Mihailo Petrović ALAS

Life Work Times

Serbian Academy of Sciences and Arts

MIHAILO PETROVIĆ 150th ALAS birth anniversary


MIHAILO
PETROVIĆ
150th ALAS
birth anniversary

SERBIAN ACADEMY OF SCIENCES AND ARTS

MIHAILO PETROVIĆ ALAS: LIFE, WORK, TIMES
ON THE OCCASION OF THE 150th ANNIVERSARY OF HIS BIRTH

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Tanja Ružin Ivanović, Žarko Radovanov, Dora Seleši

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LIFE, WORK, TIMES

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Exclusive editions, such as this monograph, call for the engagement, enthusiasm and cooperation of a number of individuals and institutions. We would like to use this opportunity and extend our gratitude to everyone who has taken part or in any way contributed to, or supported the creation and publication of this monograph.

First of all, we would like to express our gratitude to the authors of papers for their effort taken to provide expert and high level insights into some main points of Mihailo Petrović Alas' life and work, at the same time preserving an important aspect of being easy to read and appealing to a broader readership. In addition, we would like to thank to Ms. Snežana Krstić-Bukarica and Ms. Nevena Đurđević from SASA Publishing Section for performing a thorough proofread of the papers, thus making the writing even more articulate.

The monograph features a number of photographs and the copies of documents that have been obtained owing to the kindness of the SASA Archive, SASA Library, SASA Mathematical Institute, Archive of Serbia, Mr. Viktor Lazić from the "Adligat" Society, Mr. Jovan Hans Ivanović and his "Mihailo Petrović Alas" Foundation, "Mihailo Petrović Alas" Primary School, "Svetozar Marković" University Library, Belgrade City Museum, Zavod za udžbenike (Institute for Textbook Publishing) in Belgrade, Virtual Library of Faculty of Mathematics in Belgrade and Digital Legacy of Mihailo Petrović Alas.

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S. Pilipović, G. Milovanović, Ž. Mijajlović

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EDITOR'S FOREWORD

As soon as one first encounters the work of Mihailo Petrović, it becomes evident that he was a person that according to its numerous traits was a polymath. Above all, the academician Petrović was a gifted mathematician and a renowned professor at the University of Belgrade, but also a fisherman, writer, philosopher, musician, world traveler and a travel writer. He earned a degree in mathematics at the Belgrade Grand School and a licentiate degree in mathematics, physics and chemistry at the Sorbonne. At the age of 26, only a year after he had completed his studies, he defended his PhD degree in mathematics at the same university, as a student of the famous French mathematicians Henri Poincaré, Charles Hermite and Charles Émile Picard. In the same year (1894) he was elected to the position of professor at the Grand School to which he brought the spirit of the French mathematical school. It was at that point that his long and prolific journey through science began, whereas, owing to him, Belgrade achieved parity with other major European centers in mathematical sciences. He became an initiator and a leader of the Serbian mathematics and strongly contributed to the spirit of the modern European science in Serbia.

Petrović's expertize spanned several mathematical areas in which he achieved scientific results of world-class relevance: differential equations, numerical analysis, theory of functions of a complex variable and geometry of polynomials. He was also interested in natural sciences, chemistry, physics and biology, and he published scientific papers in these fields, too. In his scientific endeavor he managed to meet the most rigorous standards of the most developed European countries. In a brilliant rise, in a few years' time, up to the early 20th century, he wrote around thirty papers that he published in the leading European mathematical journals. It was due to this fact that he was elected a member of the Serbian Royal Academy as early as at the age of 30, and soon after he became a member of a number of foreign academies and prominent expert societies. He won the greatest respect of the global mathematical community: he was among few mathematicians (13) who delivered at least five plenary lectures or lectures as a visiting lecturer at the International Congress of Mathematicians (ICM). He delivered five such lectures (1908, 1912, 1924, 1928 and 1932). One such invitation has been considered by the mathematical community as an equivalent of an induction to a hall of fame. In addition, it has been considered that Petrović was a founder of new scientific disciplines, namely mathematical phenomenology and spectral theory. He invented several analogue computing machines, possessed technical patents and was the main cryptographer of the Serbian and Yugoslav Army.

Up to the Second World War he was the mentor of all doctoral thesis in mathematics defended at the University of Belgrade. Aforementioned is related to one of professor Petrović's greatest and most important achievements – he was a founder of the Serbian mathematical school that has produced a great number of renowned and successful mathematicians not only in Serbia but also around the world.

In 2018, the Serbian Academy of Sciences and Arts and mathematicians in Serbia celebrate the 150th anniversary of the birth of Mihailo Petrović Alas. Throughout this year, the Academy has organized a large exhibition dedicated to Petrović, alongside a solemn gathering and a conference. This monograph commemorates this important jubilee of the Serbian mathematics. Given the fact that a lot of articles on Petrović have already been written, and that his collected works were published at the end of the last century, the editors and authors of the papers in this monograph were faced with a daunting task of finding some new details from professor Petrović's life and career. Even more so given that his body of work is immense, spanning different scientific areas and encompassing topics that at first glance one finds difficult to combine. As Dragan Trifunović, Petrović's biographer and a man who most thoroughly studied his life and work, noted on one occasion that almost an institute was necessary that would encompass professor's entire body of work. Therefore, we set a relatively modest goal to ourselves to shed light upon some main points of Petrović's life and work, times and circumstances he lived in, as well as to elaborate on the present developments in relation to the Serbian mathematical school, through a selection of papers. The authors of the papers steered clear of technical details and excessive use of mathematical language. Hence, the monograph is intended for a broader readership, in particular to those readers who are interested in the history of Serbian science and its evolvement at the turn of the 20th century, but also to those who want to gain a deeper insight into the life of a brilliant mathematician and a polymath, and, we can quite freely say, an unusual personality.

Ž. Mijajlović, S. Pilipović, G. Milovanović

MIHAILO PETROVIĆ ALAS: LIFE AND WORK

MIHAILO PETROVIĆ ALAS AND HIS AGE

Žarko MIJAJLOVIĆ
University of Belgrade, Faculty of Mathematics

Mihailo Petrović's appearance in Serbian science and culture coincided with quite specific circumstances in Serbia and Europe. The Obrenović and Karađorđević dynasties alternately ruled Serbia. In the last four decades of the 19th century, the Obrenovićs ruled Serbia until the coup d'état in 1903, when the Karađorđevićs assumed power. Not so long before, in 1878, after the wars with Turkey and the Congress of Berlin, Serbia gained full independence and defined its borders. Until then it was considered a part of the Ottoman Empire. The bulk of the Serbian people lived in the diaspora, while science and culture were only emerging. Funds that the Serbian government could spend on science were very modest. Still, Petrović's biography suggests that these events did not stand in the way of his education and science. This can be ascribed to several facts. Petrović was born into a family that cherished the tradition of solid education of its younger generations. Besides, the family was wealthy enough to enable such education. Moreover, as the Serbian authorities recognised the importance of education, they constantly invested in it and enhanced the educational system in accordance with European standards. Gymnasiums and the Great School provided their pupils and students with knowledge that enabled them to continue their education and defend their doctoral theses at European universities.

In the 19th century, particularly its second half, science gained momentum, heralding its present-day development. The foundations of contemporary mathematics were laid. Universally recognised as the most influential mathematicians of the time, Henri Poincaré and David Hilbert introduced new mathematical concepts and a new style of abstract mathematical thinking. New mathematical theories with multiple applications in technical engineering and physics were emerging, and old theories were receiving novel grounding. It is not possible to elaborate on this in merely a few words as this deserves separate examination. Still, let us give at least two examples. Somewhat earlier, with his ε-δ definition of limit, Karl Weierstrass formally defined the analysis, while his student Georg Cantor created the set theory, establishing the framework and universal language of contemporary mathematics. Mihailo Petrović, Poincaré's direct student, began his academic career equipped with such knowledge and the understanding of science and culture that existed in Europe at the time. As a young man, he was already a well-formed mathematician and highly prolific academically. Fond of analysis, he was well familiar with the works of mathematicians of the French school in this area, examining the most topical issues in his works on differential equations and the theory of functions.

Mihailo Petrović was born on 23 April 1868 (Julian calendar) in Belgrade to a reputable family, of mother Milica and father Nikodim. Nikodim Petrović (1843–1875) earned a doctorate in theology in Kiev and taught theology at the Belgrade Faculty of Theology. As Nikodim died young, Mihailo barely remembered his father. Mihailo's maternal grandfather, parish priest Novica Lazarević (1821–1902) took care about his grandson and his education[1]. Mihailo was very close to this grandfather, until his death, as indicated by the intensive correspondence between the two of them, which has been preserved in Petrović's legacy[2]. Mihailo completed the First Belgrade Gymnasium in 1878–85. His school peers were Milorad Mitrović, Jovan Cvijić, Pavle Popović and others, who later became important figures of Serbian culture and science. He already then showed interest in mathematics, winning awards for his term papers and attracting his professors' attention with his talent. He enrolled in the Scientific-Mathematical Department of the Belgrade Faculty of Philosophy. He graduated in 1889 and soon went to Paris for specialisation and further studies of mathematics.

Petrović was gifted at mathematics and other sciences, writing his first mathematical work already as a first-year student[3]. He gained solid knowledge during his studies of mathematics at the Belgrade Faculty of Philosophy from professor Dimitrije Nešić. After arriving in Paris, he underwent one-year preparations for the entrance exam for the prestigious L'Ecole Normale Supérieure. Other candidates often prepared for this exam for several years, which attests to Petrović's success and talent. Petrović passed the exam with distinction, gaining the privilege to study at Collège de Sorbonne, the best European school of mathematics at the time. Petrović availed of this exceptional circumstance and gained extraordinary mathematical education. At Sorbonne, he first graduated from chemical sciences in 1891, from mathematics in 1892 and then from physics in 1893. As the best student in his generation, he was received by the President of

Advanced Pedagogical College, (l'École normale supérieure), Paris, 1885

the French Republic both in 1893 and 1894. He enrolled in doctoral studies at the same university. He received a Serbian scholarship, but was obliged to complete the studies in 1895. In 1894, one year ahead of schedule, he defended his doctoral thesis in the field of differential equations[4] and was commended by the examination committee, which consisted of reputable professors and leading French mathematicians of the time Charles Hermite, Émile Charles Picard and Paul Painlevé. According to the Mathematics Genealogy Project[5], the former two were co-mentors of the dissertation, though Petrović's results were close to Painlevé's area of expertise. Mihailo's grandfather Novica financed the first two years of his stay in Paris. The Ministry of Education of Serbia later recognised the talent and success of this Serbian student and granted him a state scholarship. Serbian envoy to France Milutin Garašanin attended the defence of his doctorate.

When Petrović returned from Paris to Belgrade in 1894, his erstwhile professor Dimitrije Nešić retired. Petrović applied for the vacancy of a professor at the Great School, together with Petar Vukićević, his somewhat older colleague from the Belgrade Faculty of Philosophy. Vukićević earned his doctoral degree in Vienna in 1894, also in the field of differential equations and was a good mathematician. Immediately after the defence, the results from his thesis were cited in the famous Schlesinger's monograph about differential equations[6]. Petrović was chosen for the post, after getting one vote more than Vukićević. Vukićević subsequently became a gymnasium professor and, probably under the influence of his defeat at the competition, no longer dealt with science or pursued an academic career. At the time, the Great School consistently

applied the *numerus clausus* principle, limiting the number of teaching posts. Regarding his election for the post, Petrović once said: "Had I not obtained that additional vote at the competition for a Great School professor, I would have never dealt with mathematics. I would have lived on Serbian rivers, not on a boat, but in a dinghy".

At the time, there were several mathematicians in Serbia who engaged in scientific work: Ljubomir Klerić, Dimitrije Nešić, Petar Živković, Dimitrije Danić, Mijalko Ćirić and Bogdan Gavrilović. Most of them attended German and Austro-Hungarian schools and all of them, apart from Petar Živković, lived in Belgrade. As a state scholar, Klerić completed high schools in Germany and Switzerland, becoming a mining engineer. Upon returning to Serbia, in addition to his mining jobs, he taught mechanics at the Great School. He was elected a member of the Serbian Learned Society and the Academy upon its foundation, and held several ministerial posts in the Serbian Government. He remained remembered by the construction of the tractoriograph, second-line curve drawing device, mechanical construction of transcendental numbers π and e, and other measurement mechanical devices, some of which were used for military purposes. In Serbia, Klerić was Mihailo Petrović's precursor in the construction of computing and other mechanical devices.

Dimitrije Nešić (1836–1904), Petrović's professor

Dimitrije Nešić studied at the Lyceum and high technical schools in Vienna and Karlsruhe. He was a professor at the Great School from its foundation in 1863 until his retirement in 1894. He significantly improved the teaching of mathematics. He was publishing in the Academy's *Glas (Voice)* and wrote a voluminous textbook *Algebraic analysis* on advanced mathematics. He was a rector of the Great School and president of the Academy. Živković first taught in a gymnasium in Belgrade, and as of 1889 in Užice. He wrote around twenty papers, most of them published in the Academy's *Glas*, and was elected a corresponding member of the Academy. As far as we know, Živković was the only member in the Academy's history who spent his entire career as a gymnasium professor. Danić, the first Serbian doctor of mathematics, was a professor at the Military Academy and author of solid university textbooks. Gavrilović, educated in Novi Sad, completed mathematical sciences in Pest, where he defended his doctoral thesis in 1887. He came to Belgrade in the same year, where he was elected a mathematics professor at the Great School. He spent some time in Germany, where he attended Weierstrass's lectures. He stayed in Belgrade over the course of his entire academic career, as

Dimitrije Danić (1862–1932), first Serbian doctor of mathematics

Bogdan Gavrilović (1864–1947), friend and colleague of Mihailo Petrović

Charles Hermite (1822–1901)

Mihailo Petrović's friend and closest colleague. His merits for the establishment of Belgrade University are significant. He authored excellent university textbooks on linear algebra and analytic geometry, which Radivoj Kašanin assessed as follows: "Both of these textbooks, particularly the latter, would do the honour to any nation; many nations, larger and happier than us at the time, did not have such works". Klerić and Nešić were professors at the Great School and members of the Academy, while Gavrilović became that somewhat later[7]. Although he attended Hermite's lectures in Paris just like Petrović, Mijalko Ćirić, a professor at the Great School, did not leave a visible trace in Serbian science. From this group, Nešić, Danić, Živković and Gavrilović were pure mathematicians, judging by their published papers and academic focus, while Klerić and Ćirić dealt with applied mathematics, as mechanics was often called at the time. Two doctors of mathematics, Đorđe Petković and Petar Vukićević also lived in Belgrade at approximately the same time. They also spent their careers as gymnasium professors.

There were also several other distinguished intellectuals in Belgrade who specialised in sciences akin to mathematics. For instance, Stevan Bošković, a general of the Serbian Army and full member of the Academy, is the most renowned Serbian geodesist, topographer and cartographer. He was educated at high military schools in St Petersburg and the famous Pulkovo Observatory. He carried out the first geodetic survey of Serbia, applying state-of-the-art numerical, mathematical and astronomic methods. This is also attested by the books of his professor in Russia Nicholai Zinger, a well-known Russian geodesist and astronomer from the second half of the 19th century, which he translated. Kosta Stojanović was a professor of theoretical mechanics and the first Serbian author of an advanced book on mathematical economics. This book is probably one of the most important and best works on economic sciences written by a Serbian author, which still attracts interest. Finally, let us also mention Milan Andonović, an honourable

member of the Serbian Royal Academy, a geodesist, engineer and author of astronomy books. Andonović brought to Serbia the first knowledge in the field of statistics and Gaussian law of error.[8]

In the late 19th century, though Belgrade barely had 70,000 inhabitants, it had a pleiad of illustrious scientists, such as Jovan Cvijić, Sima Lozanić, Stojan Novaković and others. Given the size of Belgrade and the number of its inhabitants, we may conclude that at the time it had a significant number of learned men and a good school producing new generations of educated young people. New technological inventions began to apply in Belgrade. Electric lighting was introduced in 1893 and the first electric tram in 1894. Given all this, we may say that the time of Petrović's return to Serbia overlapped with the zeitgeist of new-century Europe which was already felt in Belgrade. However, in other Serbian towns, science and education were reduced, in the best case, to what was taught in gymnasiums, and real science and high education in Serbia were concentrated in the capital. This continued into the second half of the last century, when the universities in Skopje (1949), Novi Sad (1960), Niš (1965), Priština (1970), Podgorica (Titograd, 1974) and Kragujevac (1976) sprang up from Belgrade University. The first studies of mathematics outside Belgrade were established in Novi Sad in 1954 at the Mathematics Department of the Faculty of Philosophy.

In the late 19th century, the bulk of the Serbian people were illiterate and the government, through scholarships and by sending students to study abroad, was more inclined to supporting and developing practical sciences such as construction, mining, legal and technical sciences, rather than fundamental sciences. The aim was to strengthen the young state in economic and military terms as soon as possible. Regardless of this, in his scientific work Mihailo Petrović met the highest standards of the most advanced European states. During his brilliant academic rise, within four years only, i.e. until the start of the 20th century, he wrote around thirty papers and published them in leading European mathematical journals. This success brought to Petrović high reputation, as well as widespread recognition. Already in 1897, about to turn thirty, Petrović was elected a corresponding member of the Serbian Royal Academy and in 1899 he became its full member. At the start of the new century, Serbia got its king of mathematics. Petrović's name and mathematical results soon surpassed the borders of Serbia, and later of Yugoslavia, after its creation. He was elected an honorary member of several foreign academies – in Bucharest, Prague, Warsaw and Krakow. He was elected a corresponding member of the Yugoslav Academy of Sciences in Zagreb, and became a member of numerous European scientific societies.

In terms of his scientific work, Mihailo Petrović belongs to a specific time. In the late 19th century, mathematics became a complex and high edifice with many floors. New mathematical disciplines emerged, with others practically dying away. In the 17th and 18th centuries, natural sciences, particularly mechanics and astronomy, were in full swing, directly impacting the development of mathematics for their own purposes. The scientists of the time dealt with their own sciences and mathematics to an almost equal extent. They introduced new mathematical

concepts and developed methods with the foremost aim to describe and resolve topical problems in their sciences. In the second half of the 19th century, this need was not so acute as the mathematical apparatus was sufficiently developed to satisfy the majority of requirements of other sciences. Moreover, due to the abundance of mathematical knowledge, it was difficult, if not impossible, for an individual to be well familiar with the entire field of mathematics. Specialisation also gained momentum as a toll of scientific productivity. The time of universal mathematicians and scientists was practically gone. Given the scope of his scientific work in the fields of mathematics, mechanics and philosophy, Henri Poincaré was certainly one of the last *homo universalis* of science. And it was Poincaré who was one of Mihailo Petrović's professors. Petrović, as a young student from Serbia, attended Poincaré's lectures and passed two exams, one which was mathematical physics. Judging by Petrović's later mathematical work, we can conclude that he was imbued with the spirit of universalism of his professor. He was equally familiar with and achieved first-class results in several mathematical fields: differential equations, numerical analysis, theory of functions of a complex variable and geometry of polynomials. He was also interested in natural sciences – chemistry, physics and biology, and he published papers in these fields. In addition, Petrović is considered to have founded new scientific disciplines – mathematical phenomenology and the spectral theory.

Henri Poincaré, around 1910

In hindsight, the influence of Mihailo Petrović on the development of mathematics in Serbia was enormous. He was the *spiritus movens* of Serbian mathematics and gave a strong contribution to the spirit of contemporary European science in Serbia. Moreover, he would gather and motivate people. This was not only the opinion of the Serbian mathematical public, but world reference publications testify to it as well. For instance, a third of the article *The Balkan Trilogy: Mathematics in the Balkans before World War I* by Snezana Lawrence and six pages in *The Oxford Handbook of the History of Mathematics*[9] are dedicated to the biography of Mihailo Petrović and his contributions to mathematics. In the former article, he is by far most widely cited author, with eleven works. In the article, Petrović is described as the greatest and most famous Serbian mathematician. It is stated that Petrović, as the most renowned Serbian mathematician of the time, defined the directions of development of the Serbian mathematical school on the foundations of French mathematics, although all Serbian doctors of mathematics of the time, apart from Petrović, were educated at Austro-Hungarian and German universities[10].

Milutin Milanković, around 1928
(Photo Archive of LSASA, F 240)

During his scientific career, Petrović published around 400 papers, of which around 300 on mathematics. He published 12 books. There are 14 casebooks from his lectures, prepared by his students or himself. As a member of the Serbian Royal Academy, the highest Serbian scientific institution, Petrović was highly active in its Department for Natural Sciences and Mathematics. Together with his friends and colleagues Bogdan Gavrilović and Milutin Milanković, he contributed to its high reputation. For instance, together with Gavrilović, Petrović wrote the Statute of the National Committee of Mathematicians for the Kingdom of the Serbs, Croats and Slovenes[11], which was adopted by the Academy's Presidency.

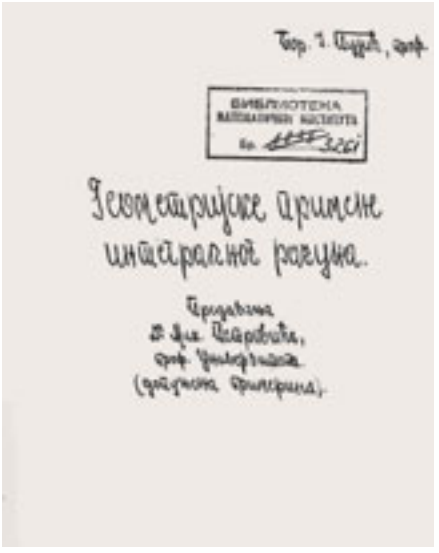
Mihailo Petrović's academic career was related primarily to the Great School, until it grew into University in 1905, and to Belgrade University, until the end of his working age. As he himself said once, as a pupil, student and professor he spent total 55 years in Captain Miša's edifice, where his gymnasium and the Great School were located. We shall therefore present several basic facts about these leading and, in addition to the Military Academy, the only higher educational institutions in Serbia at the turn of the 20th century. We shall also give a separate overview of the Mathematics Department of the Faculty of Philosophy, given that the Department was the main place of Petrović's scientific and pedagogical work.

The Great School, pursuant to the Law on its organisation from 1863 was "a scientific institution for high and professional education"[12]. After the reform of the Lyceum in the same year, it was divided into the Faculties of Philosophy, Technical Sciences and Law. The School was located in the building known today as Captain Miša's edifice. It was a large building at the time, bestowed upon the Serbian people by captain Miša Anastasijević for the needs of the Great School. In 1894, when Petrović was elected a professor at the Faculty of Philosophy, there were two departments: Historical-Philosophical and Natural Sciences – Mathematics. Until 1873, mathematics and natural sciences were taught at the Faculty of Technical Sciences only. That year, the studies of mathematics were introduced into the Faculty of Philosophy, and the Mathematics Department was set up at the same time. Education lasted for three years. The first student, Mihailo Banić, graduated from the Mathematics Department already in 1875. From the establishment of the Department until the outbreak of World War I in 1914, only 35 students graduated from mathematics[13]. In addition to Petrović, there were also other notable persons in the fields of science, culture and politics. Petar Vukićević, one of

six Serbian doctors of mathematics in the 19th century and Petrović's opponent at the competition for a professor at the Great School, graduated in 1886. For instance, it is little known that Stanislav Binički, a renowned Serbian conductor, composer and music pedagogue, graduated from mathematics at the Great School in 1894. It was only after he completed these studies that Binički dedicated himself fully to music. Mladen Berić, the first doctoral student whom Mihailo Petrović tutored and the first mathematician who defended his doctoral thesis at Belgrade University, graduated in 1909. Sima Marković, the second doctoral student under Petrović's mentorship and, together with Filip Filipović, the first secretary of the Communist Party of Yugoslavia, graduated in 1911. Let us also mention Borivoj Pujić, a student who graduated in 1914. In the 1960s, Pujić, or someone of his successors, granted to the Mathematical Institute of the Serbian Academy of Sciences and Arts 24 manuscripts – lectures of mathematics professors at the Great School and Belgrade University Dimitrije Danić, Kosta Stojanović, Mihailo Petrović and Milutin Milanković. Of these, 14 manuscripts are Mihailo Petrović's lectures. The majority of these manuscripts were written by Borivoj Pujić in a nice handwriting. These books are an important testimony to the teaching of mathematical sciences at higher educational institutions in Belgrade at the turn of the 20th century[14].

Before Petrović was elected a professor, Dimitrije Nešić was the only professor at the Mathematics Department until the arrival of Bogdan Gavrilović in 1887. After Gavrilović's arrival, mathematics was taught at two departments of the Great School – higher and lower mathematics. Dimitrije Nešić led the Higher Mathematics Department, and Bogdan Gavrilović took the Lower Mathematics Department. At the time, teachers could have the title of professors, junior lecturers and lecturers. There was also the title of an honorary professor, who could be appointed by the minister independently of the Great School Council.

During his professorship, Petrović taught various subjects. In one period, from the establishment of Belgrade University in 1905 until the appointment of Milutin Milanković as a professor of applied mathematics in 1909, Petrović was the only mathematics professor at the Faculty of Philosophy. It would happen that in a single academic year he practically taught all subjects, as seen in the number of preserved manuscripts, i.e. notes from his lectures from Pujić's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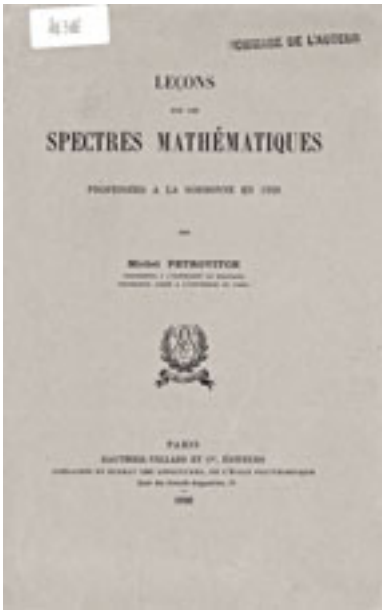
Notes from professor Petrović's lectures, taken by student Borivoje Pujić 1910–1914 (Mathematical Institute of SASA)


LEÇONS
SUR LES
SPECTRES MATHÉMATIQUES
Michel PETROVITCH

Lectures from theory of specters
at Sorbonne, 1928
(SASA Library, 46316)

collection. Those were subjects in linear algebra, analytic geometry in plane and space, differential calculus and its application, primarily in solving geometry tasks, including ordinary and partial equations, function theory[15] and algebraic equations. The last manuscript, standing out from others in terms its interesting content, was the basis for the textbook *Theory of Algebraic Equations,* co-authored and published by Mihailo Petrović and Nikola Saltikov in 1927. As this book contained a great number of solved problems on polynomials, mostly of the 3rd and 4th degrees, students and advanced secondary school pupils used it for a long time, even after World War II. By inspecting the content of these manuscripts, we can conclude that the structure and distribution of topics were to an extent similar to what was taught at the first courses on linear algebra, analysis and differential equations at the Faculty of Science and Mathematics, until the first several decades after World War II. This is entirely understandable given that professors at the time were either Petrović's doctoral students[16] or students of the first generation of Petrović's successors[17]. Judging by the manuscripts, Petrović's lectures were of algorithmic type, i.e. were not structured in the form of strict definitions, theorems and proofs, but had a continuous flow, with many examples and gradual introduction of concepts and procedures for solving concrete mathematical problems. Manuscripts were not hard to read and it seems they contained exactly the material that students had to learn. At the time, already available were the excellent books *Theory of Determinants* and *Analytic Geometry*, which were written by Bogdan Gavrilović[18] in the late 19th century and are interesting even for the contemporary reader. These textbooks could also fit into the courses held by Petrović, but were too broad and ambitious for an average student. For instance, the second book, although concerning only plane analytic geometry, had over 900 pages. This is why professor Petrović held lectures by his choice, with the aim to have students master the main techniques of higher mathematics and to successfully pass the exam. He published three university textbooks: *Computing with Number Intervals*, 1932; *Elliptic Functions*, 1937 and *Integration of Differential Equations by Use of Series*, 1938. He also published the textbook *Leçons sur les spectres mathématiques*, Paris, 1928, according to which he held lectures at Sorbonne in Paris in 1927–1928. Of these, particularly important is the book *Elliptic Functions*, which is a monograph-type publication and can be interesting for the contemporary reader as well.

Petrović lectured for 44 years at the Great School, and later at Belgrade University, together with Bogdan Gavrilović, another great name of Serbian mathematics, until his retirement in 1938. In 1894, the same year when Petrović returned from France to his homeland, mathematics for students at the Faculty of Technical Sciences became a separate course, led by Bogdan Gavrilović. Mihailo Petrović stayed at the Faculty of Philosophy. Over 15 years, the two of them were the only professors of pure mathematics at the Great School, i.e. Belgrade University, from 1894 until 1909 when Milutin Milanković became a professor of applied mathematics.

As regards Petrović's work at the University, with the help of his friend and somewhat older colleague Bogdan Gavrilović, Petrović raised Serbian mathematics to the European level. In his necrology devoted to Gavrilović, Milutin Milanković said that the two of them laid the foundations of Serbian mathematics. Petrović did so in scientific and Gavrilović in organisational terms, by significantly contributing to the transformation of the Great School into Belgrade University. The work of these two scientists, who can be considered the creators of contemporary Serbian mathematics, deserves particular attention and analysis. Without carrying out an in-depth analysis, we shall point out several details. As Poincaré's student, Petrović was an eminent representative of the French school of mathematics from the late 19th century, while Gavrilović, as Weierstrass's student, was under the main influence of German and British mathematicians who were at the time developing abstract algebra and were applying algebra in geometry. Gavrilović and Petrović were rather complementary in terms of their mathematical interests. While the focus of Petrović's work was on analytic methods, Gavrilović dealt more with linear algebra and geometry. Petrović mostly published scientific papers, while Gavrilović wrote valuable textbooks on algebra and geometry of monographic character. Unlike Petrović's, Gavrilović's works have not left a deep imprint in the Belgrade mathematical milieu, perhaps undeservedly so, let alone in the international environment as all of them were published in Serbian, although Gavrilović was a polyglot. This was certainly due to the rule that papers published in the Academy's *Glas*, in which Gavrilović was publishing, had to be in Serbian. On the other hand, more than a half of Petrović's papers were published in French, in the leading European journals. Let us emphasise once again that over entire 15 years, the two of them were the only professors of the Great School, later Belgrade University, at the height of their academic careers, owing, in fact, to the then cap on the number of university professors. In any case, both Petrović and Gavrilović, each in his own way, contributed to the development of mathematics in our country and the creation of a special atmosphere, owing to which Belgrade was transformed from a provincial town into a scientific centre.

The complementarity between Petrović and Gavrilović was not exhausted in education and science only, but was seen in their everyday lives as well. Petrović was a passionate fisherman, Gavrilović cultivated peaches. Petrović was a world traveller, while Gavrilović usually spent his free time on his estate in Grocka. Gavrilović had a family and many children, while Petrović never got married and left no direct descendants. Gavrilović was close to the Court, while Petrović was not, mainly due to his friendship with Prince Đorđe Karađorđević, who was

Petrović (violinist with a hat) leading his music troupe "Suz" at a tavern celebration (SASA Archive, 14197/II-1)

in King's disfavour. Gavrilović was the rector of Belgrade University and president of the Academy (1931–1937). Such proposals coming from the academic milieu for Petrović, in 1927 and 1931, were not accepted or approved by the authorities, which the majority of authors ascribes to King's animosity towards him. However, it should be noted that Petrović was not hampered in his scientific work or other activities. On the contrary, by inspecting the daily press and archival documents of the time, we can see that he received from the Ministry funds for his frequent travels and was highly respected as a great scientist and renowned expert both by the public and the authorities. He was engaged in important state affairs. For instance, he was the main cryptographer of the Serbian, and later the Yugoslav army, representing his homeland in international committees and delegations concerning education and fishery[19]. Petrović's unconventional life may have contributed to his not becoming the rector and president of the Academy. As the mythological deity Janus, Petrović had two faces. One was turned to mathematics, philosophy and the spiritual world, while the other looked at distant travels, fishing adventures and tavern parties. It is possible that respectable gentlemen and a part of the authorities could not imagine this other Petrović's face – the image of a rector who almost daily wades in his fisherman's boots through Danube backwaters and catches fish, and then plays the violin to entertain folks in a tavern[20]. However, those were, though high, only administrative duties, and Petrović did not

complain a lot about not having them. It is possible that he himself did not want to undertake such tasks as they would have only impeded the life that he led and loved[21].

Regardless of the said differences, Petrović and Gavrilović shared the same love towards science, students and the university. They were colleagues and the cornerstone of the Mathematical Club[22] between the two world wars. They were friends, who socialised not only in the Mathematical Club, but also in taverns, and engaged in various fishing adventures. When Milutin Milanković became a professor at Belgrade University, he immediately joined the two of them, both in scientific and social terms. These three scientists were outstanding personalities and pillars of mathematical sciences in Serbia until World War II and the arrival of a new scientific generation. Although highly individualistic in their work – for instance, none of them wrote their scientific papers with a co-author or a visible associate – they were connected through their work at the University and their warm friendship. Milanković wrote about this with a lot of sympathy in a nice biographical novel *Mika Alas – Notes about the Life of Great Mathematician Mihailo Petrović*. The atmosphere they created at Belgrade University is described by Radivoj Kašanin, Petrović's doctoral student, Gavrilović's assistant and successor at the Mathematics Department of the Faculty of Technical Sciences: "In addition to their exceptional educational background and original scientific works, all three of them featured something that I value the most and consider the highest human value – love towards young generations, understanding of young people, unselfishness and sincere help to young, talented people in their advancement. They knew how to rejoice and enjoy when young people advanced. *I was lucky to develop myself and work next to them – those great authorities of science and morality. To take pride in their friendship. I do not believe there was anywhere such an environment as was created by Gavrilović, Petrović and Milanković*".

Already in 1894, the library of the Mathematical Seminar was set up, offering to generations of mathematicians of Belgrade University broad possibilities for scientific work. Until World War I, Bogdan Gavrilović and Mihailo Petrović were in charge of the library, only to be later followed by other mathematicians. The library had a relatively rich collection of books, sets of journals, monographs and other mathematical literature. When the Mathematics Department moved in 1938 to the new building constructed next to the old building of the Faculty of Philosophy in Captain Miša's edifice, the library was moved there as well. Unfortunately, only two days before the liberation of Belgrade, on 18 October 1944, the enemy army, during their retreat, set fire to the library and destroyed it. Only a few books borrowed by individuals survived out of the entire library. As the first book of the inventory until 1907 was preserved, we found out that Bogdan Gavrilović entered by hand books until number 110, and Mihailo Petrović from this number until 301.

The story about the life path of Mihailo Petrović is inseparable from the development of Belgrade University and mathematical sciences in Serbia. In the late 19th and particularly early 20th century, higher education in Serbia was rapidly developing. In 1896, the Great School obtained some autonomy, and the mathematics curriculum came close to European standards.

The first eight professors of the University of Belgrade in 1905. Sitting from the left: Jovan Žujović, Sima Lozanić, Jovan Cvijić and Mihailo Petrović. Standing from the left: Andra Stevanović, Dragoljub Pavlović, Milić Radovanović and Ljubomir Jovanović. (SASA Archive, 14197/II-18)

The regulations of 1900 raised further the level of teaching and scientific work. Faculties became independent entities of the Great School and obtained the organisational framework preserved after World War II. In 1900, the Seminar for Mathematics, Mechanics and Theoretical Physics was created, involving the professors of mathematics, mechanics and astronomy from the Faculties of Philosophy and Technical Sciences. Mihailo Petrović and Bogdan Gavrilović played the main role in the work of the Seminar. After years-long preparations and delays, in 1905 the Great School was transformed into the university as "the highest self-managing body for higher professional education and pursuit of science". The university consisted of four faculties – of philosophy, law, technical sciences and theology. Eight full professors were appointed at the Faculty of Philosophy: Jovan Žujović, Sima Lozanić, Jovan Cvijić, Mihailo Petrović Alas, Andra Stevanović, Dragoljub Pavlović, Milić Radovanović and Ljubomir Jovanović. On their proposal, several days after the appointment, the Ministry of Education issued a decree on the appointment of professors of the Faculty of Technical Sciences. Bogdan Gavrilović, Mihailo's colleague and friend, was

among them. He was immediately elected a full professor of the Faculty of Technical Sciences[23]. Petrović and Gavrilović thus gained the leading role in the organisation of scientific work and mathematics courses at the newly established university.

Until 1909, lectures in theoretical mathematics at the Faculty of Philosophy were held by Mihailo Petrović and occasionally by Bogdan Gavrilović, as an honorary professor. That year, on their proposal, Belgrade University invited from Vienna Milutin Milanković to teach applied mathematics. This voluminous subject, taught by Milanković for years, was in fact mainly a course in mechanics and astronomy. At the time, in 1908/9, Petrović was the dean of the Faculty of Philosophy.

In the meantime, science at Belgrade University advanced to such an extent that the first doctorate in mathematical sciences was defended, under the mentorship of professor Petrović. This doctorate in the field of differential equations was defended in 1912 by Mladen Berić, a junior lecturer at the First Belgrade Gymnasium and assistant to professor Petrović. Already the following year, Sima Marković defended his doctoral dissertation on the Riccati differential equation, also under Petrović's tutorship. Those were the beginnings of the Belgrade School of Mathematics. Unfortunately, the work of Belgrade University was often halted due to wars. In the academic 1912/13 year, the University did not work due to the Balkan Wars. During the academic 1913/14 year, the University was re-opened, but World War I suddenly interrupted the work and further development of this institution. Its students and professors went to war. In August 1914, just after the war started, a part of Captain Miša's edifice was destroyed during the bombing. The enemy troops plundered the deserted and destroyed building. Mihailo Petrović took part in the war as a reserve officer. At the start of the war, in 1914, he led a group of soldiers at Skeljanska ada on the Sava river and captured around thirty Hungarian soldiers. Skeljanska ada is located opposite Obedska bara and the Kupinovo village, with the remains of the old royal town of Kupinik, the seat of despots Stefan Lazarević and Đurađ Branković.

Immediately after the war, in 1919, the University began to work, although in difficult circumstances. The curricula and university regulations were adjusted to the needs to restore and develop the country as several generations of students and experts perished, and the University cadre had already been decimated in earlier wars. In the early 1920s, the University experienced accelerated development within a short period – the number of professors increased. Among others, mathematicians Nikola Saltikov and Anton Bilimović came from Russia, significantly reinforcing the teaching cadre of the Mathematics Department of the Faculty of Philosophy. Although Mladen Berić and Sima Marković were appointed lecturers at the Mathematics Department, already in the early 1920s they left the University. Berić was forced to do so due to a personal adverse situation, while in the case of Marković, the Ministry of Education did not confirm his election for an associate professor due to his political engagement as a communist. Although professor Petrović laid a lot of hope in his first students, he was not particularly lucky with them.

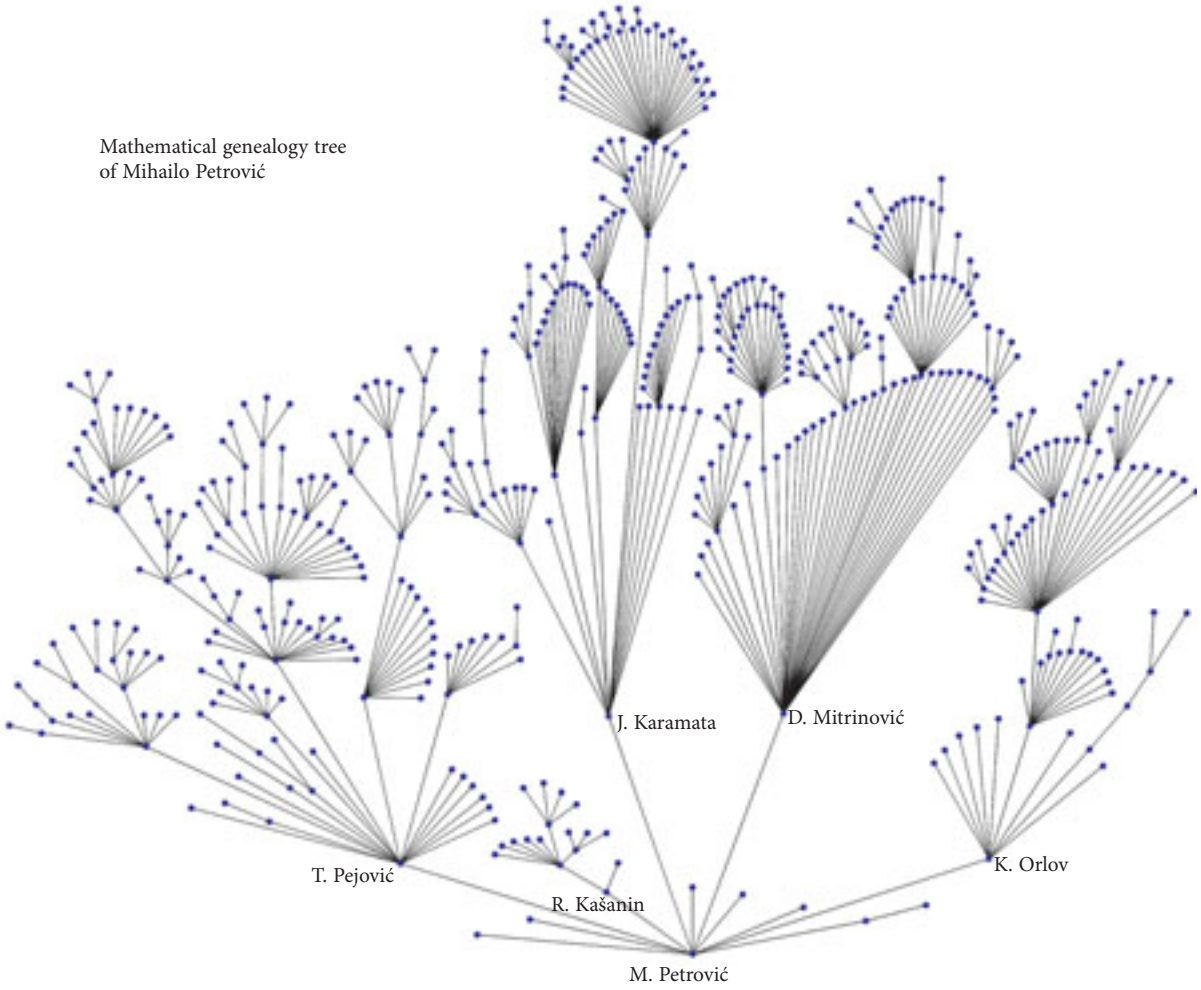
In the mid-1920s, a new generation of mathematicians matured: Tadija Pejović, Radivoj Kašanin, Jovan Karamata and Miloš Radojčić. They were all Mihailo Petrović's graduate and

Historical shot: Belgrade school of mathematics, 1926. Miloš Radojčić, Tadija Pejović, Vjačeslav Žardecki, Anton Bilimović, Petar Zajončkovski, (Jelenko Mihailović, seismologist) Radivoj Kašanin, Jovan Karamata (standing). Nikola Saltikov, Mihailo Petrović, (Pavle Popović, rector), Bogdan Gavrilović, (K. Petković, dean of Faculty of Philosophy), Milutin Milanković (sitting)
(SASA Archive, 14197/II-16)

doctoral students. In the 1930s, Dragoslav Mitrinović, Danilo Mihnjević, Konstantin Orlov, Petar Muzen and Dragoljub Marković also defended their doctoral theses under the tutorship of professor Petrović[24]. We shall give the names of all mathematicians at Belgrade University in 1926. The Department of Theoretical Mathematics of the Faculty of Philosophy consisted of: full professors Mihailo Petrović and Nikola Saltikov, lecturer Tadija Pejović and administrative assistants Jovan Karamata and Miloš Radojčić. The Department of Applied Mathematics consisted of: full professors Milutin Milanković and Anton Bilimović, associate professor Vojislav Mišković and lecturer Vjačeslav Žardecki. The Mathematics Department of the Faculty of Technical Sciences consisted of: full professors Bogdan Gavrilović and Petar Zajončkovski, lecturer Radivoj Kašanin; and the Department of Applied Mathematics consisted of: Ivan Arnovljević and Jakov Hlitčijev. All professors and assistants of theoretical and applied mathematics from the University made up the Club of Mathematicians of Belgrade University. This seminar was in fact the mathematics school of Belgrade University and the main point of gathering of Belgrade mathematicians. It is possible to say that this was the golden age of Serbian mathematics. The Club did not have any special rules, except for monthly meetings, when works of Club members were presented and academic discussions held.

Expedition of Belgrade astronomers and mathematicians to Fruška Gora, with the aim of determining a place for building the new observatory. From the left: R. Kašanin, J. Mihailović, M. Petrović, P. Popović, A. Bilimović, M. Milanković, V. V. Mišković, G. Gračanin and the guide (SASA Archive, 14188/7-2)

The mathematical successors of professor Petrović, connected through tutorship in the preparation of doctoral dissertations, make up the mathematical genealogical tree consisting of around 800 nodes – mathematicians[25]. Of this number, somewhat over 500 are Serbian mathematicians and the rest are foreign. Successors are placed in eight circles – generations, the several last of which include the majority of contemporary Serbian mathematicians. Looking at Petrović's mathematical tree, we can see four large clusters, with Tadija Pejović, Jovan Karamata, Dragoslav Mitrinović and Konstantin Orlov representing their roots. Each of them introduced new areas into Serbian mathematics or set up their own schools of mathematics. The successors of professor Pejović usually dealt or deal with logics or algebra, although Pejović's main focus were differential equations. The mathematicians gathered around professor Karamata usually engaged or engage in analysis. The students of professor Mitrinović work in discrete and numerical mathematics, while the mathematical successors of professor Orlov deal with differential equations and numerical analysis. These professors or their direct students created new mathematical centres in Serbia. Professor Bogoljub Stanković opened his own mathematical school in Novi Sad, while professor Mitrinović developed scientific work in the field of mathematics in Niš and at the Belgrade Faculty of Electrical Engineering. Of course, these divisions are rather rough, but give some sort of picture about mathematics in Serbia today.



Members of the Belgrade mathematical seminar were publishing their works mainly in the Academy's *Glas* and Yugoslav Academy of Sciences' *Rad (Work)* in Zagreb. Unfortunately, the Academy's rule was to publish papers in Serbian, which is why they remained unknown to the wider global public. There was an acute need for a new journal where papers would be published in world languages. Owing to the endowment of Luka Ćelović – Trebinjac in 1932 and the initiative of Anton Bilimović, and with the support of Mihailo Petrović and Milutin Milanković, a new journal was launched – *Publications de l'Institut Mathématique Université de Belgrade*[26]. Papers were published in Russian, English, French and German. In the same year, at the International Congress of Mathematicians in Zurich, Mihailo Petrović and Anton Bilimović presented *Publications* to the world public. The works of Belgrade mathematicians became known to the global

mathematical community. Until World War II, seven volumes of *Publications* were published. In each of these issues, Petrović published at least one paper.

Petrović's last paper was published after his death in the first post-war issue of *Publications* in 1947. In addition to Serbian mathematicians, mathematicians from other Yugoslav centres, Zagreb and Ljubljana, were also publishing in this journal. For instance, Đuro Kurepa, who was educated in Paris and was a professor in Zagreb at the time, published in 1935, in the fourth issue of *Publications* his entire doctoral thesis *Ensembles ordonnés et ramifiés*. This dissertation contains some of the key contributions to the contemporary set theory. After World War II, professor Kurepa had a very strong influence on the development of mathematics in Yugoslavia, including Serbia. The double issue VI–VII was dedicated to professor Petrović. The last pre-war volume VIII was printed on the eve of World War II, and was lost in the enemy bombing of Belgrade in 1941. In addition to mathematicians from Belgrade University, world-renowned mathematicians were publishing their papers in *Publications* both at the time and later, such as, for instance: Elie Cartan, Wacław Sierpinski, Paul Montel, Josip Plemelj, Đuro Kurepa, Paul Erdös and Saharon Shelah.

In his younger age, Petrović was interested primarily, if not exclusively, in abstract or the so-called pure mathematics. Whatever he did – differential equations, analysis or distribution of zeros of polynomials in complex plane – Petrović would detect a problem, formulate a theorem and give proofs. His scientific writings did not go further than this nor was he interested in wider application of the results obtained. Already at the start of the 20th century, he demonstrated particular interest in the practical aspect of mathematics. He pondered over how mathematics appeared in natural sciences, i.e. how it could apply to the exploration of natural phenomena. Just like Leibniz tried to arrive at a *characteristica universalis*, a universal and formal language to express all mathematical, scientific and metaphysical concepts, Petrović tried to invent a universal method to solve problems of other sciences. Analogies had a fundamental place in his examinations. He sought and gave examples of entirely disparate phenomena that were described by the same differential equations. These efforts resulted in his original work – *Mathematical Phenomenology*. He published three books, two in Serbian and one in French, in which he presented his theory[27].

Petrović was a highly prolific and versatile mathematician. He published several hundreds of papers, mainly in the leading foreign journals. He also put forward new and original ideas, and made significant breakthroughs in world science. This fact must be particularly appreciated given the circumstances in Serbia in which Mihailo Petrović worked. His algebraic results are a good example of his contributions to mathematics and his influence on the work of other mathematicians. The results in this field are closely related to the function theory and were recognised, cited and further developed by the leading mathematicians such as: Hermite, Landau, Polya, Fejér, Hardy, Montel and others. Around thirty Petrović's papers, four in algebra and number theory, are presented in the German reference mathematical journal *Zentralblatt*

für Mathematik und ihre Grenzgebiete. It should be borne in mind that those are only papers published after 1930, when this journal was launched. Petrović's theorems and works on the geometry of polynomials are contained in the most famous monograph in this field – *Geometry of Polynomials* by Morris Marden. This issue of the American Mathematical Society (the book was published twice, in 1949 and 1966) quotes four Petrović's papers[28]. This monograph also contains references to several other Serbian mathematicians: J. Karamata, M. Tomić, B. Rašajski, D. Marković and Š. Raljević. Dragoljub Marković, the founder of the Algebra Department at the Faculty of Science and Mathematics in Belgrade, is cited the most (six papers), and can be considered the true successor of Petrović's work in the field of the geometry of polynomials in our country. In the 1970s, our renowned algebraist Slaviša Prešić made significant contributions in this field. It is therefore reasonable to accept the opinion of academician Miodrag Tomić that the geometry of polynomials, together with the function theory (which can be hardly separated from the former), is perhaps the most important Petrović's field, in which he made his greatest achievements. Moreover, Petrović brought this area to our milieu. Owing to his influence, several important Serbian mathematicians were engaged in this field, making recognisable and valuable contributions.

Mihailo Petrović retired in 1938, receiving the highest recognition from his students and colleagues. The following year, he received an honorary doctoral degree of Belgrade University and the order of St Sava of the first rank. The proposal for the honorary doctorate submitted to the Council of the Faculty of Philosophy clearly highlights Petrović's merits for the creation of the mathematical school in this region: "M. Petrović created the Mathematical School, the first in Yugoslavia, raising mathematical courses at Belgrade University to the level of modern world schools. Our Faculty, University and this entire state must give the highest recognition to Mihailo Petrović". At the same time, the members of the Mathematical Seminar paid respects to their teacher and colleague. They proposed that the unit for theoretical mathematics be separated from the Seminar and called the *Institute for Theoretical Mathematics of Mihailo Petrović*. The explanation read as follows: "Our Mathematical Seminar owes to Petrović eternal gratitude as it was he who founded it, worked there and was developing it for entire 44 years. He gathered around him a large number of young people and prepared them for scientific work".

Petrović held a high rank of a reserve officer, was a reserve engineering lieutenant colonel. When the Germans attacked Serbia in April 1941, he was drafted, although he was 73 at the time. He was soon after captured and spent several months in captivity. According to some sources, he was released after the intervention of his friend, Prince Đorđe Karađorđević, while according to other sources, he was released due to his age and illness. He soon began to contract illnesses, stopped going out and, as Milanković wrote, would sit all the time in his room and write.

Mihailo Petrović had a rich, interesting and unconventional life. It is hard to enumerate in one place, let alone describe in detail everything that he engaged in. Besides tackling

various mathematical issues, Petrović was present at many other, often unexpected places. He was the author of laws and proposals of intergovernmental agreements[29] and the inventor and owner of successful and implemented patents. Many consider Petrović one of our most important philosophers and the creator of the original theory in natural philosophy – mathematical phenomenology. He wrote in a nice and interesting way, and some of his novels became a part of obligatory school reading and belonged, as they do today, to favourite youth literature. In addition to novels, he wrote essays and travelogues, and was an associate of daily papers. He wrote scientific papers and was also interested in other natural sciences, primarily astronomy, relativity theory and chemistry. He created the cryptographic system and was the main cryptographer of the Serbian and Yugoslav armies. He played the violin and led the music company "Suz", which had one of the leading roles in Belgrade's bohemian life until the start of World War II. He also collected folk poems and folklore elements. Finally, he was a passionate fisherman and a great world traveller and seafarer on northern and southern seas. This great mathematician and great traveller passed away silently, dreaming about a new and great oceanic travel. Mihailo Petrović died in Belgrade on 8 June 1943, in his home on Kosančićev venac 22.

Many Serbian and several foreign authors have written about the work and life of Mihailo Petrović. The author of this text had a difficult task not to fall into the dangerous trap of repetition and mere enumeration of the already well-known facts. We have therefore focused on the newly revealed archival records, for instance from *Adligat*, and on details and personalities surrounding Petrović. Some sources have not been explicitly mentioned here, while some less known have been stated. We have not given the list of authors who have written about Petrović as we would have thus wronged others whom we might have left out. However, I must mention Dragan Trifunović, Petrović's biographer, historian of mathematics and professor at Belgrade University. He wrote and edited several books about Petrović and his age. He not only shed light on Petrović's name in the past half a century, giving Petrović the place he deserves in Serbian mathematics, but also revealed numerous, less known details from Petrović's life. If we failed to specify some sources, they probably derive from the above works by Dragan Trifunović. In addition

Mihailo with his mother Milica in Bern in 1918 (SASA Archive, 14188/25)

to all Petrović's works, *The Collected Works of Mihailo Petrović*, published by the Institute for Textbook Publishing and Teaching Aids in 1997–99, contain complete and valuable scientific analyses and contributions of renowned Serbian mathematicians. Owing to the Academy's engagement and by curtesy of this publishing house, *The Collected Works* have been digitised and are available to the interested public in the Virtual Library of the Belgrade Faculty of Mathematics and its digital legacy devoted to Mihailo Petrović. Owing to authors' contributions in this publication, a reader can learn about other details of Petrović's work and interesting episodes from his life[30].