation of the Sun. Generally speaking: the Sun activity affects the inhabitants on the Earth. Many meteorological factors also affect our frame of mind. But this should be discussed by meteorological professionals. A meteorological factor can be the length of the day that is sunlight, its intensity - the parameters depending on seasons. However, the distant stars and zodiac signs do not exert influence. Numerous, elementary reports indicate that horoscopes use the concept "zodiac signs" which due to the precession of the Earth rotation axis are not at present identical to "zodiacal constellations" against the background of the Sun whose movement is apparent reflecting the actual movement round the Sun.

The "rotary map of the sky" published by the Main Board of Polish Society of Amateur Astronomers is a very useful and interesting educational aid in astronomy. It includes all necessary elements to describe appearance of the sky at different time and seasons and location of the Sun against the background of stars. This should make easier for pupils to get to know when the Sun rises and sets and in the dark to start e.g. evening or night astronomical observations. To find planets one should use so called "Astronomical Calendar" published yearly also by the Main Board of Polish Society of Amateur Astronomers.

Unfortunately some firms produce maps for ... astrologers, though they are addressed to pupils, students and teachers. Instead of marks on the ecliptic indicating "the situation" of the Sun against the background of stars (as marked on the maps published by Polish Society of Amateur Astronomers), the producers of these graphically impressive maps place the names of zodiac signs which have nothing in common with the actual localization of the Sun. It should be mentioned that due to the precession of the Earth rotation axis mentioned earlier, the zodiac signs at present differ from zodiacal constellations by about one and half constellations out of the series of twelve constellations situated on so called ecliptic. After hearing this information pupils and students often ask: "in such a situation how should we read horoscopes or move prophesies by one or two signs". The answer is only

one: do not read horoscopes. They are without any sense, they include general prophesies and are not based on any nature laws. One can only regret that newspapers or even main TV stations broadcast these horoscopes and in discussions they refer to astrological authorities. Astrology is not science.

As a physicist who is careful and critical towards physical experiment and astronomical observation results, I am fully aware of cognitive area limitations and I am convinced that new discoveries take place. Maybe according to this rule of being cautious and critical my statements should not be so firm. I am encouraged in this respect by the authorities in physics who made many critical statements about astrology, horoscopes and phenomena described only for sensational and commercial reasons in public.

I am convinced there are many natural phenomena which should be dealt with by physicists who as scientists are accustomed to precise investigations taking into account side effects difficult to get under control. They are able to recognize them, often eliminate or at least take into account in the results of their investigations.

Astrophysics, the science about physics of the phenomena occurring in the Universe plays a significant role in the development of progressive perception of law working (known from laboratories or everyday life) on a larger scale than from laboratories or the Earth. We extend the work of these laws „in the Universe" and perceive manifestation of their work.

Astrophysical investigations are characterized by the following features:

1) No possibility of repeating the experiment at the convenient time for the astrophysicist, depending on unexpected events e.g. upburst of the supernova star,

2) The astrophysicist has to deal with extreme states of matter, a broader range of parameters. In the Universe there is such thinness of interstellar gas that the physicist in the laboratory would call it extremely high „vacuum". Pressures in the star centers are extremely high. Temperatures have also a wide range of values.

3) We are inhabitants of the Universe interior, we cannot make a comparative analysis of another object in the cosmic distance scale because the Universe as known so far is a single object. The language of mathematics used for description of phenomena and laws discovered in the cosmic space is a common feature of natural science. When some concepts, phenomena are described using a language of mathematics, they are explicit. Then the discoveries can be easily verified. For practical reasons it is very important that nature (also cosmic objects) is described using the language of mathematics.

4) It is surprising that even before the era of space flights the set of information about astronomical objects was extremely rich. In most cases it was sufficient to make physical studies of properties of electromagnetic wave reaching the astronomical objects (e.g. light, radio waves) to measure: temperature of star photosphere, pressure in star atmospheres, chemical composition, so called radial velocity of the objects in the outer space, rotation of the Sun, distance to stars, expansion of the Universe, evolution of stars and observational facts confirming the hypothesis of Big Bang.

Making pupils familiar with these discoveries including knowledge about basic observational methods can encourage pupils to carry on study of these problems at higher level i.e. during the university studies.