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## NAKED-EYE ASTRONOMY IN MASS TOURISM

**Abstract:** This paper considers the possibility of developing astro-tourism in small countries such as Serbia and other Balkan countries, with "discreet" astro-tourism reduced to naked-eye astronomy as part of mass tourism rather than elite tourism that is realized through specialized programs with spacecraft and space stations, spectacular planetariums and observatories with giant telescopes. The specific relationship between the virtual and the real world is highlighted in this paper especially when considering younger generations. Furthermore, the differences in the way stars are perceived by astronomers and "ordinary" tourists or non-astronomers is also emphasized. Tourists are not enchanted by celestial bodies themselves, but by a complete scene, which consists of integrated skylines and landscapes, as a complex stage where in various combinations and forms these celestial bodies are observed, and of their own experience. These complex sky-earth landscapes, astro-landscapes, present astro-tourism resources of the small countries like Serbia, provided that a tourist can "read" their astronomical text. In this regard, Belgrade was used as the example for drafting a "package" of astronomical information that can be easily prepared and adapted according to the needs of a particular group, so that every tourist may know what can be seen, where and when. With the help of a rotating star map (planisphere), visitors may observe the sky with the naked eye.

**Key words:** naked-eye astronomy, astro-landscape, astro-tourism, Serbia

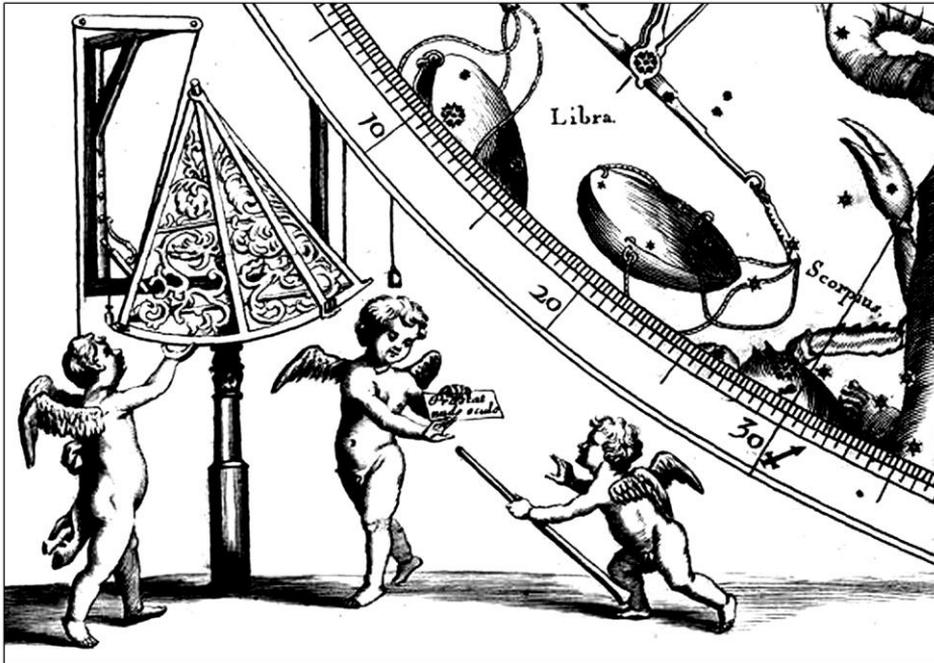
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## It is better with the naked eye

In Havelius's star atlas (1690), the bottom left corner of the margin of the northern sky map (sheet 55) displays two geniuses/cherubs with Havelius's sextant. One of them refuses a telescope that is offered by the third, showing a paper that says *Prestat nudo oculo* (It is better with the naked eye).



*Fig. 1. Detail of the Havelius's northern sky map (Hevelii, 1690)*

Hevelius wrote this "spiteful" comment, even though he himself used and constructed telescopes knowing that the future of astronomical observations would be based on them. We decided to present this recommendation in the same manner as a motto of our article, fully aware that urban generations born in the age of the Internet have been growing up with virtual images of star maps on screens of computers and smart phones rather than actual images of the night sky covered with stars. We are aware that today Hevelius's recommendation has little chance of being accepted by members of the newer generations, except perhaps occasionally by those "ordinary" tourists (not space or astro-tourists) who travel away from urban spaces with excessive light pollution.

## Astro-tourism

Space tourism and astro-tourism are new, special forms of tourism. Space tourism refers to space flights financed by individuals ("private astronauts") for their personal satisfaction/fun. By paying expensively for their trips, space tourists become co-financiers of serious space programs ("spaceflight participant", "commercial astronaut"). On the contrary, astro-tourists do not depart from the Earth, but attend specially designed lectures at planetariums, visit both modern and ancient astronomical observatories, and

learn about the organization of work and astronomical instruments. All these preparations are conducted in order to enable tourists to observe celestial bodies, under professional guidance, for personal satisfaction or fun (Belij & Tadić, 2015). Finally, astro-tourists go "outdoors" i.e. to the countryside, outside a city to avoid artificial light from large cities and polluted atmospheres, which prevent people from seeing the night sky in its full beauty (Cinzano, 2002). Seeing their chance in astro-tourism, countries such as Chile, South Africa, Portugal, Canada, New Zealand, Spain and the United States, and specific regions such as Palma, Baja California, Serena or Hawaii have already started developing, in cooperation with their astronomical associations, a so-called celestial ecotourism in national parks and at archeoastronomical sites – places where light pollution of the night sky has not yet arrived (Nordgren, 2010; Rashidi, 2012). Weaver distinguishes not only astronomical objects and phenomena as resources of astro-tourism, but also optical phenomena in the atmosphere (rainbow, halo, northern lights, meteors) and divides them into the following three groups: nocturnal, diurnal and crepuscular (Weaver, 2011).

Regardless of the effort invested in a fairly complex organization that includes astronomical institutions and their instruments, professional astronomers or so called science educators, and attractive sites, astro-tourism still attracts a small number of people who are lovers of astronomy and mostly residents of large cities in developed countries.

Generally, astro-tourism does not have great significance for either tourism in the countries like Serbia or the popularization of astronomy. The popularization of astronomy involves masses, as any other popularization, so a breakthrough in the lucrative and in this sense still unexplored field of mass tourism would bring benefits to it. Astronomy can enter into the field of mass tourism only without telescopes, focusing on "ordinary" tourists and observations with the naked eye of the sun and the moon during daylight, and in the night sky, stars, constellations, stellar configurations, certain galaxies, the Milky Way and planets, and various light phenomena connected with them, all of which belong to the scope of a so-called naked-eye astronomy (Moore, 1966; Rey, 1976; Upgren, 1998; Talcott, 2009; Hockey, 2011).

### **Naked-eye astronomy – who cares?**

In an attempt to entice young people to the naked-eye astronomy, it must not be forgotten that the young have a sense of time much different from that of their parents', that they often feel more at ease in the virtual than real, physical world, and that it is not easy to get them interested without the use of up-to-date teaching and observation novelties. The Internet, mobile telephony and television are an inseparable part of their everyday life, so that they become overloaded with information and images, among them with hundreds of thousands of astro-photographs of planets, stars, nebulae, and galaxies taken with the Hubble Space Telescope (Barclay, 2003). Astro-photographs enable everyone to know what the Andromeda Galaxy, in the constellation of the same name, looks like, the dark Horsehead Nebula in Orion or Ring Nebula in Lyra, but once they leave the computer and the virtual world and enter the real world, they cannot find the vast majority of these constellations in the night sky. Unlike their parents, most young people have never seen the North Star, Sirius, Scorpius and the Pleiades, and even the Milky Way or summer sunrise in the sky above their cities.

Habitually, they would enter their location in one of the astronomical programs and with music observe the current picture of the night sky covered with stars, then they would pick up their phones. However, instead of using it as a tool for orientation in the sky, they unconsciously do the opposite: they check whether "everything is in its place" in the sky, just as it is on their smartphone (Fig. 2). When they begin an introduction to astronomy in such a paradoxical way, observing the real starry sky as a pale copy of the computer simulated reality, it is difficult to attract them to astronomy with the "unarmed" eye: it could be cold outdoors at night, mosquitoes could be unbearable in summer, clouds could sometimes cover half of a constellation, and what is most important, unlike the tablet display, they cannot touch the planet with their finger to open the drop-down menu with a photo and basic information about the particular planet.



*Fig. 2. Honoré Daumier's cartoon from 1857 and the modern version*

Without starting a discussion on how astronomical education should begin, in the classical way, gradually, from Thales and the gnomon, or without following the historical development of astronomy, right from the Hubble Space Telescope and astrophotography of the "Star Hatchery", this paper focuses on the way naked-eye astronomy can be discreetly introduced into standard tourism programs. However, it is important to first highlight the way a tourist, that is, a "non-astronomer", perceives celestial phenomena and celestial bodies, because their notions are quite different from those of a professional astronomer.

### **The sky seen by a tourist / non-astronomer**

From the standpoint of naked-eye astronomy, celestial astro-tourism resources do not include astronomical objects by themselves, nor their radiation (i.e., tangible phenomena that can be directly or indirectly "felt"), but what can be seen with the naked eye in the sky above a particular area or within an area. Thus, it is not the Sun as our closest star with its spots and protuberances, but the Sun as a glaring disk with its illusory movement on the horizon; it is not the Moon as Earth's natural satellite with its craters and "seas", but the Moon as a silver disk with its phases; it is not the stars as giant balls of hot gas, but as bright multicolored twinkling dots grouped into constellations and asterisms; it is not the

constellations as accurately framed parts of the sky by arches of certain declination circles and celestial parallels, but as picturesque clusters of stars vested in mythological attire; it is not big planets as physical bodies similar to Earth or Jupiter, but as "wandering stars" that do not twinkle; it is not the Milky Way as an area with the greatest concentration of stars in the Galaxy, but as a hazy band of white light across the night sky; it is not the Andromeda Galaxy as a giant island of stars, but as a hazy spot in the constellation of the same name; it is not meteors as burning rocky or metallic bodies, but as "shooting stars" that just for a moment light up the night sky.

When dawn breaks, when and where the sun rises and sets, when the sun is at its upper culmination, the duration of daylight, and when the evening twilight ends, are all phenomena that today's busy inhabitant of a large city does not register because he/she does not need them. But away from home, on vacation and when traveling, that same person becomes romantic, looks up in the sky and starts noticing phenomena related to the sun, primarily sunrise and sunset. Sunrise and sunset still impress modern man as well as they impressed prehistoric man, with the difference that every time it goes down the prehistoric man feared will it rise again, while modern man, naively, has no doubt in this.

A hugging couple on a summer vacation, watching the setting sun under a gazebo in front of Fort Londza in a small town of Oia on the Greek island of Santorini, for example, does not see a star of a "spectral class G2V" nor a mathematical dot that is intersecting the almucantar at  $h = -51'$  at that moment, they are simply watching the sunset: mesmerized by a beautiful scene in which the main role is played by the sun, the scene that is composed of everything around them – white houses and churches with blue domes, windmills, caldera-bay, offing and the purple sky, olive trees, the scent of Mediterranean flora and the song of crickets – earth and sky backgrounds fused together (landscape and skyscape) where the event takes place, and they alone, with their imagination and emotions aroused.

Sunrises and sunsets of the full moon, Cygnus with outstretched wings in a whitish veil of the Milky Way, Scorpius with Antares, Taurus with the Seven Sisters – Pleiades, the whole Winter Hexagon with Orion before whose beauty the dawn (Eos) blushes, "shooting stars", Venus (Morning Star/Evening Star) at dawn break or at evening twilight, leave a similar psychological effect on tourists.

### **To a tourist "non-astronomer"**

The romantic view of celestial bodies and phenomena, typical of people on vacation, should be encouraged by a planned introduction of naked-eye astronomy into the programs of "ordinary" tours, that is, into mass tourism programs. These observations should not be based on tours conducted by a professional/academic guide as specialized astro-tourism tours are, but rather on current astronomical information that would help tourists to observe certain astronomical phenomena, without anyone's guidance and supervision, so that they could be able to see them in their own way and in the company they choose, from the place of their choice.

Before going on holidays or journeys, modern tourists collect various kinds of information about the places they would pass through and the destinations they would visit. Most search for weather and bio-climate forecasts, but only few seek astronomical

information and this is why the organizer of the travel should prepare this information for a particular place/places and a particular day/period, together with the rotating map of the stars. Today, it is rather easy to find and prepare basic astronomical information.

First, information on the geometry of the sun should be prepared (Tadić, 2008): moments of sunrise and sunset, local apparent noon, the ratio of light and darkness (daylight and night, morning twilights and evening twilights), as it was done in the case of Belgrade (44° 49'N, 20° 28' E), for August 20, 2016 (Tab. 1).

*Tab. 1. Geometry of the Sun: Belgrade, August 20, 2016.*

<b>Phenomenon</b>	<b>h:min</b>	<b>Note</b>
Break of dawn	03:55	Least bright stars visible with the naked eye fade out
Beginning of the morning civil twilight	05:15	Only the brightest stars are seen; artificial lights are turned off
Sunrise	05:46	Moment of the sunrise at the open sea (elsewhere, because of the relief the sun rises later)
Local apparent noon	12:41	Mid of the daylight: the sun is right towards the south, shadows are facing north
Sunset	19:36	Moment of the sunset at the open sea (elsewhere, because of the relief the sun sets earlier)
End of the evening civil twilight	20:07	Only the brightest stars are seen; artificial lights are turned on
Beginning of darkness	21:26	Last traces of visible light, in the clear sky without moonlight, all stars visible with the naked eye can be seen

Apart from the moments of moonrise and moonset, for the Moon the current phase and the moment of upper culmination should be indicated (Tab. 2). The sight of people watching moonset or moonrise is not nearly as common as when it comes to sunsets and sunrises. There are three reasons for this: first – the moon rises, culminates and sets about fifty minutes later every day, so these moments can be in any part of the daylight and night, second – moonset or moonrise are not "in color", and third – unlike the solar disk that is always "full", the moon's disk constantly changes its shape (going through different phases). It is most attractive for observation when it is full, not only because of its brightness but also because it is visible throughout the night: it appears when the sun sets.

*Tab. 2. Geometry of the Moon: Belgrade, August 20, 2016*

<b>Phenomenon</b>	<b>h:min</b>	<b>Note</b>
Moon phase		Fullmoon (97%), Pisces
Moonrise	20:48	
Upper culmination	02:02	Altitude 39.4°
Moonset	07:58	

Source:<http://www.timeanddate.com/astronomy/>

Occasionally, these data could be supplemented with the data on Solar and Lunar eclipses. Solar eclipses occur two to three times per year and last for a minute or two, and on rare occasions, even eight minutes. They can be observed in relatively narrow strips of land on the surface of the Earth, to which astronomy lovers and other curious

individuals/astro-tourists travel. Unlike a Solar eclipse, some Lunar eclipses can be observed by all inhabitants of the Earth's hemisphere during night. Three Lunar eclipses occur annually at most (in some years, not a single one), which do not last longer than 108 minutes. In a total Lunar eclipse, the moon's disk is not in real darkness, sunrays scattered in the Earth's atmosphere give it a copper red color, which makes the scene even more attractive/mystical.

In special cases, for the travels to northern countries, more information about the periods of connected dusk and white nights (north of the parallel 50°) and the polar days (north of the Arctic Circle) can be added.

As far as stars and constellations are concerned, it is sufficient to provide travellers with rotating star maps and instruct them how to use them. In addition, explanations about the so-called configurations of stars, imaginary geometric shapes whose vertices consist of the brightest stars of different constellations should be provided. In the spring sky, it is the Great Spring Triangle, in the summer –the Great Summer Triangle, in the autumn –the Great Square of Pegasus, and in the winter sky –the Great Winter Hexagon (Tadić, 2004a; Tadić, 2004b). The aforementioned configurations are identified at first sight, and when they are identified, they present the starting point for recognizing constellations, first those whose stars "are borrowed" and then neighboring ones. The Great Summer Triangle, for example, is "tied" with Cygnus and Aquila constellations, positioned in the Milky Way, which together with Perseus, Cassiopeia, Sagittarius and Scorpius constellations determine its position on the northern celestial hemisphere; the Great Square of Pegasus lies adjacent to the Andromeda constellation where the Andromeda Galaxy lies – the only celestial object outside our own Galaxy that can be seen with the naked eye in the northern hemisphere.

Data should be given for planets that can be seen with the naked eye occasionally in the sky, five planets in total: Mercury, Venus, Mars, Jupiter and Saturn, which shine by reflecting the sunlight (Tab. 3). They are different from stars because they do not twinkle and because they change their position within the constellations. The brightest of them, and brighter than all the stars, is Venus, which can be distinctly seen during the morning and evening twilights. For naked-eye astronomy, planets are particularly interesting when they are concentrated in a particular part of the sky.

It is not vulgarization of astronomy if astrological data are added, provided that tourists are informed in a competent and unambiguous way (humorous way) that this is just entertainment. Any real astronomical situation can be used for positive "astrological" motivation of a tourist group. For example, on August 20, 2016, the guide might say: "Let us be on guard that the Sun, Venus and Mercury is in Leo, Jupiter is in Virgo, and the full Moon is in Pisces! –in the next few days our hearts will be exposed to a rain of Cupid's darts." He/She can say this, or anything else, since astrological interpretations are known to be completely arbitrary.

Finally, a patient observer who has been gazing for a while at a certain part of the night sky, cannot help but notice at least one meteor, a light trace of a burning meteoroid. Meteors appear in the form of certain meteor showers ("rains"), each at the same time of the year from the constellations after which they have been named: Lyrids in Lyra, Leonids in Leo, Draconids in Draco, etc.

Tab. 3. Planets seen with the naked eye: Belgrade, August 20, 2016, 21:26 h  
(the end of astronomical twilight – beginning of darkness)

Planet	Part of the sky	Constellation	Note
Saturn	SW	Ophiuchus	Just above Mars (altitude 18°)
Mars	SW	Scorpius	It is near a star Antares, similar to Mars (less brighter, twinkling)

Source:<http://www.stellarium.org/>

Tables with data should be preceded by a few introductory sentences, for example, in the following form.

***Be on friendly terms with the stars in the sky***

*While you are on vacation or traveling do not let the Sunrise and set without you noticing it; do not fail to recognize a Moon's phase; do not fail to observe the constellations and perhaps one of the planets in some of them.*

*Forget about the cameras and cell phones, looking through/using them, you will not see anything.*

*Do not forget to take a rotating star map every evening. With it and with the data in the attached tables (1-3) you will know what you can see these days in the night sky with the naked eye, when and where; a piece of advice is to observe the phenomena in pair, with someone who is particularly dear to you.*

*While observing the night sky, as long as you know what you are watching, it will belong only to you: after each observation you will feel better and in a good mood because a look into the depths of extraterrestrial space brings peace and serenity to our souls.*

Imagine the effect that a tour guide would create if he/she recited to a group of tourists on a bus/plane, before distributing rotating star maps and printed astronomical information, for example, When I heard the learn'd astronomer by Walt Whitman, or at least the first stanza of the poem Night Has a Thousand Eyes by Francis by William Bourdillon (Albery & Ratcliffe, 1994):

The night has a thousand eyes,  
And the day but one;  
Yet the light of the bright world dies  
With the dying sun.  
[...]

If there is nothing strange when a tour guide tries to impress his/her group of tourists by, for example, singing a church hymn Axion estin (It is Truly Meet) in Church of the Holy Virgin of the Monastery of Studenica, why, in the same sense, would not a poem inspired by astronomy be accepted when it is known that astronomy/astronomers and poetry have always been "on friendly terms" (Upgren, 1998; Dimitrijevic, 2003; Stanić, 2015).

## Conclusion

Serbia and other Balkan countries cannot compete with developed countries with respect to astro-tourism. Consequently, this is one of the reasons why Balkan countries should introduce naked-eye astronomy into their tourism programs – observations of the night sky without a telescope.

From the standpoint of naked-eye astronomy, a resource is not only a clear night sky without the Moon's light, celestial phenomena and objects that can be seen with the naked eye; it is only one half of what can be seen, a more exciting half-skyscape, the other half (the background), in the physical sense is always made of a landscape as its complement.

While gazing at the night sky, a busy resident of a large city, who usually "never has time", who is used to a sedentary way of life (office lifestyle), who never sees the horizon because of high buildings and the sky because of smog and artificial light, is not enchanted by celestial bodies themselves (the setting sun, for example), but by overall scenes that consist of integrated landscapes and skylscapes, as a complex stage in which various combinations, forms and colors these celestial bodies are observed, and they themselves, the observers/tourists with a subjective sense, free from any interest.

Serbia and other Balkan countries have diverse landscapes (seaside and mountain, cultural and natural) vaulted by skylscapes "unpolluted" with light, which merge in the eye of the observer into exciting and unique scenes as products of a particular moment – astro-landscapes. In order to take advantage of this unique visual complex as tourism resource of small countries, astronomers-showmen, spectacular astronomical facilities, national parks and archeoastronomical sites are not needed. It is enough to provide people on vacation (tourists) with rotating star maps and adequate astronomical information that answer the following questions "What?", "Where?" and "When?" (the answer to the question "Why?" can come later). With the information "package" that contains a few introductory sentences, systematized data on the diurnal motion of the Sun and the Moon, and the positions of visible planets, tourists are ready for astronomical observations without a telescope, as they please, from a place they choose, when they want, and with whom they want to "read" what can be seen and inevitably think about what cannot be seen.

Such nonintrusive encouraging of tourists to learn to read "astronomical texts" of astro-landscapes so as to perceive their full beauty, provides threefold benefit: a tourist as an individual becomes spiritually richer, naked-eye astronomy more popular, and mass tourism more meaningful.

## References

- Albery, N. & Ratcliffe, P. (1994). *Poem for the Day One*. London: Chatto & Windus.
- Barclay, C. (2003). Back to basics: naked-eye astronomical observation. *Physic Education*, 38 (5): 423–428.
- Belij, M. & Tadić, M. (2015). Astrotourism – Possibilities for Development in Serbia. *Bulletin of the Serbian Geographical Society*, 95(3): 59-73.
- Cinzano, P. (2002). The situation of light pollution and the night sky in Italy, in Europe and in the World. *Proceedings of the IDA Regional Meeting: Let's save the night*, Cinzano, P. (Ed.). ISTIL, Thiene, Italy, 91–101.

- Dimitrijević, M. (2003). *Kosmički cvet: antologija pesama o kosmosu*. Beograd: Prosveta.
- Hévelii, J. (1690). *Uranographia: totum caelum stellatum*. Gedani anno MDCXC. (Opisanie vsego zvezdnog neba. Gdansk, 1690, Izd. "FAN", UZSSR, Taškent, 1968).
- Hockey, T. (2011). *How We See the Sky: A Naked-Eye Tour of Day & Night*. Chichago & London: The University of Chicago Press.
- Moore, P. (1966). *Naked-eye astronomy*. London: Lutterworth Press.
- Nordgren, T. (2010). *Stars Above, Earth Below: A Guide to Astronomy in the National Park*. Chichester: Springer & Praxis Publishing.
- Rey, A. H. (1976). *The Stars: A New Way to See Them*. HMH Books for Young Readers.
- Stanić, N. (2015). *Multiverzum ljubavi*. Beograd: samostalno izdanje.
- Tadić, M. (2004a). Sferna geometrija Velikog zimskog šestougla. *Zbornik radova – Geografski fakultet Univerziteta u Beogradu*, 51, 13-18.
- Tadić, M. (2004b). *Astronomija: pogled ka zvezdanom nebu*. Beograd: Zavod za udžbenike.
- Tadić, M. (2008). Sunce nad ružom kompasa na srednjoj geografskoj širini Srbije ( $\varphi = 44^\circ$ ). *Zbornik radova – Geografski fakultet Univerziteta u Beograd*, 56, 25–32.
- Talcott, R. (2009). *Teach Yourself Visually Astronomy*. New Jersey: Wiley Publishing.
- Upgren, A. (1998). *Night Has a Thousand Eyes: A Naked-Eye Guide to the Sky, Its Science, and Lore*. New York: Springer.
- Weaver, D. (2011). Celestial ecotourism: New horizons in nature-based tourism. *Journal of Ecotourism*, 10 (1): 38–45.