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SERBIAN AND INTERNATIONAL HONORS AWARDED TO MILUTIN MILANKOVIĆ

Abstract. In this paper we present honors and awards granted to Milutin Milanković, one of the greatest Serbian scientists. Awards are classified in accordance with the areas in which Milanković had achievements. Most of these honors are also presented in his Digital Legacy, an Internet site of the Faculty of Mathematics in Belgrade.

Introduction

This paper belongs to the series of articles related to the life and scientific work of Milutin Milanković and his Digital Legacy, <http://legati.matf.bg.ac.rs/milankovic>. A group of participants of the Digitization project of the Faculty of Mathematics in Belgrade and the Mathematical Institute of the Serbian Academy of Sciences and Arts started in 2012 to build the Digital Legacy, an Internet site of the Faculty of Mathematics. The general idea of the Legacy was to present biographies of the prominent Serbian scientists from the past who worked in mathematical sciences. We also wanted to have at one place all their scientific and technical works and personal data such as photos, letters and other related documents in order to better understand their work and life. We designed this Internet site having in mind the general audience, but the scientific community, too. Up to now, biographies of three scientists, academicians and the former professors of the Faculty of mathematics are offered there: Anton Bilimović, Bogdan Gavrilović and Milutin Milanković. In this paper we present international and Serbian honors granted to Milutin Milanković, one of the greatest Serbian scientists. Most of these awards are documented and presented in his Digital Legacy.

Short biography



Milutin Milanković was born on 28 May 1879 in Dalj (Slavonia, then part of Austro-Hungarian Empire, now part of the Croatian Republic). He finished high school in Osijek, so called "Gimnasia realka" and then he started studies in engineering construction at the Hochschule in Vienna. There he graduated in 1902 and defended his doctorate in 1904. Milanković was the first Serbian engineer with the title of Doctor of Science.

Belgrade University was founded in 1905. Soon, in 1909, Milanković was invited to come in Belgrade for professor of applied mathematics at the newly founded

university. This year started his scientific and university career in Belgrade. For his coming were responsible Bogdan Gavrilović and Mihailo Petrović who were the only university professors of mathematics in Belgrade before Milanković arrival.

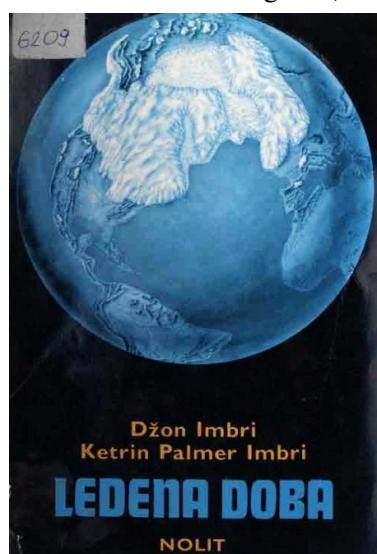
Milanković remained at the university until his retirement in 1955. There he taught applied mathematics (mechanics, astronomy and theoretical physics). He was the first University of Belgrade professor who taught celestial mechanics. He also taught the history of astronomy and the Special Theory of Relativity. Milanković in 1924 becomes a full member of the Serbian Academy of Sciences and Arts. He was also a member of the "Deutsche Akademie der Naturforscher Leopoldina" in Halle and the corresponding member of other academies in the world. Professor Milanković died on 12 December 1958 in Belgrade.

Milanković has written twenty books and fifty scientific papers on climatology, mathematics, celestial mechanics, astronomy and geophysics. Belgrade's publishing house "Zavod za udžbenike i nastavna sredstva" released in 1997. *Selected works of Milutin Milanković* in seven books. The most important and the most famous book from this collection is *Canon of Insolation and the ice-age problem* (Kanon der Erdbestrahlung und seine Anwendung auf das Eiszeitenproblem). This was the first edition of this book in Serbian.

Achievements and honors

The main Milanković's contribution to science is his famous theory of ice ages. This theory was developed starting from the complex calculation of secular perturbations in the movement of the planets. The first variant of his theory is published in the book *Théorie mathématique des phénomènes thermiques produits par la radiation solaire* (1922, publishers: Yugoslav Academy of Science and Arts, Zagreb and the publishing house Gauthier Villars, Paris). Thanks to this work he became known in the global scientific community, and soon receives a call for the cooperation with the famous German climatologist W. Köppen-a on the preparation of the capital work, the *Handbuch der Klimatologie* (Handbook of Climatology, printed in 1930).

Milanković wrote the part "Mathematische Klimalehre und Astronomische Theorie der Klimaschwankungen" (*Mathematical doctrine of climate and astronomical theory of climate fluctuations*) of this book. He develops there the theory of the solar heating and the planet insolation, with special reference to the Earth. Applying this theory, Milanković gives a very good model of evolution of ice ages on the Earth and the precise mathematical theory of terrestrial climate. This work has been translated into Russian in 1939. Now as a recognized scientist, he started cooperation on the part of "Handbuch der Geophysik" (Handbook of Geophysics) also a capital work prepared by B. Gutenberg. Milanković's wrote there four chapters where he studies the old and difficult problem, the movement of the Earth's poles. Here Milanković develops the theory of displacement of the Earth's poles and alternation of ice ages.



Cover of *Ice ages: solving the mystery* (Serbian translation)

As already mentioned, his main work is "Kanon der Erdbestrahlung und seine Anwendung auf das Eiszeitenproblem". Milanković finished the book just before the start of the Second World War. Already

printed copies of the book were destroyed in the Nazi bombing of Belgrade on 6 April 1941. However, typographic plates of the book were saved, and the book was quickly reprinted and finally published. This book is the synthesis of all Milankovic's previous work and research that were located on the border of several natural sciences: astronomy, celestial mechanics, geophysics and mathematics. The book appears at the worst time, during the war. At this time Milanković almost had no communication with colleagues and scientists in the world. Hence, the world scientific community was quite late familiar with the Milankovitch theory. John Imbrie and Katherine Palmer Imbrie wrote the book *Ice ages: solving the mystery*. There they explained in a popular way the mystery of ice ages, what they were like, why they occurred and when the next one will occur. A part of the book is devoted to Milutin Milanković and his astronomic theory and proofs that the earth's irregular orbital motions lead to the peculiar climatic changes which bring on ice ages. The book is translated into Serbian.

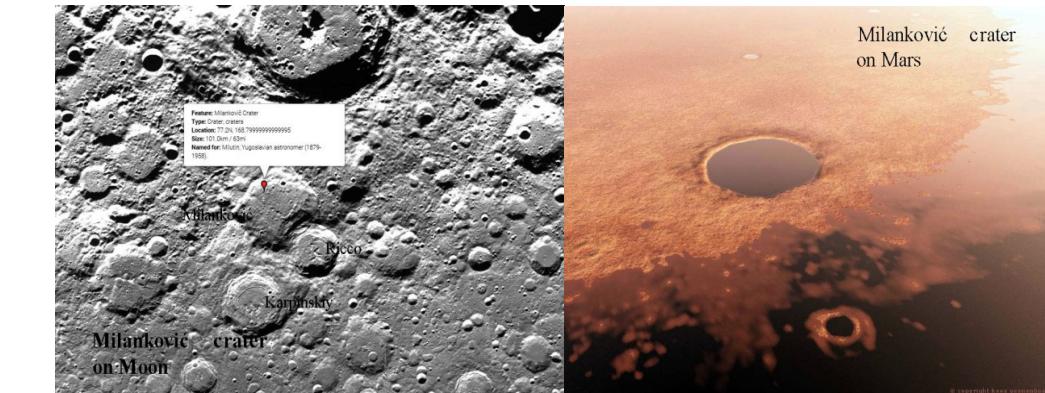
In recent years new proofs for Milanković theory are given. For example, in the cliffs of Kerguelen islands in the southern Indian Ocean have been found fossils which helped to determine changes in water temperature during the last 450 thousand years. The obtained results are in excellent agreement with the theory of ice ages.

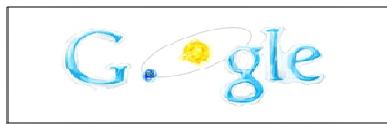
Milanković was also successful in the calendar reforms. Orthodox Church organized in the 1923 congress dedicated to the reform Julian calendar that was used in the Orthodox Church. Milanković, as a representative of the Serbian Orthodox Church gave an improvement in the reckoning of the Gregorian calendar. Milankovic's calendar reform proposal was accepted by the community of Orthodox churches. However, most of the Churches of the orthodox federation, including Serbian, although they were present at the Congress, did not start the implementation of the reformed calendar. In the same year, King Aleksandar Karadjordjević awarded Milanković the Medal of St. Sava of the third order for his contribution to the calendar reform.

Milankovic's contribution to world science is honored in many ways. We list them in free order.

European Geosciences Union, Division on Climate, established in 1993 Milutin Milankovic medal in recognition of the scientific and editorial achievements of Milutin Milankovic. This medal is reserved for scientists for their outstanding research in long term climatic changes and modeling. Until 2016, this medal is awarded to 25 scientists, including the mentioned John Imbrie.

IAU (International Astronomical Union) named several celestial objects after Milanković. One minor planet is named after him: 1609 Milankovitch. One crater on Moon and one crater on Mars are also named after him.





Google doodle, the Google introductory icon, devoted to Milanković theory of ice ages was published in May 28, 2010, on the occasion of his birthday. The path of the Earth around the Sun is depicted.

Streets in 13 towns in Serbia are named after Milanković, including the great boulevard in Belgrade. Also, the name Milutin Milanković is given to several secondary schools in Belgrade, Kruševac in Serbia and one in Republika Srpska.

On two occasions, celebrating 100 years and 125 years of his birth, the Yugoslavien (FRY) Postal Service has issued a commemorative stamp and a first day envelope.



Image and work of Milutin Milanković are also depicted on Serbian coins and banknotes. National bank of Serbia issued in 2009 the coin having the value of 20 dinars and in 2011 issued the banknote having the value of 2000 dinars. The avers of the banknote is dominated by the Milanković's portrait. There is also shown the computation of the snow line for the past part of the quarter of 600,000 years. On the other hand, the revers depicts the Milanković's figure and fragment of stylized presentation of the solar disk. The central part is dominated by Milanković's work "The path of the northern celestial pole".





Many scientific and thematic meetings and conferences were devoted to Milutin Milanković. Here we shall mention here just few of them.

SASA (Serbian Academy of Sciences and Arts) is the centenary of 1979. organized Symposium "The Life and Work of Milutin Milanković 1879-1979"

At Columbia University in New York in 1982 an international symposium entitled "Milanković and Climate" was held.

SASA on the occasion of the 125th anniversary of his birth, in 2004, organized a symposium "Paleoklima Earth's climate system".

Association "Milutin Milanković" organized a conference on science and work of Milutin Milanković "Calendar knowledge and contribution of Milutin Milanković" 14-15. September 2011 in Belgrade. The Association issued the Proceedings of the conference.

To mark 120 years of Meteorological Observatory in Belgrade, in 2007, it was established the National Center for Climate Change as a part of the Republic Hydro-meteorological Service of Serbia. Center, in accordance with the final documents of the Sixth Ministerial Conference of the UNECE "Environment for Europe", held in October 2007 in Belgrade, performs the functions of Sub-regional Climate Centre for South East Europe. The Centre has been given the name of Milutin Milanković.

In recent years, a special role in popularizing the work of Milutin Milanković, has the Association "Milutin Milanković" (<http://milutinmilankovic.rs>). The association was founded in 2007 with the headquarter in Belgrade. Here are some of the activities of the Association:

The Association has made several films about Milanković.

In the premises of the Association a permanent exhibition devoted to Milanković life and work is organized. It also organized a series of thematic exhibitions and lectures on Milanković in Belgrade and other cities in Serbia, Republica Srpska and Montenegro.

Association published an illustrated book: *Milutin Milanković - traveler through the Universe and the Ages*.

Faculty of mathematics in Belgrade and the Association "Milutin Milanković" made the digital legacy "Milutin Milanković" located at <http://legati.matf.bg.ac.rs/milankovic>. Legacy contains: 17 books of Milutin Milanković, five his manuscripts of lectures at the University, his 47 published scientific, eight books that other authors wrote on Milanković, two scientific papers on Milanković written by other authors.

Several authors wrote on Milanković: the academicians Tatomir Andjelić, Nikola Pantić and Zoran Knezević and a group of researchers working on the project Digitization of scientific and cultural Heritage: Nadežda Pejović, Žarko Mijajlović, Saša Malkov and Nenad Mitić.

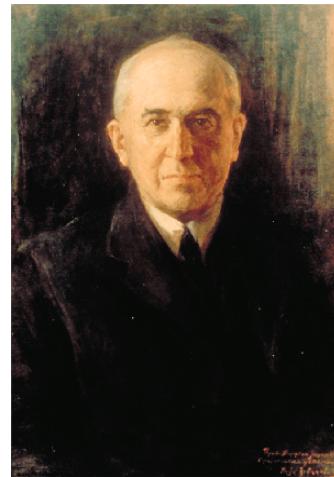


The original look of Milanković's birth house and his memorial center now

The Government of the Republic of Serbia together with the Croatian government restored in 2007 the birth house of Milutin Milanković in Dalj (Croatia). The house was built in 1820, and in 1979 became a cultural monument. The house was damaged and very ruined. After the reconstruction and renovation it turned into the educational memorial center, with a memorial room of the famous scientist, museum space, the Heritage collection of Milutin Milanković, lecture hall and the exhibition gallery.



Sreten Stojanović: Milanković's bust (1944)



Paja Jovanović: Milanković's portrait (1943)

There are also many artistic presentations of Milanković's image and work. Busts of Milutina Milankovića are posted at the following places: In front of the University of Novi Sad (sculptor Vladimir Jokanovic); in the lobby of the Mathematical Institute SASA, Belgrade; the Hydro-Meteorological and Geological School "Milutin Milanković" (Sculptor Sreten Stojanović); in front of the geomagnetic Institute Grockoj (sculptor Drinka Ivanović-Radovanović); SASA library (sculptor Sreten Stojanović); at the Museum of Contemporary Art in Belgrade (sculptor Sreten Stojanović) and the Association "Milutin Milanković" in Belgrade.

Conclusion

Milutin Milanković had great achievements and gave important contributions to geosciences and climatology. He published more than seventy scientific papers and books, most of them related to these fields. For his merits in science he obtained many

awards and his personality and his work are still honored and celebrated in many ways. All his scientific work is digitized and it is now a part of his digital legacy. There is also presented most of the awards granted to him. We believe that the material in the legacy will serve to better understand Milanković's life and scientific work.

Acknowledgment

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