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MILAN J. ANDONOVIĆ
(1849 -1926)

Abstract. Milan Andonović was one of the first Serbian authors who published a manuscript in the field of Probability and Statistics, a man who is considered to be the actuator of a cadastre implementation and a scientist who significantly influenced on the astronomy and the science in general in Serbia toward the end of XIXth century. In this paper we give a short review of his biography, on his scientific contributions and digitized books deposited in the Virtual Library of the Faculty of Mathematics in Belgrade.

Keywords: Serbian scientists; XIX and XX century; Astronomy; Geodesy; Virtual library.

Figure 1. Milan J.Andonović

Milan Andonović was born on July 23, 1849 in Požarevac. He finished primary school in Pančevo (which belonged to the Austria at the time) and learned German. In 1868 he finished secondary school in Požarevac and the same year he entered Technical faculty at Grand School in Belgrade (Figure 2).

In 1872 he was chosen among the best students by the Ministry of Civil engineering and sent to German University in Karlsruhe for further education in Polytechnic studies. In 1874 the academic council of Grand School sent him to the famous professors Ritter, Jordan and Helmert in Aachen for further education in Polytechnic studies, where he

specialized mechanics and geodesy. In 1875 he returned to his homeland and started to work as a professor of technical sciences at one of the high schools in Belgrade. Although he specialized geodesy, he devoted one year to study disciplines such as astronomy, method of last squares and cadastre under mentoring of professor Bauerfeind, in 1878. Two years later he passes the graduate exam on Technical High School in Munich. After that, in the same year he returned to Serbia, where he began to work as a professor of geodesy and the theory of last squares at Grand School in Belgrade (1).

Figure 2. Grand School in Belgrade, early 20th century

He published one of the first scientific papers on Probability and Statistics: *Basics probability and the theory of least squares*, in 1886. In his research interest probability theory was not his only specialty. He was very successful in other sciences, especially in astronomy and geodesy. His importance for the development of Serbian science is substantial. In 1886 he publishedthe manuscript: *The shape and size of the Earth.* Andonović published a number of other scientific papers, books and discussions related to surveying, astronomy, shape and size of the Earth, the theory of least squares, survey and cadastre. All of his manuscripts are printed in Belgrade (4).

During 1889 and 1890, Technical Faculty separated from the Grand School and the first head master of this faculty was Milan Andonović. He introduced and developed the use of cadastre in Serbia in the late 19th century. In 1890 he suggested and realized the foundation of the Geodetic Institute. In a very short time, during only five years, the school provided modernized and well knowledge equipped geodesists, who gave significant contribution to the development of Serbian Kingdom at the time. Many towns in Serbia were surveyed under the auspices of the Institute. On one occasion, 1924, when fifty years of professor's Andonović scientific and national work was being celebrated, in the name of all students of the Geodetic Institute, his college Dr. Kosta Jovanović had an introductory speech. There is an interesting part of that speech, which best describes the importance of

professor Andonović:

„*With his energetic propaganda he succeeded to open some questions about the Cadastre implementation and showed that the Cadastre is one of the essential needs of any country and government for the accurate regulation of taxes, for the realization of agricultural reforms, such as watering and drainage, for grouping disintegrated villages in order to form more practical surfaces for the agricultural work. Also, the Cadastre regulation is necessary in organization of mortgage loans, for the exact limitation of farm households, and for the lowering the number of disagreements about household boundaries, etc."*

In one of the German's famous scientific journals *Zeitschriftfür Vermessung swesen* from 1891, pages 321-328, in the manuscript: *Das Vermessungswesen in Koenigreich Serbien* the educational plan and program of Andonović's Geodetic School is analyzed with compliments and approvals, and with the conclusion that the teaching curriculum coincides with the same tasks established at the time in Germany.

In 1905, when Grand School was raised to the level of University, Milan Andonović was not elected asa full professor and therefore he demanded retirement. But soon after the retirement, he was elected for a part-time professor at the University and since then had been worked in the same status for more than 20 years (2).

With his son and other experts he founded the Surveying and Building Academy in 1907, where many Serbian surveyors and civil engineers were trained. This academy produced more than 300 trained and educated civil engineers and geodesists.

He introduced the teaching of astronomy into Serbian schools and promoted the science in general together with Jovan Dragišević, Milan Nedeljković and ĐorđeStanojević. He also published in 1888 the first textbook in Serbia on modern astronomy: *Cosmography*. The book consists of more than 500 pages and describes and firmly analyses the state of astronomic scientific achievements at the time (3).

During the turbulent period of wars and political instability in Serbia from 1912 until 1918, professor Andonović was politically active and he published several articles in order to explain Serbian political situation. In these manuscripts he pointed out the justification of a federation and strongly rejected statements that Serbia is responsible for the initiation of the First World War.

After the war, during the period of 1918-1926, he continued to build his University career. He mentored many high graduate personals in technical sciences, what was extremely important mission at the after-war time. Also, he was particularly engaged in preparation and implementation of the Cadastre Law. He died on August 31, 1926 in Vienna.

He published a significant number of scientific papers and books. Also, he is the author of great number of discussions devoted to surveying, astronomy, shape and size of the Earth, the theory of least squares, survey and cadastre:

1. *Basics probability and the theory of least squares*, 1886, p. 263;
2. *The shape and size of the Earth,* 1886, p. 34;
3. *Cosmography with basic astronomical notes for high school teachers*, 1888, p. 533;
4. *The volume and size of our Earth*, 1889, p. 46;
5. *The Universe*, 1889, p. 30;
6. *Basic geodesy with distinctive view of the cadastral question*, 1890-1897 (1st part

1890, p.368, 2nd part 1897 vol. 1, p.369-1390; vol. 2, p.1391-1641);
7. *The cadastre*, 1889, p. 83.

Also, in 1901 his scientific biography got enriched with his public lecture on the Reparceling and Land management at Serbian Royal Palace. Furthermore, as it is already mentioned, during the First Word War he was very politically active, so he published many articles and political discussions in German and French. Here are some of his works in this area:

1. *Macedonian Slavs are Serbs: in the defense of justified Serbian rights and interests on Balkan*, 1918, p. 118;
2. *Suvobor et Avala*, Epopé Serbe en 1914, 1915;
3. *Die Wahrheitueber den oesterreich.*Thronvolgermord in Sarajevo, 1915;
4. *Unschuld des KoenigreichsSerbiensfuer den Weltkrieg, durch seine Feindedargethan und bewiessen*, 1916;
5. *Le Royaume de Serbieen versl'abominable trahison Bulgare*, 1917.

Milan Andonović has left behind fifty years of a extremely productive social, scientific and political work. He was a man of practice, excellent expert in many scientific fields and a good pedagogue. Fifty generations of engineers were educated and firmly prepared to be geodesy experts by following his lectures and textbooks. The distinctiveness of professor Andonović was that he propagated science as a true apostle. Beside science, together with his students, he spread culture all over Serbia and Balkan, especially before the war. His work wasn't limited only on schools, he dispersed scientific way of thinking where ever he could. At the time, if there wasn't for his textbook, Serbs would be without the literature in geodetic science.

He was a patriot and a part of his life he devoted to serve his fatherland. For example he spent a lot of effort for retrieving respectability of Serbia during the war and for improvement of Serbian social, scientific and cultural status after the war. Besides mentioned achievements, he is also remembered as a great humanitarian. According to the some sources, if there were not his altruistic and unselfish engagements, certain institutions at the time would be shut down.

Milan Andonović was a regular member of Serbian Scholarly Society and a member of the Committee of Mathematical and Natural sciences. Also, from 1883 to his death he was a member of the Committee of Science and Literacy expansion among Serbian people. From1892 to his death he was a honorary member of Serbian Royal Academy (Figure 3).

Figure 3. A Symbol of Serbian Royal Academy

He was a member of the Association of Yougoslav Architects and Engeneers, together with worldly famous scientist Nikola Tesla, prof. Kosta Glavinić, prof. Kirilo Savić, prof. Miloš Savčić, prof. Milivoje Josimović and prof. Nikola Stamenković. The last but not the least of his numerous activities and memberships are given as follows:

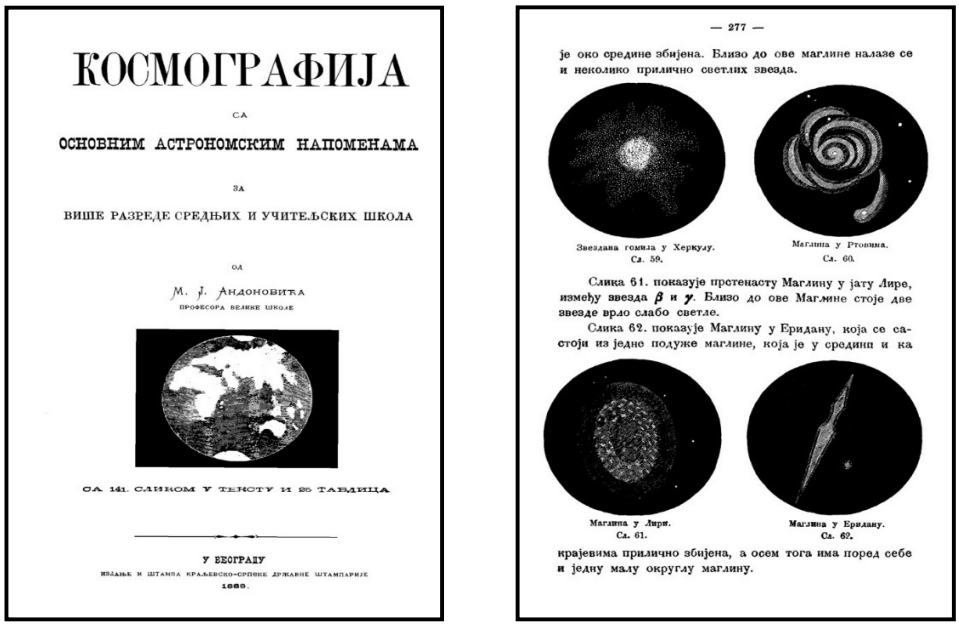
1. *First honorary and life president of the Union of States Actuaries***;**
2. *Honorary and life president of the Association of Yougoslav Architects and Engeneers***;**
3. *Honorarypresident of the Academics singing Society Obilić***;**
4. *President of the Gymnastic Society Dušan Silni;*
5. *President of the Journalistic Society.*

The first extremely important manuscript of Professor's Andonović ***Basics probability and the theory of least squares***, printed in 1886 by the Royal Serbian Civil printing office, proves that the *Theory of Measurement Errors* and *Geodetic Measurements* started to develop in Belgrade's School 130 years in the past from now (7). From the scientific point of view, there is nothing to be added to this book, neither then nor afterwards. Academician Milan Andonović had really strong impact and influence on the foundation and the development of Geodetic School in Belgrade due to his book based on the probability theory and the theory of least squares.

There are digital copies of his books in the Virtual Library: "*Cosmography"* 1888, Belgrade and "*The Universe*" 1889, Belgrade. Hard copies of both books may be found in the Library of Astronomical Observatory of Belgrade. Books are digitized by the courtesy of Vojislava Protić-Benišek (4).

His public lecture ***The Universe*** is a rich illustrated technical and poetical collage concerning the state of knowledge and importance of the "science of universe". On about 30 pages followed by a large number of illustrations (about 34 photos and drawings) the author described our Solar System (Sun, Moon, planets, comets, meteors and zodiacal light) in an interesting way by using verses of poets inspired by the universe and celestial bodies (Lj. Nenadović and J. Jovanović-Zmaj).

Cosmography (Figure 4) was intended for high school students and students of other secondary schools. The book is subtitled "With basic astronomical notes".It is an extensive and quite comprehensive peace of an astronomical science in Serbian consisting of 533 pages, 141photos and drawings and 25 tables and a large star map. A suitable map entitled "Polutarska zona I zodijak" (Equator Zone and Zodiac) was also given. For these illustrations Milan Andonović expressed his gratitude to Dr E. Weiss, Director of the Vienna Observatory, who was very glad to adorn this book with illustrations from his most recent work.The explanations and descriptions of the phenomena are very precise and detailed. At the beginning of the book, there is a preface, named "The Word in Advanced". In the preface he explains the reasons for writing this book and why it is necessary for every educated person to be read the book(6). The author says:



КОСМОГРАФИЈА

СА

ОСНОВНИМ АСТРОНОМСКИМ НАПОМЕНАМА

ЗА

ВИШЕ РАЗРЕДЕ СРЕДЊИХ И УЧИТЕЉСКИХ ШКОЛА

ОД

М. Ј. Андоновића

ПРОФЕСОРА ВЕЛИКЕ ШКОЛЕ

СА 141. СЛИКОМ У ТЕКСТУ И 25 ТАБЛИЦА

У БЕОГРАДУ

ИЗДАЊЕ И ШТАМПА КРАЉЕВСКО-СРПСКЕ ДРЖАВНЕ ШТАМПАРИЈЕ

1886.

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је око средине збијена. Близо до ове маглине налазе се и неколико прилично светлих звезда.

Звездана гомила у Херкулу. Сл. 59.

Маглина у Ртопина. Сл. 60.

Слика 61. показује протенасту Маглину у јату Лире, између звезда β и γ. Близо до ове Маглине стоје две звезде врло слабо светле.

Слика 62. показује Маглину у Еридану, која се састоји из једне подуже маглине, која је у средини и ка

Маглина у Лири. Сл. 61.

Маглина у Еридану. Сл. 62.

крајевима прилично збијена, а осем тога има поред себе и једну малу округлу маглину.

Figure 4. Pages from *Cosmography*

"*The science about the world (Cosmography) is very progressive. It's spreading every day, its content is rising permanently and the obtained results are being more complete and more accurate day by day…No student or a person of basic education and specially no teacher should be ignorant about the science of the world. The truths discovered about the nature, no one can deny…The superstition rules wherever nature isn't scientifically analyzed and where people are not interested in natural sciences…The science on the Universe as a natural science puts and leads a human being into the nature. It elevates and makes lofty by its very substance everyone engaged in it, it puts a human being to the position at which the natural, sound and true observing, as well as conceiving of things is also possible…In nature we may observe uniqueness and the completeness of all elements…According to my personal opinion, in high schools one should denote every notion in Serbian where possible. That's how I did it.*"

This preface shows the author's brilliant vision which is fascinating, and everything written in the preamble, may be used for today's modern book of science. The *Cosmography* is divided in 8 parts, and every part consists of several subsections. More precise, there are 24 chapters and 181 sections. In the very end of the book there is a detailed index of notions and names, and the corrections of some important mistakes that are notified afterwards. The book is written in very beautiful style, almost as a literary work, and is worth reading also from that point of view.

Probably, it was used as a secondary textbook at the Military Academy and the Grand School, the forerunner of the Belgrade University. In addition to the foreign literature, Andonović mentioned in the bibliography two Serbian authors: *Trigonometry* of Dimitrije Nešić and *Cosmometry* from Jovan Dragašević. Thus, it describes celestial sphere, constellations, the shape and size of the Earth, the Earth's rotation and revolution, the apparent movement of the Sun, coordinate systems, time, calendars, Solar system, stars, tides, precession, Cosmogony and among other things, Kant-Laplace's theory about the

origin of the World (i.e. the Solar system). Besides all this, there are twenty fully solved problems with detailed explanations. Generally speaking, this piece of work was very appreciated and valuable according to the world's standards at the time. Basically the book has been the universal astronomy textbook, easily read, but with no avoidance of necessary mathematical expressions. Apart from its out-of-date items, the book was written according to all necessary standards of a modern scientific literature.The reader navigates easily and comes to the wanted item. There we find many forgotten words and terms whose meaning has changed today. For example, ***stardust*** (serb. zvezdana prašina) there means ***meteorite***, ***cluster*** (serb. zvezdano jato) there means ***constellation***, the ***inflow and outflow*** (serb. priliv i odliv) there means ***tide, comet star*** (serb. zvezda repatica) there means ***comet***. Furthermore, for each constellation he introduces ***alinjman*** which has the meaning similar to ***asterism***. For example, alinjman ***Big Bear*** has four stars and presents the asterism trapeze of the constellation Big Bear. Also, the alinjman North Star is the line that passes through the rear wheels of the Big Chariot (in Serbian called Velika kola) toward to the North Star (5).

Using the astronomical literature actual at that time specially the results of Wetzel, Miller, Klein, Bruns, Littrow he succeeded to synthesize in this textbook almost all the knowledge of current interest in astronomy at the time. It would be nice if this book would be again printed. This would enable every interested reader to find answers to large number of astronomical questions in one place.

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