

SAVREMENA MUZEALIZACIJA I KOLEKCIJA MUZEJA SOLARNE ENERGIJE

CONTEMPORARY MUSEALIZATION AND COLLECTION OF MUSEUM OF SOLAR ENERGY

Suzana POLIĆ,
Narodni muzej Srbije; IHTM,
Sanja PETRONIĆ,
Akademija tehničkih strukovnih studija Beograd, Beogradska politehnika,
Zoran STEVIĆ,
Univerzitet u Beogradu, Elektrotehnički fakulteta, Beograd
Univerzitet u Beogradu, Tehnički fakultet u Boru, Bor
Marko JARIĆ,
Inovacioni centar Mašinskog fakulteta u Beogradu d.o.o

Savremena muzejska praksa, koja u procesu muzealizacije obnovljivih izvora energije, u prvi plan ističe ideje, a potom eksponate, pogodna je za muzejsku kontekstualizaciju solarne energije. Imajući u vidu razvoj ideja o korišćenju ove vrste energije, predmet istraživanja je kolekcija Museum of Solar Energy, u kontekstu zaštite kulturnog nasleđa. U okviru razmatranja metodoloških, naučnih i obrazovnih aspekata delatnosti ovog muzeja, uz komparativnu analizu koncepta Frances Young Tang Teaching Museum, daje se projekcija mogućeg razvoja muzeja kao realnog i virtuelnog prostora za sticanje formativnog iskustva u radu sa solarnom energijom.

Ključne reči: obnovljivi izvori energije; muzealizacija; Museum of Solar Energy

Contemporary Museum Practice, which in the process of musealization of renewable energy, emphasizes ideas, and then exhibits, is suitable for museum contextualization of solar energy. Given the development of ideas on using this type of energy, the subject of research is The Collection of Museum of Solar Energy, in the context of protection of cultural heritage. Within the review of the methodological, scientific and educational aspects of this museum, with a comparative analysis of the concept of Frances Young Tang Teaching Museum, we propose the possible development of the museum as a real and virtual space to acquire formative experience in working with solar energy.

Key words: Renewable energy sources; Musealisation; Museum of Solar Energy

1 Introduction

Thrust about solar energy, as a phenomenon, which is a constant that determines human existence, began long before the first solar cells and modern models of their application. Therefore, the issue of the musealization of solar energy, connects with the research of historical sources. On the other hand, new technologies change the forms of museums, so first virtual museums are created in the XXI century, as Museum of Solar Energy is [1], which works as a virtual space in which the visitor enters the collection of interesting and unusual solar energy Artifacts, as well as obtaining basic information about solar cells, with giving instructions How Solar Energy Can Be Harnessed by Anyone with a Little Determination work.

Bearing in mind that in this paper, the subject of research is the musealization of solar energy in the polysemantic context, which outside the technological space is investigating the framework for the development of the optimal work methodology in the scientific and educational domain, we realized a comparative study from new international museum practices.

The survey was especially in accordance with the new definition of the museum adopted on august 2022, at ICOM General Conference held in Prague, by ICOM Extraordinary General Assembly, where is Approved a New Museum Definition: "A museum is a not-for-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible

and intangible heritage. Open to the public, accessible and inclusive, museums foster diversity and sustainability. They operate and communicate ethically, professionally and with the participation of communities, offering varied experiences for education, enjoyment, reflection and knowledge sharing.” [2]

2 Historical view of solar energy

The Museum of Solar Energy in the web site section, entitled *Science of Solar*, points out that “... *Solar Energy has been in the Works Since the Late 1800s, when Scientists First Sought to take the Sun's Energy and Harness It for Our Own Use*”. However, in the context of the history of the ideas, we believe that it would be very useful to be known that scientific sources indicate that the awareness of the use of solar energy occurs before the new era, which there are traces and records in accordance with the then degree of civilization. From the abundance of scientific sources, here we note only a few unavoidable facts. In the era of Pharaoh Akhenaten and his wife Nefertiti, the sun was divinised as God Aton, which confirms visual records that clearly shown the solar energy impact the human life (Fig 1), [3-5]. On the fascination of the Sun of one of the leading philosophers in the fifth century BC, Anaxagoras (Ἀναξαγόρας, 500-428 B.C.), wrote Plato (429?-347 B.C.E.) and Diogen Laertius (Διογένης Λαέρτιος, fl. 3rd century AD) [6]. Plato has also developed the idea of the good through the analogy with the Sun [7], which, as it considers the theorist Posavec, has the importance of a milestone that "humanity leads to the center of a fundamental event in which the world is based on an opinion and knowledge." [8]



Fig 1: Ancient Egypt: Expression of honour for the life power of the divinised sun-disk (god Aton), era of the pharaoh Akhenaten (1353. B.C. i 1335. B.C.) and his wife Nefertiti [3-5]

There are many significant works in the period since the capital encyclopedic work from 1508, called *Margarita Philosophica Nova* (Fig 2a), which Gregor Reisch made. Among other things, gives us the opportunity to explore Aristotelian and scholastic doctrine of gravity, levity and natural circular motion, during the sixteenth century, and later affirmation of Copernicus doctrinal tradition who disputing Aristotle's theory of aether, with specially avoiding their meta-physical implications [9, 10] .The end of the Long tradition of astronomical culture is Hertzsprung-Russell diagram (Fig 2b) [11], practically "tool" that connects effective temperature (diagram abscissa) and luminosity (ordinate diagrams).

The historical examination would have to contain a description of significant works of scientists and the philosophers of Ruđer Bošković (Roger Boscovich, 1711-1787), which was the founder of the Observatory in Milan, author of a poem in Latin, about the eclipse of the Moon and Sun (*De Solis ac Lunae defectibus*, London, 1760) (Fig.3), and the scientist which, based on the movement of the Sun-spots, determined the time of turning the Sun, with the help of one's own method [12,13]. Another Sun-observation angle can be found in the work of German Teozof Julius Hamberger (1801-1885), who represented the idea of holy physics (*Physica Sacra. Monographie Über die Himmlische Leblichkeit*, 1869). He researched philosophical expressions about the truth of living in the Sun [14]. Of course, there were other deserving scientists for the history of solar energy ideas.

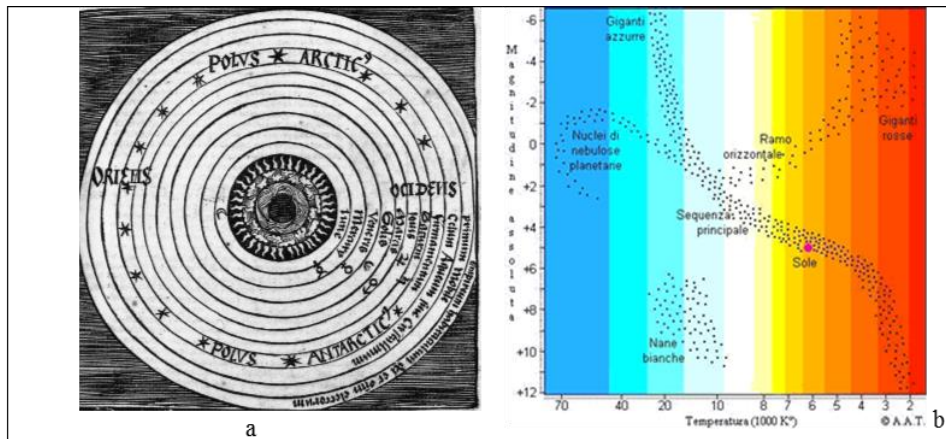


Fig 2. The Sun in a layer of different meanings, in the range of 500 years: a- Gregor Reisch, *Margarita philosophica nova*, Strasbourg 1508 [9]; b- Hertzsprung-Russell diagram, Associazione Astrofili Trentini [11]

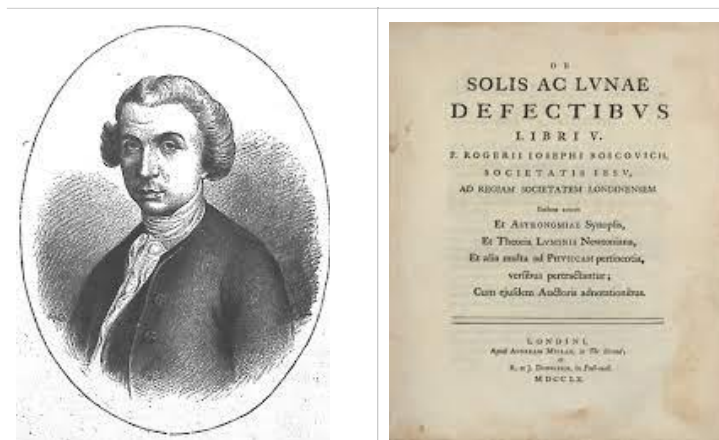


Fig 3. Ruđer Bošković (Roger Joseph Boscovich), physicist, astronomer, mathematician, philosopher, diplomat, poet, theologian, Jesuit priest, and a polymath from the Republic of Ragusa, and his *De Solis ac Lunae defectibus* [13]

3 Digitalization and semiotechnology

In the era of digitization, in which disappears need for the direct relationship between human being and museum subject (if it is available in the digital version) actualised is the warning of philosophers and aesthetics Boris Grojs, about of reconciliation by the contemporary man with the fact that he trusts a digitized image, not his immediate Insight into a "natural image" that disappears under the rush of the digital play, practically in the information market [15]. This theorist emphasizes that “discourse has to conform to certain expectations”, and “we have neither access to the world nor to our own construction of the world” [16]. On the other hand, theorist Christian Bromberger emphasizes the point of view of Umberto Eco, that “any communicative act is dominated by the massive presence of socially and his-torically determined codes” and therefore the items of the information carriers are. Keeping in mind that “semiotics connect the world of things to the world of culture”, Bromberger states that semiotechnological analysis is necessary [17,18].

Observing the museum object from the point of view of the *Theory of objects* [19] that formulise Abraham Mole on the line of Aristotle's intellectual heritage, as well as the *Theories of complexity and industrial civilization* (Théorie de la Complexité et civilization industrielle) of the same author [20], it can be observed that museum artefact which had a technological function, and therefore statistically observable in the method of the research of process, after becoming a Museum collection, he was no longer there to do a functional process, but to introduce the idea, the form of thought and the functionality of technological processes.

According to an opinion by Mole (with the experience of the University Professor, the Physics engineer, the philosopher, who started his career in the field of physics, and the French pioneer of information sciences and communication studies), a denotative meaning of the artefact, provides an opportunity for phenomenological investigations of canonized forms of relations between humans and worlds produced facilities, according to optimization rules, as well as the functions of the artefacts in the civilization perspective.

In the domain of the functional and structural complexity of the artefacts that creates a man as a *Homo Faber*, through the prism of the entropy of information, the relationship between the man towards the universe is also considered. However, as Bromberger emphasizes, as integral of the culture, cases and discursive operations, for example, "is a common set of structural duties, but they are also different - there is evidence - due to mutual constraints that shape them"[18].

Restrictions are imposed by the possibilities of new technologies. In that sense, Werner Schweibenz emphasizes the importance of the foundations set for the development of virtual museums [21] in scientific investigations that began in the period 1992-1995, which refer to the strategies in the domains: Interactive Multimedia in Museums, then information strategies, Like structures for electronic museums. [22 - 24]

Should also have in mind and *Technical Internet context* related to its functional dynamics [25], conceptual models for multi-format data sources and ontologies (mapping, merging, and alignment) [26], with Bakikis et al, they emphasize that:,,...although there are now well-established ontologies for the Cultural Heritage domain and most of the related fields, there are only few tools that humanities scholars, museum practitioners and other people working in this domain, can easily use to model, manage, analyse and interlink cultural data.“ [27] It is necessary to emphasize that this is a mutual relationship: autonomy of the facts within the ontological and factographic display of complex phenomena depends on the user perception of an artifact that represents one clip of time, because how long ago, Merleau – Ponty reminds us, one phenomenon starts another: "... even when there is no reason, there is always a motive" [28].

4 Museum of Solar Energy and knowledge sharing

Museum of Solar Energy, through the oldest copies of the item from its collection reflects the time in which the museology took a significant shift, from '*Muséologie d'Objet*' to '*Muséologie d'Idée*', as interpreted by specialist in cultural mediation and heritage issues, professor emeritus Jean Davallon [29]. The phenomenology of renewable in the field of temporal cyclicity of the natural phenomenon of solar energy, has found its reflection in the virtual space of the museum, which has a polysemantic structure, given the great range of solar cell purposes (Fig. 4) [1].

The method of the flow of innovation, development of ideas and transformations with continuity is supervetermining, in Figure 4, is one of many possibilities in creative establishing collection, because there is no universal criterion for the method of shaping the collection. The process is constituted normatively and experientially in an open relationship to the facts, but always keeping in mind the current technological and methodological situation.

This Collection is a *Analysis Situs*, the place of the different knowledge about natural phenomena, and technical implications of Solar energy. On the basis of accumulated information and systemic research, in accordance with the division made by the Gluzinski, three spotted can be direction that users orientate: *material facilities* (historical and research orientation), then on *man* (sociological orientation) and on the *value and meaning* (cultural orientation) [30]. For example, in the case of Hubble Space Telescope, it is determined that the display of solar cells from this telescope, in the context of the museum collection, encourages all three types of user interest: *historical and research orientation* (e.g. microparticle impacts on the Solar Array[31], or investigation of the vibrational disturbances [32]); *sociological orientation* (e.g. human, and bureaucratic entities within the vast developmental and technical structures of Big Science programs [33, 34], or biographical memoirs [35, 36]); *cultural orientation* (e.g. renewable energy sources in cultural heritage protection [37, 38], or art presentation of Hubble's solar panels [39], (Fig. 5)).

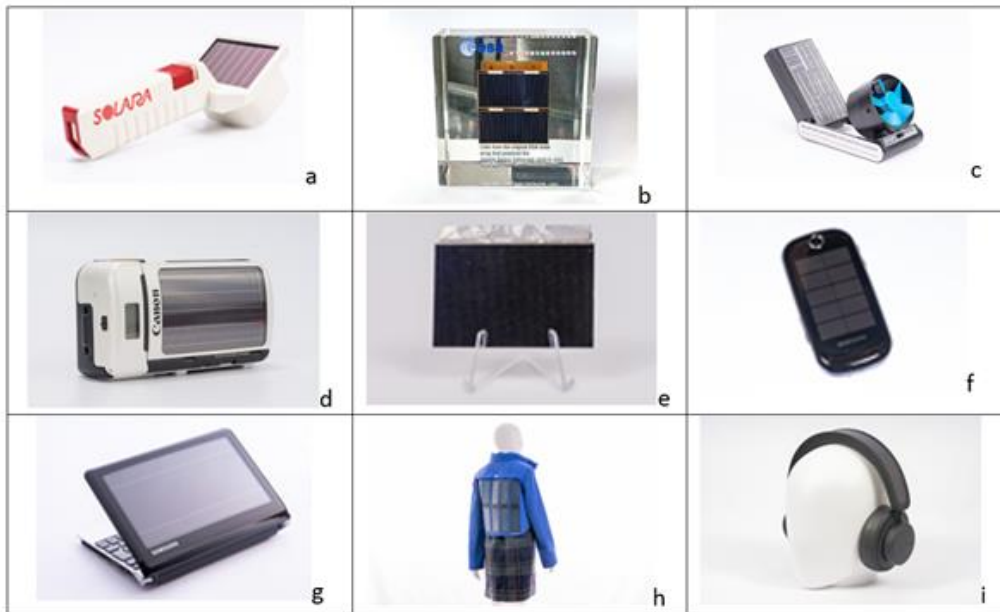


Fig. 4. Short history of creativity and innovation from the collection of the Solar Energy Museum: a- Solar Powered Lamp Camping Gaz, Amorphous, Product, 1989; b- Hubble Space Telescope, Monocrystalline, Silicon, 1990; c- Solar Car Ventilator Fan, Product, 1990; d-Canon Sure Shot Del Sol, Product, 1995; e- Multi-Junction Satellite Mesh, GaAs/Ge, 2000; f- Samsung S7550, Monocrystalline, Product, 2009; g- Samsung NC215S, Monocrystalline, Product, 2011; h- Tommy Hilfiger Solar Powered Jacket, Amorphous, Clothing, Product, 2014; Urbanista Los Angeles Headphones, Dye-sensitized, Product, 2021, [1]



Fig. 5. ESA/Webb presents

“Artist's impression shows Hubble's new solar panels unfolding during Servicing Mission 3B in 2002” [39]

And on the end, we recognize the specific philosophical and symbolic level: the Hubble Space Telescope in which the key important possibility of using solar energy, shows that in this collection, metaphorically, the equivalence of *Causa Formalis* and *Causa Finalis* one of the most important principles of collection origin.

Bearing in mind that in the analysis of the museum, the question of acquisition of the formative experiences of its young users is very important, this research was focused on comparative analysis of the collections on the Web. Results showed is that for *Museum of Solar Energy*, for further improvement comparatively the best example Frances Young Tang Teaching Museum [40]. The following parameters are taken into account: museum's mission focuses on active engagement with ideas, artworks, and exhibitions, all types of media and objects to explore intersections between the

visual and performing arts, natural sciences, and humanities and involves faculty and students as curators and advisors for its signature interdisciplinary exhibitions. Returning to the new definition of the museum, we emphasize here that all of the mentioned functions of the museum should be seen from the perspective of the community relationship in order to create various experiences for thinking and knowledge sharing.

5 Conclusion

In this paper, the subject of the research was the *Museum of Solar Energy*, through its web presentation, which shows a very significant collection that observes the materialization of the development of ideas about the use of solar energy. By exploring the museum collection shown, from the wide range of theoretical analyses, we made a selection of several important settings for formatting the theoretical context that may be a basis for the development and improvement of this museum concept. Our results have shown that necessary theoretical parameters arise from semio-technological analysis, *Theory of Objects*, *Theory of Complexity and Industrial Civilization*, and cultural differentiation by Gluzinski, as well as phenomenological investigations of canonized forms of relations between humans and worlds produced facilities. Considering *Technical Internet Context*, we also took into account research strategies for the development of virtual museums, as well as ontology and technical support, with a special accent on data autonomy. In this context, an analysis of contemporary museum practices gave a basis for a vision of the possibility of knowledge sharing in the *Museum of Solar Energy*, in accordance with contemporary musealization, which represents a dynamic process, which also shows the new international definition of the museum.

6 Acknowledgment

Exploring presented in this paper done is thanks to the support of the Ministry of Education, Science and Technological Development of the Republic of Serbia (Contract number 451-03-68/2022-14/200026).

7 References

- [1] <https://solarmuseum.org>
- [2] *ICOM approves a new museum definition*, <https://icom.museum/en/news/icom-approves-a-new-museum-definition/>(accessed 29. 8. 2022.)
- [3] **Spence, K.**, *Akhenaten and the Amarna Period*, https://www.bbc.co.uk/history/ancient/egyptians/akhenaten_01.shtml
- [4] <https://www.biblicalarchaeology.org/daily/ancient-cultures/ancient-near-eastern-world/akhenaten-and-moses/>(accessed 22.8. 2022.)
- [5] <https://historyofyesterday.com/akhenaten-the-cursed-pharaoh-3e7bd8f9c422>(accessed 22.8. 2022.)
- [6] **Sloterdijk, P.**, *Sfere: makrosferologija*, Fedon, Beograd, 2015.
- [7] **Platon**, *Država*, Kultura, Beograd, 1966.
- [8] **Posavec, Z.**, *Ideja dobra: Interpretacija usporedbe sa suncem-Platon:Država 505--509c*, *Politička misao: časopis za politologiju*, 9 (4), 1972, str. 415-425
- [9] **Knox, D.**, 'Copernicus's Doctrine of Gravity and Natural Elemental Motion', *Journal of the Warburg and Courtauld Institutes*, vol. 68 (2005), pp. 157-211
- [10] **Wildberg, C.**, *John Philoponus' Criticism of Aristotle's Theory of Aether*, Berlin 1988.
- [11] <https://commons.wikimedia.org/w/index.php?curid=37250306> (accessed 22.8.2022.)
- [12] **Stoiljković, D.**, Povodom Ruđera Boškovića, u: *Ruđer Bošković*, Gradac, br. 180-181, god. 38, 2011.
- [13] *Virtualna zbirka djela Ruđera Boškovića*, <http://virtualna.nsk.hr/boskovic/de-solis-ac-lunae-defectibus/> (accessed 29. 8. 2022.)
- [14] **Faivre, A.**, The Theosophical Current: A Periodization, *Theosophical History VII/5, A Quarterly Journal of Research*, Volume VII, No. 5, January 1999, pp.167-207

- [15] **Groys, B.**, The Insider is Curious, the Outsider is Suspicious, Geert Lovink, ed., *Uncanny Networks: Dialogues in Virtual Intelligentsia*, MIT Press, 2002.
- [16] **Lovink, G.**, *Interview with Boris Groys, German Art Critic and Media Theorist*, <https://networkcultures.org/geertlovink-archive/interviews/interview-with-boris-groys/> (accessed 29. 8. 2022.)
- [17] **Eco, U.**, *La Structure absente: Introduction à la recherche sémiotique*, Mercure de France, Paris, 1984.
- [18] **Bromberger, Ch.**, Technologie et analyse sémantique des objets : pour une sémio-technologie, *L'Homme*, 1979, tome 19 n°1, pp. 105-140.
- [19] **Moles, A. A.**, Objet et communication, *Communications 13: Les Objets*, 1969., pp. 1-22
- [20] **Moles, A. A.**, Théorie de la complexité et civilisation industrielle: Notes sur l'application du concept de complexité à la théorie des objets, *Communications 13: Les Objets*, 1969, Seul, pp. 51 – 64
- [21] **Schweibenz, W.**, The "Virtual Museum": New Perspectives For Museums to Present Objects and Information Using the Internet as a Knowledge Base and Communication System, In: Zimmermann, Harald H.; Schramm, Volker (Hg.): *Knowledge Management und Kommunikationssysteme, Workflow Management, Multimedia, Knowledge Transfer. Proceedings des 6. Internationalen Symposiums für Informationswissenschaft (ISI 1998)*, Prag, 3. – 7. November 1998. Konstanz: UVK Verlagsgesellschaft mbH, 1998. S. 185 – 200
- [22] **Bearman, D.**, Interactive Multimedia in Museums. Eds. Susan Stone and Michael Buckland, Michael, *Studies in Multimedia: State-of-the-Art Solutions in Multimedia and Hypermedia*. Proceedings of the 1991 Mid-Year Meeting of the American Society for Information Science San Jose, California, April 1991. Medford, NJ: Learned Information, 1992. 121-137
- [23] **Bearman, D.**, Information Strategies and Structures For Electronic Museums. Ed. Museum Documentation Association (Great Britain), *Information: The Hidden Resource, Museums and the Internet*. 7th Conference 1995 Edinburgh, Scotland. Cambridge, England: Museum Documentation Association, 1995. 5-22
- [24] **Bearman, D.**, Museum Strategies for Success on the Internet. Ed. Giskin Day, *Museum Collections and the Information Highway*. Proceedings of a Conference on Museums and the Internet 10 May 1995. London: Science Museum, 1995. 15-27
- [25] **Djindjian, F.**, The virtual museum: an introduction, *Archeologia e Calcolatori*, Supplemento 1, 2007, 9-14
- [26] **Mehwish, A., V. de Boer, E. Daga, M. van Erp, E. Hyvönen, A. Meroño-Peñuela**, *Semantic Web*, vol. Pre-press, no. Pre-press, pp. 1-4, 2022
- [27] **Bikakis, A., E. Hyvönen, S. Jean, B. Markhoff, A. Mosca**, Editorial, Special issue on Semantic Web for Cultural Heritage, *Semantic Web*, vol. 12, no. 2, pp. 163-167, 2021
- [28] **Merleau – Ponty, M.**, *Phénoménologie de la perception*, Editions Gallimard, Paris, 1945.
- [29] **Davallon, J.**, Introduction. Le public au centre de l'évolution du musée, *Culture & Musées* (2), 1992, pp. 10-18
- [30] **Gluzinski, W.**, Museology and cultural differentiation, in: V. Sofka ed., *Museology and developing countries - help or manipulation?* ICOFOM Study Series 14, Stockholm, 1988, pp. 139-145
- [31] **Berthoud L., K. Paul**, Microparticle Impacts Observed on the Hubble Space Telescope Solar Array, *Physics, Chemistry and Dynamics of Interplanetary Dust*, ASP Conference Series, B.A.S. Gustafson and M. S. Hanner (eds.), Vol. 104, 1996.
- [32] **Foster C., M. Tinker, G. Nurre, W. Till**, Solar-array-induced disturbance of the Hubble Space Telescope pointing system, *Journal of Spacecraft and Rockets*, Vol. 32, No.4, July-August, 1995
- [33] **Cotton, D.**, *When Big Science Fails: The Hubble Space Telescope Flaw and Implications for the Space Program in the Post-Cold War Era*, Ph. D. thesis, University of Colorado Department of History, April 2014
- [34] **Wolfe, A. J.**, *Competing with the Soviets: Science, Technology, and the State in Cold War*

- [35] *America*. Johns Hopkins University Press, Baltimore, 2013.
- [36] **Holder, R.D., S. Mitton**, Georges Lemaître: A Brief Introduction to His Science, His Theology, and His Impact. In: Holder, R., Mitton, S. (eds) *Georges Lemaître: Life, Science and Legacy*. Astrophysics and Space Science Library, vol 395. Springer, Berlin, Heidelberg, 2012.
- [37] **Mayall N.U.**, *Edwin Powell Hubble 1889-1953, A Biographical Memoir*, National Academy of Sciences, Washington D.C., 1970.
- [38] **Polić, S., S. Petronić**, Methodological problems of the application of renewable energy sources in cultural heritage protection, Proceedings / *7th International Conference on Renewable Electrical Power Sources*, Belgrade, October 17-18. 2019., SMEITS, Belgrade, Serbia, 2019., pp.265-269
- [39] **Petronić, S., S. Polić, M. Dragović, M. Srećković, A. Milosavljević**, Distinctions on renewable energy sources and cultural heritage protection, Proceedings / *7th International Conference on Renewable Electrical Power Sources*, Belgrade, October 17-18. 2019., SMEITS, 2019., pp.257-263
- [40] https://esahubble.org/images/solarpanels_unfold/ (accessed 29. 8. 2022.)
- [41] <https://tang.skidmore.edu> (accessed 29. 8. 2022.)