PLANETARY MAPS FOR PUBLIC AND EDUCATIONAL OUTREACH - EXPERIENCES FROM THE MAKING OF THE MULTILINGUAL MAP OF MARS AND VENUS

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1. INTRODUCTION

In recent years we obtained detailed topographic and geologic information on the planetary bodies' surfaces (namely Venus, the Earth, Mars, the Moon and - though in somewhat less details - the Jovian Moons). The next planetary body to fully mapped will be Titan in 2005. These worlds all have their own characteristics. Maps are powerful tools not only for scientific research but also for education. Children love to browse World Atlases and wander their pages. Geography books or classes targeted for any age group can not miss maps, usually contour or thematic maps. In this paper I propose to use planetary maps for the same purpose, published in the first language of its users.

Now, years after the publication of detailed planetary maps, the broad public and students still do not have planetary maps designed specially for them. Maps for amateur "backyard" astronomers (albedo maps for Mars, shade relief maps for the Moon) and maps for scientific research (published by USGS, for example) are not the subjects of this paper. There are planetary maps for download on the internet but this I also list among the scientific maps. In this paper I will (1) review the possible reasons for the making of such planetary maps; (2) give recommendations for various examples where such maps could be published, (3) analyze the making of one such series in detail, which has been made by an international cooperation (the Multilingual Map of Mars and the Multilingual Map of Venus as part of the multilingual map series of the ICA Commission on Planetary Cartography) and (4) discuss the relevance of nomenclature and terminology system used on planetary maps made for the general public.

2. WHY TO MAKE PLANETARY MAPS FOR NON-SCIENTISTS?

In recent years the public is less interested in space sciences or space activities than it was in the birth of the Space Age. This is partly because of the end of the many "first missions", partly because the space (or planets) are appearing less in the media or in publications, or during the studies of children. In Hungary, schoolchildren learn about planets for 2 hours during their 12 years of study. Universities do not offer planetary science courses, only very few elective ones. In contrast, in the mass media, UFO stories, stories about aliens, horoscopes can be found easily and regularly. Science fiction (SF) had also strong effect in inspiring young students to became space scientists: now even this literature has lost from its attractive force: most SF stories today has more fiction than science and fantasy has more readers than SF. This also makes people less interested in space sciences.

Planetary maps comparable to maps of the Earth could make the sense in the students that the planets are planetary bodies like our own. Life is still waiting to be discovered outside the Earth but planetary bodies like Europa or Mars are candidates, which makes their surface even more interesting for everyone. In summary: planetary maps could help to bring those people who are not very much interested in space, closer to reality - or space science.

According to the current scientific debates, more and more researchers tend to think that intelligent or animal life is not so common in the universe we thought a few decades ago. This way protection of environment of the Earth is even more important than ever. Planetary maps appearing in regular school and world Atlases can bring this thought or sense to the people, by visually showing them how other lifeless worlds are different from our one. Students can realize how our environment is so unique by looking at the vegetationless surface (or: environment) landforms of other planetary bodies.

2.1 The Role of Maps

Space exploration could be the most important thing one day in the future in the fields of economics, natural or social sciences. But now the formal education gives limited knowledge on this very broad field. Since maps contain a vast amount of information combined together, it is the most "compressed" form of our knowledge in this field.

Therefore these maps could be the most cost- and time effective ways (and also, if made so, the most easily understandable because of its visual representation) to show people the present knowledge on the planets (inlcuding the Earth, as a planetary body).

Global, context- and detailed maps - cartographic or now satellite photomosaic - are basic tools in understanding the spatial distribution of landforms on the Earth. Books about planets usually don't have maps, or if they do, they are scientific or simplified scientific maps which are hard to read for both students and the general public. Planetary maps that could be compared with maps of the Earth could be an even more powerful tool in comparative Planetology. They would visually help better understand *our planet* as well: on global scale, planet tectonics; on regional scale, mountain or crater formation; on local scales volcanic forms or dunes etc.

Maps of different planets using the same legend and coloring codes show clearly the uniqueness of our planet and also show the different evolutionary pathways for planets and their landforms (therefore it would be recommended to use paleogeographic maps of the Earth in this context as well). In the planetary, astrogeological or astrobiological - perspective, maps of the seafloors of the Earth (or Antarctic or Arctic regions) are of the same interest.

Maps could be used in a very broad list of disciplines. The first users would be geographers (teachers and students of geography) and geologists, but now biologists (astrobiologists), engineers, and even teachers of literature and history (who could use the planetary nomenclatures to make their discipline more interesting for children!).

3. ADDRESSING CHILDREN AND THE PUBLIC

3.1 World Atlases

Students of almost all ages like to "wander" on the pages of maps imagining their surface travel on distant countries etc. Even on maps which show places they will never be in person. Maps of Mars or Venus could be an addition to the already traditional World Atlases (for children or the general public). Adding few more pages could inspire people to be more interested in space sciences and would show shockingly the contrast between the Earth and other Worlds. People were always interested in undiscovered places - now sites to-be-visited could appear again in World Atlases (as our world has no more undiscovered spots). The children reading these atlases could be the ones who will have to find landing sites for future missions - this can be another aspect of how we can make space sciences more attractive to the new generation.

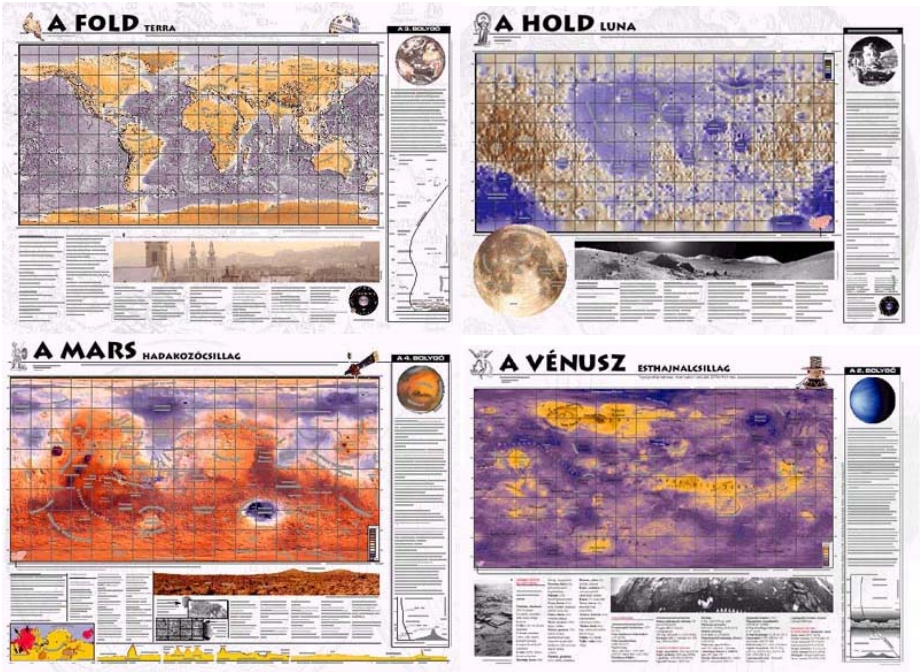
3.2 Maps for children

The planetary maps made for the younger generation requires not only expertise on planetary science and cartography but also on elementary teaching and visualizing. Good examples for such maps exists, but only for the Earth.

These maps would serve as starting points on the way to space science - but eventually these people will use detailed scientific maps for their research. These maps could be placed in textbooks of Geography (where the discipline of Planetary Sciences is included), or, if it exists in the given countries educational curriculum, in textbooks of Geology or Astronomy. Sadly, these latter disciplines are left out from most (and more and more) countries' curricula. The textbooks of Geography and Geology therefore can serve as a gathering place for comparative information on other planets (for instance when discussing mountain formation, a short comment would present mountain formation on other planetary bodies. This could make the processes of our planet better understood).

Planetary maps would found a good place in children's books about space, or as wall maps in classrooms of elementary, middle or high schools. Planetariums and Museums of Natural Sciences are another possible sites where such maps could be displayed.

We have prepared a series of wall maps (or "posters") for elementary and high schools (*fig. 1-4.*). In these maps we used the latest laser altimeter topographic data for coloring the maps. We added short descriptions of the geography of each planet; the profile of their atmosphere; a panorama image from their surface; a photo of their globe and an explonation of the Latin names appearing on the map. Because of financial reasons we were unable to publish these maps yet, but they are available for free download on the internet. In the scientific content, we followed the experiences from the Multilingual Map of Mars, described later in this paper.



Figures 1-4. Wall Maps of Solar System Bodies series (for middle and high schools): the Earth, Moon, Mars, Venus, 2001, http://planetologia.elte.hu.

3.3. Maps for the news media

In the public understanding of Space Sciences, planetary maps could also have a role. In the printed and electronic media, maps appear regularly. But even if a map could show appropriately a topic that is in the news, editors usually do not have the background to draw such maps, because the making of simple planetary maps require different knowledge from that of making a political map. This special knowledge must be given by the joint work of planetary scientists, cartographers and teachers or PR people, designers - media cartographers alone will not do that.

Thus if we want to make planetary maps for the broad public, the scientists themselves have to start working on such maps together with other experts. This is also because - though landforms don't change every year - discoveries require to re-draw planetary maps (or add more details) relatively frequently.

4. THE MAKING OF THE MULTILINGUAL MAP OF MARS AND VENUS

Under support of the Commission on Planetary Cartography of the International Cartographic Association, we at the Planetology Group of the Cosmic Material Research Group of Eötvös University, Budapest has edited a multilingual map of Mars [1] for use in Central European universities, in Croatian, Czech, Hungarian and Polish languages (Fig. 5. and 6.) as part of the series of multilingual maps of the Solar System bodies, a project launched by the Commission on Planetary Cartography of the International Cartographic Association.

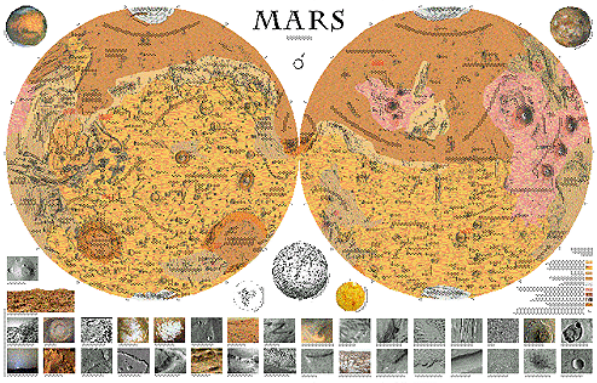


Figure 5. The Multilingual Map of Mars, Central European Edition, 2001. Front page.

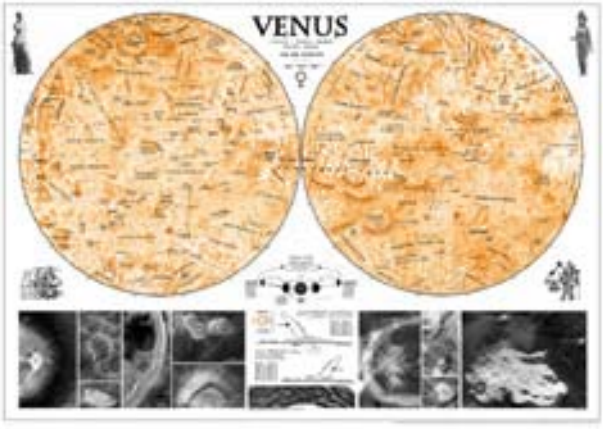


Figure 6. The Multilingual Map of Venus, Central European Edition, 2003.

The maps were prepared in cooperation with the geological and astronomical institutions in 6 countries, namely Russia, Hungary, the Czech Republic, Croatia and Poland and Bulgaria.

The Shade relief base maps [2] - and the original idea of a multilingual map - was supported by the Moscow State University for Geodesy and Cartography (MIIGAiK). The maps were made in Lambert Transversal Equivalent Azimuthal Projection in which the surface appears as two hemisphere globes. This is closer to the well known map projections used for mapping the Earth and it is unlike most planetary maps which usually use mercator projection. This is another way to bring closer the planets to the experiences of the children.

4.1 Background

A University Planetology Group formed at the Eötvös University, Budapest in 2000. We have decided to start our activity by compiling a basic set of educational materials for the education on Planetology. We understood that planetary science is taught at middle schools within the frame of Physics and also within the subject of Geography, but very little emphasis is placed on it. In the best case students accepted at universities can name the planets but they have no additional knowledge on this topic. In the popular science literature there is much outdated information on this subject.

We tried to follow the traditional way of teaching Geography. At Eötvös University we published a small booklet "Atlas of Planetary Bodies" -- a regional Planetology textbook. The basis of all geographic studies are maps and nomenclature - so we were looking for a cartographic atlas of the planets. We found partners for this work at MIIGAiK, Moscow, where The Atlas of the Earth-like Planets and their Satellites was published in 1992 (see [5]).

4.2 The Multilingual Map concept

The concept to publish multilingual maps of Solar System bodies came from the Commission on Planetary Cartography of the International Cartographic Association (Prof. Kira Shingareva, chair of ICA Commission on Planetary Cartography). MIIGAiK's Shade relief base map was prepared for the first Multilingual Map of ICA Commission on Planetary Cartography, which was published and edited by the Institute for Cartography of Dresden University of Technology, Germany, in German, Russian, English, French and Spanish languages [13]. We used this as a reference, but we added more text (description of Mars), a full nomenclature [3], cross-sections [4], colors [5] etc. and more feature names in the map.

The ICA Commission on Planetary Cartography is putting serious effort to publish these maps in various languages. The original maps of Mars, Venus and Mercury (with the Moon, in preparation) is first published in 5 languages (German, Russian, English, French and Spanish); our group is preparing the Central European version (with Croatian, Czech, Hungarian and Polish languages; English (or, may be Latin, since it is the official language of planetary nomenclature) as a common language will be added to these in the next editions); and we are in contact with countries of the Balkan region, where new editions may appear (Bulgarian, Romanian etc. languages). We have learned after publishing the map, that in Slovakia and Romania they would wanted to have a vesion in their languages but we did not have enough space on the map for those ones. In the future We may consider having more languages, somewhat less text, an "interesting facts" section, and a design and layout that is more attractive to young students. There are also plans to prepare Far Eastern editions in the future.

4.3 The process of making the map

MIIGAiK loaned the shade relief map to us in “traditional analogue format”: in tracing-paper. We have scanned it by precision scanner and than worked it up digitally, adding coordinate grids also digitally.

We have wrote a general text in which we describe the main geographic features of the planet - like World Atlases do about the Earth; the basic geological history; and as in geographic atlases, we added orbital and body parameters along with data of the longest/highest planetary features. This text written in English originally. Then we contacted the geology or astronomy departments of the main Central European universities and planetariums to find scientist who could adequately translate the text. We made every work via the internet. The text has been translated to Polish, Czech, Hungarian and Croatian. Since we found more than one partner universities from each country, we had the opportunity to have more people working together on the same text (often one astronomer and one geologist).

All mentioned languages use the same “CE” font family, this made the publication technically easier.

After the printing, we sent the electronic version of the map to our partners on CD so that they could use it - and, if they wish, modify or print it.

The map includes several cross sections (Tharsis Montes etc) which were made based on recent MOLA data. Since the nomenclature changed slightly since the German version of this map was published, we used the latest IAU nomenclature and we included the full nomenclature with coordinates and diameter data for Mars [3] (we used the Westerly (since 2002: the “old”) coordinate system)

We found many various height data published in various works. On the map therefore we only used the MOLA data as it appeared on the digital version of The Topography of Mars map [4]. The coloration of the map came from the Geologic-morphologic Map of Mars, as published in [5]. In the Venus map we did not use use extra coloration. As for the illustrations, HST, MGS, Mariner 7 photos of the globe of Mars appear on the map. On the Venus map we used Magellan radar images in Mercator projection and a Venera lander panorama. These images were downloaded from public NASA sites on the internet. Several images of various (representative) geologic features appear are on the map, which can help better identify and imagine the basic characteristics of the landforms or landscapes of Mars. [6]

As a historical background, we included old drawings of Mars, but willingly, omitting any map with canals. The three historic maps were made by C. Huygens [7] M. Konkoly [8]. C. Flammarion [9]. On the Venus map we used the different cultural representations of Venus (statues, drawings).

4.4 Use of the Map

The map is designed in the first place for use by middle /high and university students. It also can be used as a wall map, which is especially useful for astronomy clubs and school classes. Our goal is to make our map a part of middle schools geographic map collection. The map is distributed in Hungary to members of the Hungarian Astronomical Association (MCSE) for a very low price, but individuals can also order it. There seem to be a high interest from all age groups, who knows about the map - but the advertising is difficult. This map is especially useful in schools where computer projector is not available.

The Multilingual Map of Mars has won the Special Price in the Hungarian Map Competition 2001., organized by the Lázár Deák Cartographic Foundation and the Hungarian National Széchenyi Library in the category Scientific Maps and Atlases [11].

4.5 Future work

We are now in the work of making the next map: the Multilingual map of Moon.

5. TRANSLATION, TRANSCRIPTION OF TERMINOLOGY AND NOMENCLATURE: THE ROLE OF THE USED LANGUAGE

The right nomenclature is a profound question since people get in touch with planetary landforms via their names.

In geography, nomenclature and terminology serves as the basis for all knowledge. In planetary geography, nomenclature and terminology can not be less important. It is therefore important to compile a collection of definitions and well understandable description of terms used in the planetary nomenclature (i.e. landforms). This work is a purely scientific one, but there is a need for a linguistic work as well:

Translating the planetary names is an important and necessary work, since this makes planetary science understandable (and therefore, it make teaching more effective) for young students and the public - this is a only very effective of making Planetology widely understood: to use the language of our target audience and skip the scientific terminology.

Using only Latin names even in popular publications makes this science understandable for only the few members of the scientific community. An example: if a text is intended to read by average people, we should not use the word “macula” alone (which makes no sense in most languages) - but use “dark spot (macula)” instead. If we use macula, it will be scientifically correct but will be obscure for those who read it. If we use it together with its translated form, this way the specifity of this meaning - which is important and meaningful here - is preserved. [12]

In Hungarian there is no appropriate planetary terminology for terms like Sulcus or Chasma - or even ejecta - which are often used in Planetology and in planetary maps. In educational materials for elementary and secondary schools - or the broad public - Latin or English terms should be avoided, and only Hungarian (or the given first language of the students) forms are advisable to use so that the target audience understand it.

There are debates even on the basic rules: for example, should the Latin geographic terms be translated or only transliterated to Hungarian - or should we leave it in the original Latin form. The currently used Latin nomenclature of IAU gives an international, therefore linguistically neutral nomenclature.

But if a word - like hegy (mountain) for Mons - exists in a given language, why should we use a foreign word for the same feature? There are many arguments pro and contra.

The Latin naming system is intended to be neutral and international. It is not debated that this is a very useful system - but not for popular science or education, where it is more important that the readers understand what we are talking about and that they could compare other planets’ landforms with our own Earth’s landforms - and the personal experience of the readers.

For a multilingual map, we published feature names on the map in a common language. This is naturally the IAU Latin nomenclature. However, we found that in maps made for local public, generally students, (in a one- language environment, where they do not speak English, which is the case in the larger part of the World) the feature names may appear differently, by translating one or both elements (common term, proper name) of the IAU Latin names.

Our observation is that even in these 4 countries involved in the making of the Multilingual Map of Mars, they have translated terms of geologic ages using different methods: one such method is to stick to the original, English / Latin term (Amazonian, as used in Czech), other one is to translate the term (Amazoni or Amazoniszi in Hungarian, Amazonsko in Croatian, Amazoński in Polish).

In Hungary, we formed a group of planetologists, geologists, cartographers and linguists to find a good translation for common names, proper names and common terms in planetary science. The basic rules and names should be officially accepted by the appropriate group of the Hungarian Academy of Sciences before it can be officially used as a part of the Hungarian orthography. It is the “24th hour” to form an accepted rule for the use of planetary names in Hungarian, since more and more articles are published in the press and in books. Our experience is that every journalist and scientist try to form its own way of translating, which leads to confusion and often linguistically or scientifically not acceptable forms.

Translating a Latin name can cause problems: first the translator have to find the uninflected base of the word, then the original name (of what the feature was named), and how this original is written in the given language.

If it is a proper name, the original must be used (if it uses Latin lettering), if a common name, it may be translated, but with care.

The least problem is caused by the transcription the proper names that were written originally in Arabic, Hindi, Cyrillic etc. letters: in this case, we have to "reverse engineering" the original word, using the English, from this finding the original, and from that, transcripting it to the given language, using the orthographic instructions and rules of the local Academy of Sciences or other institution.

For other words, like Arcadia, Elysium it can be discussed whether it should remain in Latin from or using the Greek form, or should we transcript them to the given language (like Árkádia or Elízium, in the case of Hungarian). (The situation is the same with names of asteroids. In the case of Hungarian, planet names follow the Hungarian pronunciation of the word, not the Latin form - in the case of other bodies, we simply use the terms accepted by IAU).

There are few feature names that has a common Hungarian form (like Mariner-völgy for Valles Marineris). There is a (almost) commonly accepted rule that common words like vallis-valley should be translated in every case, as in maps of the Earth (the Hungarian “völgy” instead of the local words of valley).

In some cases there is a bias towards English in planetary maps, like in the case of Io, where many names use the English form of Mediterranean geographic names (Caucasus, Nile, Danube). In most European languages, they have their own words (exonimes) for these. Should we use the "alien" English form or should we "translate" these to our language?

Seafloor topography can serve as an Earth analogue to how to handle planetary names or terms [10] since they are the same way artificially given names (both proper names and landform names) and they are the best analogues to lifeless planetary surfaces.

6. ACKNOWLEDGEMENTS

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