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DIGITIZATION OF COLLECTED WORKS OF JOVAN SIMOVLJEVIĆ

Abstract. Jovan Simovljević (1929–2007) was Professor at the University of Belgrade, at the Astronomy Department of the Faculty of Mathematics. Prof. Simovljević belongs to the closest circle of distinguished Serbian astronomers. He gave a significant improvement in the theoretical computational methods for the complicated calculations of ephemerides for the Solar-System bodies.. In the sixties of the last century he introduced at the Belgrade University a new subject of *Theoretical Astronomy*. To this subject he wrote textbook *Fundamentals of Theoretical Astronomy (Основи теоријске астрономије)*. The digitized version of this book is available in the Virtual library of the National Digitisation Centre (<http://elib.matf.bg.ac.yu:8080/virlib>). In this article the author also writes about other works of Prof. Simovljević: PhD thesis, collected scientific papers and coauthor booklet *Total Solar Eclipse of February 15, 1961 (Потпуно помрачење Сунца, 15. фебруар 196)*. All these works are also available at the Virtual Library.

Key words: Digitization, Jovan Simovljević, theoretical astronomy, ephemerides

Introduction

In this article collected works of Jovan Simovljević, a distinguished Serbian astronomer from the second half of the XX century, are presented. All the works have been digitized and are available at the Virtual Library of the National Digitisation Centre (<http://elib.matf.bg.ac.yu:8080/virlib>). In addition, his biography is also shortly presented.

Biography of Professor Simovljević

Prof. Dr Jovan Simovljević was born on July 26, 1929 at Šid. His father's name is Lazar and his mother's name is Danica, née Kovjanić. His primary-school education took place in Zemun and Novi Sad, that in the secondary school (gymnasium) in Novi Sad where he took degree in 1948. In that same year he enrolled at the Group of Astronomy of the Belgrade Faculty of Sciences from which he took degree in 1952. In 1954 he obtained a teacher's position at a secondary school and at the same time joined the Department of Mechanics and Astronomy of the Faculty of Sciences. In 1956 he became assistant at the same Department. During the school year of 1961/1962 he spent three months in Warsaw working under the supervision of Prof. Felician Kempinski. He obtained his PhD in 1963 at the Faculty of Sciences in Belgrade, the title is *A Generalization of Vector Elements for the Keplerian Motion (Генерализација векторских елемената Кеплерова кретања)*. He became assistant-professor at the same Faculty in 1964, the subject was *Theoretical Astronomy (Теоријска астрономија)*; associate professor he became in 1971 and full professor in 1980. He was retired on January 1, 1995.

Professor Simovljević was our astronomer of high reputation and an excellent teacher. His research field concerned the classical theory of planetary motion, especially the motion of minor planets and comets. He published many papers. He taught *Theoretical Astronomy* to the



university students of the fourth year. He was an excellent teacher, he gave interesting presentations systematically and introduced clearly new notions. In an interesting and illustrative way he wrote the university textbook *Fundamentals of Theoretical Astronomy* (*Основе теоријске астрономије*) published by Gradjevinska knjiga, Belgrade 1977. Many generations of astronomers learnt in this textbook how to integrate the differential equations of the Keplerian motion numerically, to calculate the ephemerides for minor planets and comets, to calculate the orbits of minor planets and comets, calculation of corrections to orbits and determination of special perturbations.

◀ **Professor Jovan Simovljević**

In addition to his engagement in the research and teaching Prof. Simovljević devoted a lot of his time to other activities. He was a member of the Leadership, Council and Assembly of the Faculty of Sciences, member in the Council of the Department of Mathematics, Mechanics and Astronomy at the same Faculty, then member of the Council and Scientific Council of the Astronomical Observatory in Belgrade and member in the Council of the Seismological Institute of Serbia. He was the head of the Chair of Astronomy and Celestial Mechanics at the Faculty of Sciences and a member of the International Astronomical Union. He was also member of the Editorial Board and Publishing Council of journal *Publications of the Department of Astronomy* published by the Astronomy Department of the Faculty of Sciences. He is among the founders of Astronomical Society *Ruđer Bošković*.

In addition to all of this Prof. Simovljević was a nice intellectual with an ample interest including except astronomy also many other fields. He possessed a knowledge of encyclopaedic level, not only in astronomy, but also in mathematics, history and archeology. He knew several foreign and ancient languages, Greek and Latin. He was especially keen in the use of the Serbian language where he clearly preferred the Cyrillic letters. Prof. Simovljević will be remembered in Serbian astronomy as a beloved teacher who gave a significant contribution to the development of our astronomy in every respect, scientific, technical and pedagogical.

Professor Simovljević and Astronomy Department

In the books *Thirty Years of the Faculty of Sciences of the Belgrade University* (*Тридесет година Природно-математичког факултета Универзитета у Београду*), published in Belgrade in 1980, and *Memory 125 Years of the Faculty of Mathematics* (*Споменица 125 година Математичког факултета*), published in Belgrade in 1998, Simovljević gave a short historical review concerning the development of astronomy among Serbs by 1977. It is curious to note that these articles, each having about thirty pages, were written without a single error. The period between 1978 and 1998 in the same *Memory* was treated by Prof. Jelena Milogradov-Turin. There one finds many interesting data.

For the case of the period before 1947 we can learn that Kosta Alković (1836–1909), who taught physics and mechanics at the Grand School, also presented astronomical topics to

his students. One of them, Milan Nedeljković (1857–1950), was the first to teach astronomy and meteorology in the framework of the Chair of Astronomy and Meteorology founded according to the Law of Amendments to the Statute of the Grand School from 1880. Milan Nedeljković is the founder of the first temporary Observatory for astronomy and meteorology of the Grand School which started its activity in 1887 in Belgrade (its part Vračar). Đorđe Stanojević (1858–1921), the first among Serbs who wrote scientific papers in astronomy, as well as one of the first astronomical books *Starry Sky of the independent Serbia* (*Звездано небо независне Србије*) published in Belgrade in 1882, also taught at the Grand School, and at the University afterwards. The University was founded in 1905 and in 1909 Dr Milutin Milanković (1879–1958), who had worked as a civil engineer in Vienna, was invited to join the Faculty of Philosophy to teach applied mathematics. He was the first to teach celestial mechanics. Academician Milutin Milanković was a scientist of world reputation. A lot of papers have been written about him. His collected works have been published (publisher Zavod za izdavanje udžbenika Beograd, in 1997). After Milanković have been named a minor planet, a Moon crater and a Mars crater. After Prof. Nedeljković had been retired, Dr Vojislav Mišković (1892–1976), who had spent some time in Nice working as an astronomer, was invited in 1926 to teach astronomy. He taught astronomy in the framework of the newly founded Chair of Theoretical and Practical Astronomy at the Faculty of Philosophy and was the founder and Director of the new Astronomical Observatory in Belgrade (situated in Zvezdara) for many years. With his advent the development of astronomy among Serbs begins in the aspects of teaching and science.

The second period 1947–1977 was the period of thirty years of the Faculty of Sciences. Prof. Simovljević contributed to the development of astronomy in this period. Namely in 1947 the Faculty of Sciences was separated from that of Philosophy: astronomy became the second group of subjects, the first was mathematics and the third physics. Soon celestial mechanics and mechanics were separated from applied mathematics and the Department of Mechanics and Astronomy was founded. At this department the first assistants for mechanics and astronomy in 1954 became: Radmilo Đorđević, Jovan Simovljević and Jovan Lazović. So the first exercises in astronomical subjects were started under Simovljević who was assistant of Professor Mišković. Then at the Department of Mechanics and Astronomy the lectures were presented by M. Milanković, V. Mišković, A. Bilimović and T. Anđelić.

The Department of Mechanics and Astronomy was split in 1962 in two departments: that of astronomy and that of mechanics. Simovljević spent the rest of his career at the Astronomy Department, till the retirement in 1995. At the Astronomy Department in addition to Simovljević the lectures were given by the following persons: Jovan Lazović, Zaharije Brkić, Ivan Atanasijević, Branislav Ševarlić, Vasilije Oskanjan, Jelena Milogradov-Turin, Mirjana Vukićević-Karabin, Dragutin Đurović and during a short time Milivoje Rakić. As assistants at the Department during a longer or shorter time were engaged: Zlatko Čatović, Milan Vuletić, Predrag Punoševac, Jelena Petrović, Katarina Kovač and Nikola Vitas. In 1994 the Faculty of Sciences ceased to exist, to be succeeded by several faculties, among them the Faculty of Mathematics. At the Department of Astronomy of the Faculty of Mathematics there are now (in 2008) two full professors (Trajko Angelov and Mike Kuzmanoski), three associate professors (Stevo Šegan, Nadežda Pejović and Olga Atanacković), two assistant-professors (Dejan Urošević and Anđelka Kovačević) and three assistants (Dragana Ilić, Bojan Arbutina and Dušan Onić).

Unfortunately, The Department of Mechanics is from 2007 without both teaching staff and students.

To those who knew him more closely, especially to astronomers and specialists in mechanics, Professor Simovljević was kind, straightforward and well-meaning. As far as known to us, his life was silent and for a majority of colleagues the impression was a reserved, modest and, at first glance, isolated person. Nevertheless, sometimes he reacted emotively knowing to say rather strong words. The reasons for his strong reactions he knew to forget quickly. The following sentence of his has been remembered. Once, in the eighties of the XX century during the Session of the Scientific and Teaching Council of the Faculty of Mathematics, one of the professors criticized all full professors which was, above all, directed against mathematicians. For a reason, known to him only, Professor Simovljević asked to speak saying just this: Let anyone, who thinks that I am lying, go with a burnt candle three times around the Cathedral” (thus to ask penitence). A silence followed and Prof. Simovljević went out. At the Astronomy Department he was in the closest relationship with Jovan Lazović and among his companions were professors from the Mechanics Department. He had a close contact till the very last day with Dragomir Simeunović - Pitagora who taught mathematics at the Faculty of Mining and Geology and who was together with Simovljević in their student days.

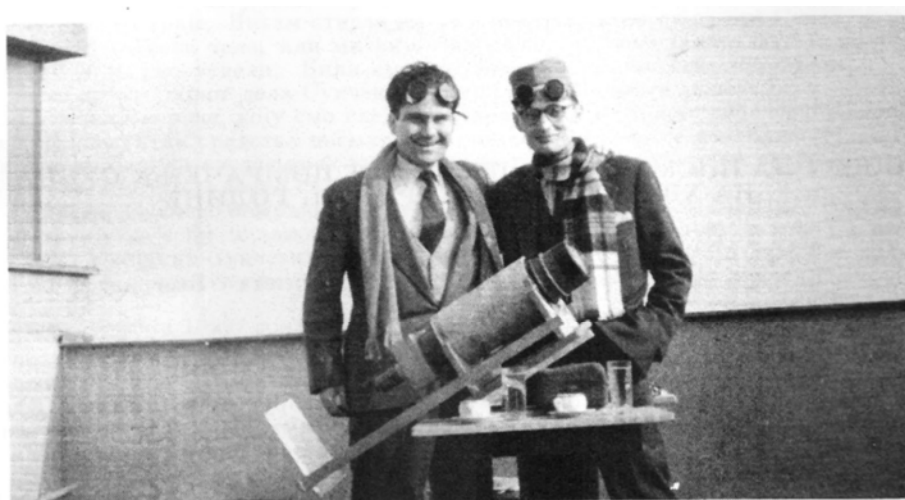
Jovan Simovljević's PhD Thesis

Jovan Simovljević in his PhD thesis *A Generalization of the Vector Elements of the Keplerian Motion* (*Генерализација векторских елемената Кеплерова кретања*) introduced the notion of the vector element of the planetary motion, without regard to its geometric or kinematical interpretation. The main analysis of this notion concerns the case of the perturbed motion using the differential equations of the general osculating element. The author examines the action of some components of the perturbational acceleration depending on the desired form of the differential equation of the motion element. Through this in a unique way one examines all vector elements used by that time and a procedure how to form the new ones was demonstrated. These new elements can be more suitable for some purposes than the already known ones in exceptional cases only. The supervisor of the thesis was Felician Kempinski, a professor at the Warsaw Polytechnic. The thesis was defended in 1963 in Belgrade at the Faculty of Sciences. At that time this thesis according to its size was the smallest one at the University of Belgrade. Simovljević's PhD thesis has been digitised as part of the project aimed at archiving all Serbian PhD theses with mathematical or astronomical contents printed in the past.

The Scientific Activity of Prof. Simovljević

Professor Simovljević's legacy contains reprints of his scientific papers published by 1980 in the form of a book. The book has about 250 pages with 22 reprints ordered chronologically. The list of these, as well as of other papers, is enclosed to this article. It is curious to note that, except for the case of one paper, he is always the only author.

Jovan Simovljević's papers can be divided into three groups. The first group comprises the papers devoted to the general questions of osculating elements in the planet motion and the function of time. Simovljević gave a general way of presentation and their properties by which he excluded the possibility of introducing new elements or parameters which would seem as better than those already known in some applications, as had been the case before. In the papers of this group Simovljević bore in mind the real applications of theoretical astronomy, the solutions of particular problems being as good and as applicable as possible, most frequently in the complicated calculations of special perturbations.



Слика 4. Сима и Јоца на посматралишту задовољни после обављеног посла и изванредног доживљаја. Ту је и кафица. Сима је са поносном српском шајкачом, што је тада била реткост и храброст.

Figure 1: The photograph with the caption is from journal “Vasiona”, No 2-3, 2005

The second group of Simovljević’s papers is composed by those concerning various questions in the problems of proximity among minor planets. Here an impetus was given by numerous papers of J. P. Lazović and M. Kuzmanoski in this field. Simovljević examined in details the perturbations produced by a small body at a short distance, but always remaining within realistic limits containing the group of known minor planets and bearing in mind the capabilities of observational techniques of that time concerning these celestial bodies. In his last paper he also gave a new approach to the perturbation calculation for the case of the proximities between minor planets.

The papers dealing with solar eclipses belong to the third group. This collection of papers appears as a special monograph concerning the eclipse phenomenon for our territory during the last thousand years. Such lists and commentaries concerning the central solar eclipses containing the main data about them were formed long ago for many countries, in the case of some of them as early as in the XIX century. Simovljević did this for our country in the last century.

In what follows a short review concerning a few scientific papers written by Professor Simovljević will be given.

Of interest is Paper No 5 in which the work of archeologist Emanuel Prochazka [8] from Czechoslovakia concerning the dating is presented. Starting from this paper Simovljević uses astronomical methods for the purpose of dating the tombs of prehistoric cultures. The tombs in this case were oriented according to the main points of the horizon determined by the sunrise and sunset. The dating is based on the fact that due to the precession the appearance of the starry sky changes over centuries above the horizon of a given place.

In Paper No 4 Simovljević gave his original calculation for the basic elements of the total solar eclipse in Yugoslavia on February 15, 1961. He determined the geographic coordinates for the three main lines of the totality band in our country and also the duration of the phenomenon and the elevations of the Sun on the middle line of the totality band. Then as early as in 1965 in Paper No 9 he calculated the astronomical data concerning the second, also the last, total solar eclipse of August 11, 1999, in our country in the preceding century. This

calculation was preceded by the question of if this phenomenon would be visible from our territory. Simovljević determined that the eclipse would be total for a small area in northeastern Vojvodina. He found that the longest duration of the totality would be about 100 seconds. The importance of this calculation is high because at that time computers were still not used for such purposes, their application had to come only. We are witnesses that Simovljević's computation was excellent and that expeditions from the whole of the country clustered on August 11, 1999 in order to observe from the northeast of Vojvodina one of the most beautiful sights which can be seen in the sky. It should be noted that this nice phenomenon took place only two months after the cease of the heavy bombardment by the NATO Alliance. We all had already had the habit of gazing at the sky which had been ripped by the enemy bombers. This time our eyes saw a wonderful and magnificent sight. The present author participated in one of these expeditions with S. Šegan to Đala in the extreme north of Serbia. S. Šegan had calculated for this eclipse all the necessary data again [5] using a computer. All astronomers are fascinated by every solar eclipse like Professor Simovljević. So the present author observed this wonderful phenomenon again on March 29, 2006 from Turkish town of Side.

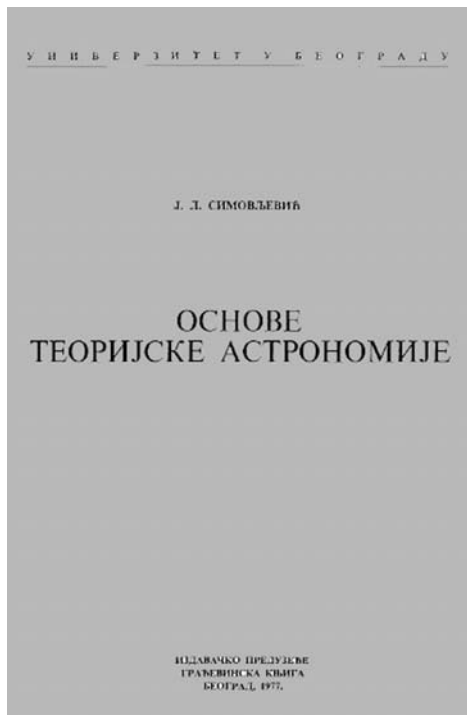
Further on in Paper No 10 Simovljević's intention was to examine in as many details as possible two short notes concerning solar eclipses which were registered in a known historical source of ours from the middle of the XIII century, the chronicle of Archdeacon Toma from Split. Simovljević calculated all the necessary astronomical elements for both eclipses. They took place on June 3, 1239 and October 6, 1241. His calculation was more accurate than those of his predecessors. For example, he concluded that the second eclipse was seen from Split as a partial one only, but having a very large phase.

As for other Simovljević's technical papers they are largely popular. Nevertheless, from this group we want to distinguish Paper No 3 in which he has an original contribution, as well as Paper No 5 with very detailed data concerning the course of the total eclipse in our country in 1961. The most complete data concerning this phenomenon were calculated by Simovljević and they were published as Appendix to monograph *The Total Solar Eclipse of February 15, 1961* ("Сунчево помрачење од 15 фебруара 1961") by V. V. Mišković (printed as Посебно издање САН СССР, Прир.-мат. 27, 1960) which has also been digitised. In addition to these technical papers Simovljević also published a number of articles in the field of science popularisation. He wrote articles for daily papers, delivered public lectures at the Popular University of Kolarac, popularised astronomy from radio and television.

Textbook Fundamentals of Theoretical Astronomy

Printed in 1977 was dedicated to the memory of Prof. Vojislav Mišković (1892–1976). It occupies 200 pages and consists of *Introduction*, five chapters and *Appendix*. In *Introduction* the orbit determination for minor planets and comets is presented followed by units of mass, distance and time, Gaussian day, coordinate systems and coordinates of celestial bodies. In the first chapter *Keplerian Motion* (Кеплерово кретање) are given the integrals of the differential equation for the Keplerian motion, the Keplerian orbits (circle, ellipse, parabola), elements of motion (classical astronomical and vector) as well as the corresponding transformations), initial conditions, system of initial conditions, the ratio of the areas of sector and triangle (procedures of Gauss and Hansen) and the chord of a parabolic orbit. The second chapter *Ephemerides Calculation* (Рачун ефемерида) gives the ephemerides for minor planets and comets, the procedure of composing ephemerides, the determination of the

opposition date, position calculation and composing ephemerides by numerical integration of the differential equation of motion and the comparison of the calculated and observed positions. In the third chapter *Orbit Calculation* (*Рачун орбита*) one presents the calculation of unperturbed orbits for minor planets and comets, the calculation of a circular orbit, calculation of an elliptical orbit, the Gauss-Encke method, the Laplace-Leuschner method, Väisälä's method and the calculation of a parabolic orbit. The fourth chapter *Calculation of Orbit corrections* (*Рачун поправки путања*) gives the correcting of the Keplerian orbits, variation of orbital elements and the correction of the initial conditions of motion. In the fifth chapter *Calculation of special perturbations* (*Рачун специјалних поремећаја*) one presents the real motion of minor planets and comets, numerical integration, the calculation of special perturbations for the rectangular coordinates, calculation of special perturbations for vector elements, the differential equations, calculation of special perturbations for scalar elements, indirect differential equations and the perturbational acceleration. Appendix *Numerical Integration of Differential Equations for Motion of Celestial Bodies* (*Нумеричко интегралњење диференцијалних једначина кретања небеских тела*) deals with interpolation, numerical differentiation and numerical integration.



This textbook is provided for students who study astronomy at the Faculty of Mathematics for subject *Theoretical Astronomy*. From the methodological point of view the book was nicely written, the material is gradually and clearly introduced. It is interesting and illustrative. The simplicity of derivation of complicated formulae of the ephemeris calculus is specially underlined. The book is full of mathematical expressions, equations and methods. At first glance it resembles mathematical textbooks, full with symbols, vectors, differential equations followed by short texts. In fact theoretical astronomy is an application of mathematics for the purpose of solving particular complicated problems of planetary motion. It is curious to note that in the book there are no figures, for instance the coordinate systems are described without a single plot. At places where a figure should have been, the notions are described so picturesquely and clearly that a presentation without figures was possible. The book contains no examples or problems for solving so that it

needs a collection of problems as its supplement. But at the end of the majority of chapters there is a *List of Formulae* (*Преглед образаца*) which serve for the purpose of effective numerical calculations and which is very useful in the solving of some problems of theoretical astronomy. Many generations of students of astronomy have learnt using this interesting textbook. Since all printed copies had been sold a long time ago, we decided to digitize this excellent book and make it available to the generations to come.

Booklet *Total Solar Eclipse of February 15, 1961*

The booklet *Total Solar Eclipse of February 15, 1961, Instruction how to observe* (*Потпуно помрачење Сунца 15.2.1961, Упутство за посматрање*) was published by astronomical society “Ruđer Bošković” in 1960. It has 24 pages and two appendices:

a map of the FPR of Yugoslavia with the zone of totality,
a small map which should be completed and sent to the address of the Society by observers.



The booklet was devoted to the total eclipse of the Sun of February 15, 1961. It is composed of articles written by Radovan Danić, Nenad Janković, Pero Đurković and Jovan Simovljević. Jovan Simovljević in this booklet presented the data concerning the moments and position angles of the contacts ordered as a table for 15 cities and towns of the FPR of Yugoslavia. The booklet appeared as a valuable instruction for observing one of the most beautiful celestial phenomena, total eclipse of the Sun.

Conclusion

Professor Simovljević liked his profession and was devoted to the science of astronomy and pedagogical work at the University. This is confirmed through numerous papers published by himself. He was a person of ample interests and rich general education. In addition to all, he was comprehensive, careful and systematic. He was interested in many themes and in addition to his science he knew excellently history and archeology, religion, ancient languages, numismatics and many other not usual and to other people poorly known themes. He improved significantly the Serbian astronomy. Generations of his students will preserve with respect the reminiscence of Prof. Jovan Simovljević.

Appendix: Selected Bibliography of Jovan Simovljević

a) Scientific Papers

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ДИГИТАЛИЗАЦИЈА ИЗАБРАНИХ РАДОВА ЈОВАНА СИМОВЉЕВИЋА

Професор Јован Симовљевић припада кругу најугледнијих српских астронома. Имао је значајне доприносе у математичким и рачунским методама за прорачун ефемерида, као и у прорачунима тоталних помрачења Сунца. Као професор Катедре са астрономију Математичког факултета Универзитета у Београду увео је нови предмет на редовним студијама, *Теоријска астрономија*. Професор Симовљевић био је веома образована особа и поседовао је енциклопедијско знање из многих области и говорио је неколико језика. Професор Симовљевић умро је 19. Октобра 2007. У овом чланку представља се биографија професора Симовљевића и пишемо о књигама и научним радовима који су дигитализовани и налазе се у Виртуелној библиотеци Математичког факултета и Националног центра за дигитализацију, <http://elib.matf.bg.ac.yu:8080/virlib>. Посебно су представљене његове књиге *Основи теоријске астрономије* и *Потпуно помрачење Сунца 15-II-1961*.

Кључне речи: Дигитализација, Јован Симовљевић, теоријска астрономија, ефемериде

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