

# Mihailo Petrović ALAS



Serbian Academy of Sciences and Arts





MIHAILO  
PETROVIĆ  
150<sup>th</sup> ALAS  
birth anniversary



Serbian Academy of Sciences and Arts

143





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**PUBLISHED BY**  
SERBIAN ACADEMY OF SCIENCES AND ARTS  
(SASA)

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**ORIGINAL TITLE**  
Mihailo Petrović Alas – rodonačelnik srpske  
matematičke škole

**ENGLISH TRANSLATION**

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**PHOTOGRAPHS FROM**

SASA Archive  
Archive of Serbia  
ADLIGAT  
Elementary School “Mihailo Petrović Alas”  
Library of SASA  
University Library “Svetozar Marković”  
National Museum, Belgrade  
Virtual Library of the Faculty of Mathematics  
Digital Legacy of Mihailo Petrović Alas

**TECHNICAL EDITOR**

Mirko MILIĆEVIĆ

**PRINTING**

Službeni glasnik, Belgrade

**PRINT RUN**

250 copies

ISBN 978-86-7025-769-6

SERBIAN ACADEMY OF SCIENCES AND ARTS

# Mihailo Petrović Alas

The Founding Father  
of the Serbian School  
of Mathematics

BELGRADE 2018





EXHIBITION PRESENTED BY  
**GALLERY OF THE SERBIAN ACADEMY  
OF SCIENCES AND ARTS**

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**THIS EXHIBITION HAS BEEN ASSISTED BY**

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Library of SASA  
Mathematical Institute of SASA  
Foundation "Mihailo Petrović Alas"  
Elementary school "Mihailo Petrović Alas"  
Center for Museology and Heritology, Faculty  
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For their financial support, the Serbian Academy of Sciences and Arts extends its gratitude to

Ministry of Education, Science and Technological Development of the Republic of Serbia



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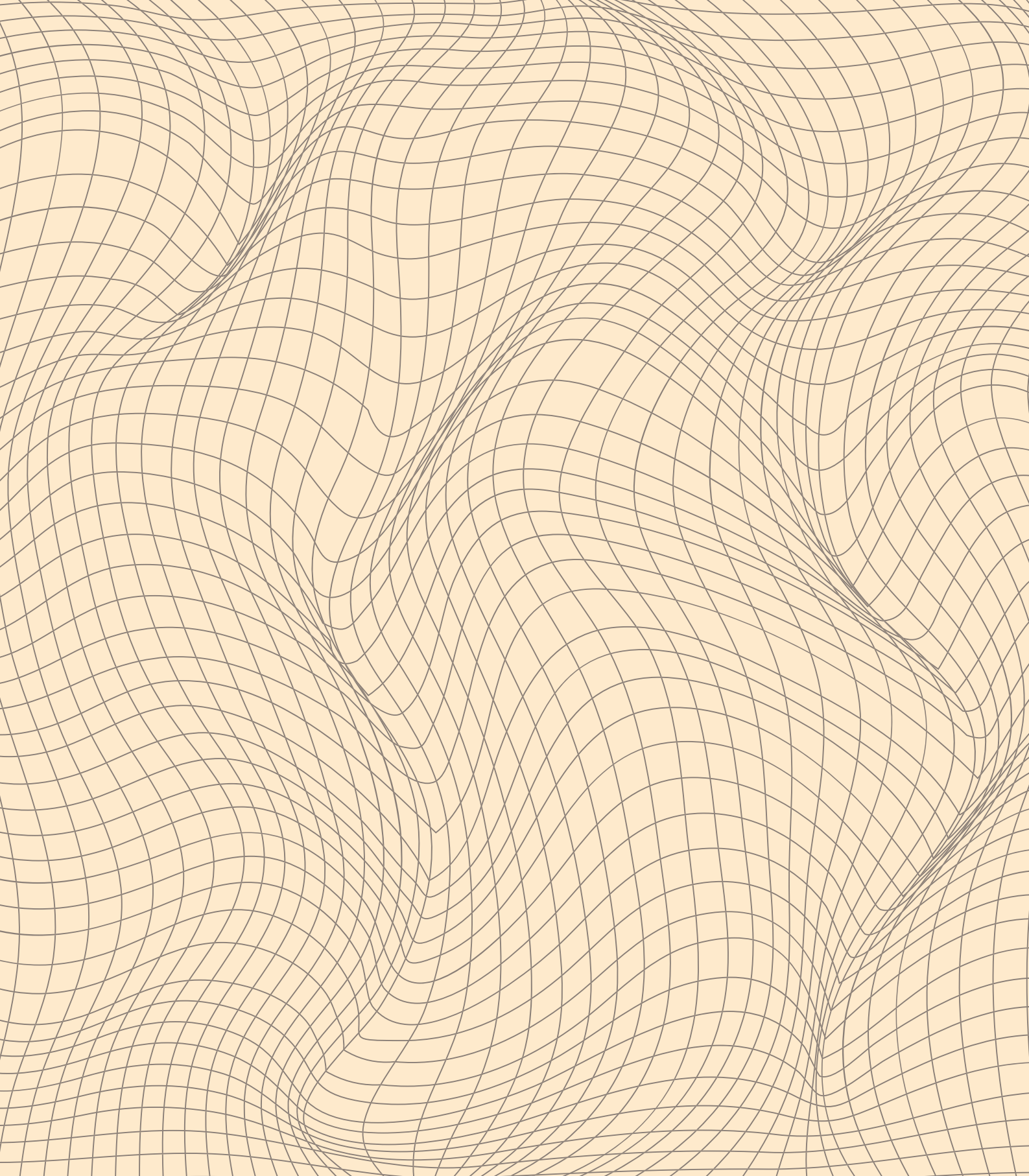


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IN 2018, THE SERBIAN ACADEMY OF Sciences and Arts (SASA) and mathematicians in Serbia celebrate the 150<sup>th</sup> anniversary of the birth of academician Mihailo Petrović Alas, a great Serbian mathematician and one of the founders of the Serbian mathematical school. The academician Petrović was a distinguished professor of mathematics at the University of Belgrade, but also a fisherman, writer, philosopher, musician, world traveler and travel writer. He earned his doctoral degree at the Sorbonne in 1894, where his professors were illustrious French mathematicians Henri Poincaré, Charles Hermite and Charles Émile Picard. The same year, he returned to Belgrade, where he became professor at the Belgrade's Grande école (Grand School – Velika škola), to which he brought the spirit of the French mathematical school. With Petrović's return, Belgrade achieved parity with other major European centers in mathematical sciences. Petrovic achieved scientific results of world-class relevance in fields of differential equations, complex and numerical analysis, geometry of polynomials and mathematical phenomenology. He also invented several analog computing machines and was the main cryptographer of Serbian and Yugoslav Army. One of professor Petrović's greatest and most important achievements was establishment of the Serbian mathematical school, which has produced a great number of renowned and successful mathematicians not only in Serbia but also around the world, who have continued Petrović's mathematical work. Until the Second World War, all doctoral dissertations in mathematics defended at the University of Belgrade had been done with his mentorship. The exhibition entitled "Mihailo Petrović Alas" is dedicated to academician Petrović and is a part of marking this important anniversary in the history of Serbian mathematics and science in Serbia.



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# BIOGRAPHY

IN THE SECOND HALF OF THE 19<sup>TH</sup> CENTURY, the groundworks were laid for the emergence of Serbian mathematics. Universally recognized as the most influential mathematicians of that time, Henri Poincaré and David Hilbert, introduced new mathematical concepts and new style of abstract mathematical thinking. New mathematical theories with multiple applications in technics and physics were emerging, and old theories were receiving novel grounding. Mihailo Petrović, Poincaré's doctoral student, began his academic career armed with such knowledge and a European understanding of science and culture. As a young man, he was already well-formed as a mathematician and moreover, very productive academically. Tending to analysis, he already knew well the works of mathematicians of the French school in that area and in his works he was already discussing the most topical issues in the field of differential equations and theory of functions.

Mihailo Petrović was born on April 23<sup>rd</sup>, 1868 O. S. (the Julian calendar) in Belgrade to a renowned family, his mother Milica and father Nikodim. Nikodim died as a young man, so Mihailo barely remembered his father. Mihailo's grandfather on his mother's side, archpriest Novica Lazarević, was in charge of taking care of Mihailo and his schooling. Mihailo enjoyed a very close relationship with his grandfather, as illustrated by preserved correspondence exchanged with him. Mihailo completed the First Belgrade Gymnasium in 1885 and was already at that time showing an interest in mathematics, winning awards for unit papers and capturing the attention of his professors with his talent. He subsequently enrolled in the natural science section of the Faculty of Philosophy in Belgrade. He graduated in 1889, and shortly afterwards went to Paris to receive further education and undertake advanced study of mathematics. Upon his arrival to Paris, he began to prepare for the entrance exam to the prestigious L'École Normale Supérieure. Petrović passed the exam with the highest marks and began his studies at Sorbonne, Europe's leading school of mathematics. He first obtained a graduate degree in mathematics in 1892

from Sorbonne and subsequently a graduate degree in physics in 1893. As the best student in his generation, he attended receptions given by the President of the French Republic in 1893 and 1894. At the same university, he went on to enroll in the doctoral program, and in 1894 he defended his doctoral dissertation, "*On Zeros and Infinities of the Integral of Algebraic Differential Equations.*" The commission was made up of the most distinguished professors and leading mathematicians of that time, Charles Hermite, Émile Picard and Paul Painlevé. The former two had been the dissertation co-supervisors, although Petrović's results were closer to the academic field in which Painlevé worked.



Advanced Pedagogical College, ENS  
(L'Ecole Normale Supérieure),  
Paris, 1885

Petrović returned from Paris in 1894, at the exact time his former professor, Dimitrije Nešić, retired. He therefore applied for the vacancy to become a professor at the University. Another application was submitted by Petar Vukićević, a slightly older fellow student at the Faculty of Philosophy. Petrović was chosen for the post, having obtained one vote more than Vukićević. Vukićević subsequently became a gymnasium professor and probably due to the defeat of his application, he ceased to engage in academic work or pursue an academic career. At that time, the Grande école (Grand School) was consistently adhering to the principle of *numerus clausus* which limited the number of professorship posts, often to the detriment of development of the Grand School and science in Serbia as such. Petrović once said the following regarding his election for the post: *"If I had not obtained that one additional vote for my application for a Grand School professor, I would have never pursued mathematics as my profession. I would have lived on Serbian rivers, not on a boat, but on a dinghy."*

Upon his return to Belgrade, Petrović encountered several mathematicians engaging in scholarly work: Ljubomir Klerić, Dimitrije Nešić, Petar Živković, Dimitrije Danić and Bogdan Gavrilović. Among them, Professor Bogdan Gavrilović was held in particularly high regard and he soon became a close friend and fellow colleague of Petrović. Gavrilović was, among other things, a writer of excellent university textbooks on linear algebra and analytical geometry, about which Radivoj Kašanin said the following: "Both textbooks, but particularly the latter one, would have been to the credit of every nation and at that time many nations far bigger and happier than us did not have such works." At approximately the same time two other scholars with Doctoral degree in mathematics were also residing in Belgrade, namely Đorđe Petković and Petar Vukićević, pursuing their careers as gymnasium professors.

In his scholarly work, Mihailo Petrović upheld the highest standards of the most developed European countries. During a brilliant upward career span, in only four years, by the beginning of the 20<sup>th</sup> century, Petrović had published some thirty papers in leading European mathematical journals. This success brought a great



Dimitrije Nešić,  
Petrović's professor



Bogdan Gavrilović,  
friend and colleague  
Bela Čikaš



Dimitrije Danić,  
the first Serbian scholar  
awarded doctoral degree  
in mathematics

reputation to Petrović and he soon received major recognition. Already in 1897, less than thirty years old, he became a correspondent member of the Serbian Royal Academy and in 1899 a regular member. With the new century, Serbia enthroned its king of mathematics. He became an honorary member of several foreign academies of arts and sciences, namely those in Bucharest, Prague, Warsaw and Krakow. He was elected a correspondent member of the Yugoslav Academy of Sciences in Zagreb and became a member of numerous European learned societies.

In terms of his academic work, Petrović belongs to a specific time. Due to the rising voluminousness of mathematical knowledge, it was difficult, if not impossible, for an individual to be well acquainted with all of the mathematical knowledge of the time. The era of universal mathematicians and scientists was slowly passing. Henri Poincaré was certainly one of the last *homo universalis* of science in the sense of the understanding and breadth of academic work in mathematics, mechanics and philosophy he displayed and he was one of the professors of Mihailo Petrović. Judging by his later scholarly work, we can conclude that the spirit of universalism in his professor was inculcated in Petrović as well. He equally excelled, and achieved first-rate results in, several mathematical fields: differential



equations, numerical analysis, theory of functions of a complex variable and geometry of polynomials. His interest also expanded to natural sciences, chemistry, physics and biology, and he published academic work in these fields too. Further, it is considered that Petrović was a founder of new academic disciplines, namely mathematical phenomenology and spectral theory.

The influence of Mihajlo Petrović on the development of mathematics in Serbia was enormous. He was *spiritus movens* of Serbian mathematics and has strongly contributed to the spirit of contemporary European science in Serbia. Moreover, he knew how to gather people together, awaken their interest and motivate them. This is solely an opinion of Serbian mathematical public, but also the fact we is established in world-class reference journals. Thus *The Oxford Handbook of the History of Mathematics* gives prominent space to academic biography of Mihailo Petrović. It emphasizes that Petrović, as the most prominent Serbian mathematician at that time, set the directions of development of the Serbian mathematical school on the foundation of French mathematics.

In his academic career, Petrović published some four hundred papers, of which three hundred were in mathematics. Furthermore, he published twelve books and there are fourteen manuscripts based on his lectures, crafted either by students or himself. The academic career of Mihailo Petrović was tied to the Grand School, which became a University in 1905 and subsequently to the University of Belgrade, until the end of his professional life. As he once said himself, he had spent a total of fifty-five years in the Mansion of Miša Anastasijević, where the gymnasium he attended was located, along with the Grand School, first as a pupil, and later as a student and a professor. The Department of Mathematics of Faculty of Philosophy was the main site of Petrović's scholarly and pedagogical work.

During one period, from when Belgrade University was established in 1905 until Milutin Milanković became a professor of applied mathematics in 1909, Petrović was the sole professor of mathematics at the Faculty of Philosophy. For this reason, it happened that in one school year he practically taught all subjects, as illustrated by the versatility and number of manuscript books that



Charles Hermite,  
Piru, around 1887.



Henri Poincaré  
around 1910.



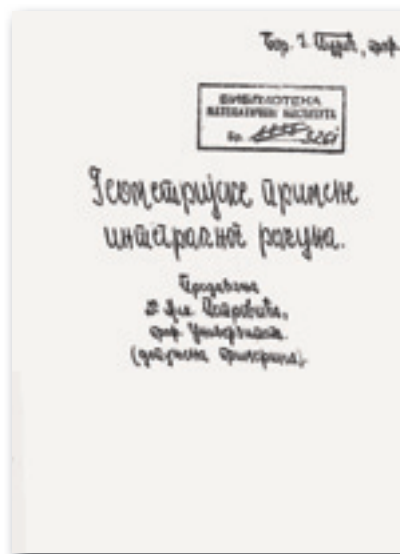
Milutin Milanković,  
around 1928.  
(SASA Archive, F 240)

have been preserved, that is, student notes on his lectures. They included subjects in linear algebra, analytical geometry in a plane and in a space, differential equation and its applications, ordinary and partial differential equations, and theory of functions and algebraic equation. Judging by the manuscripts, the lectures of professor Petrović were not structured in the form of strict definitions, theorems and proofs and were not difficult to follow. It seems that they contained exactly the material which the students were supposed to learn. He published three university textbooks: *Computing with Number Intervals*, 1932, *Elliptic Functions*, 1937 and *Integration of Differential Equation by Use of Series*, 1938. He also published the textbook *Leçons sur les spectres mathématiques*, Paris, 1928, which he followed when he gave lectures at Sorbonne in Paris in 1927–1928.

When we talk about Petrović's teaching work at the University, we have to say that along with his colleague, Professor Bogdan Gavrilović, Petrović elevated Serbian mathematics to the European level. Milutin Milanković emphasizes that the two of them laid the foundations of Serbian mathematics. Petrović did it in terms of academic work, and Gavrilović in terms of organizational work, helping

the Grand School to grow into the University of Belgrade. Gavrilović and Petrović were complementary in their interests in mathematics. While the focus of Petrović's work was on analytical methods, Gavrilović focused more on linear algebra and geometry. Petrović mostly published scholarly works, while Gavrilović wrote valuable monographic textbooks in algebra and geometry. Unlike Petrović's papers, Gavrilović's works, perhaps undeservedly, have not left a major trace in the mathematical community of Belgrade, even less internationally, since they were all published in Serbian. This was also at least partially due to the rule that papers in *Academia's Gazette*, where Gavrilović published, had to be published in Serbian. On the other hand, the majority of Petrović's papers were published in French and in leading European journals. Whatever the case may be, Petrović and Gavrilović, each in his own way, have enormously contributed to the development of mathematics in Serbia and to the creation of an atmosphere in which, from a provincial town, Belgrade has developed into one of the centers of academic work.

It is interesting that the aforementioned complementarity of Petrović and Gavrilović was not exhausted in the



Notes by student Borivoje Pujić from professor Petrović's lectures held in 1910–1914. (Mathematical Institute of SASA)



Lectures in spectral  
theory Petrović gave at the  
Sorbonne 1928.  
(Library of SASA, 46316)

field of education and science, but also extended to their everyday life. Petrović was a great fisherman, Gavrilović was a gardener who bred peaches. Petrović was a world traveler, while Gavrilović mostly spent his spare time at his country estate in Grocka. Gavrilović had a family and lots of children, while Petrović never married and did not leave direct heirs. Gavrilović was close to the royal family, while Petrović was not, primarily due to his friendship with Prince Đorđe Karađorđević, who fell out of grace with the King. Consequently, Gavrilović was the chancellor of the University of Belgrade and the president of the Academy (1931–1937), while the candidacy of academic circles of Petrović for this post in 1927 and 1931 was not accepted or approved by the authorities. Most authors attribute this to King's animosity towards him. However, it has to be said that Petrović did not encounter obstacles in his academic work or any other activities. On the contrary, he enjoyed a great reputation both among the general public and among government representatives as a great scientist and a great expert. He was winning important state commissions, for example he was the main cryptographer of the Serbian and the Yugoslav Army and represented his country in international commissions and delegations in the areas of education and fisheries. It is possible that his unconventional life has contributed to the failure of his nomination to become the chancellor and the president of the Academy. Similarly to mythological divinity Janus, Petrović had two faces. One was turned towards mathematics, philosophy and the spiritual world, the other looked towards faraway roads, fisherman's adventures and tavern gatherings. It is possible that some parts of the government could not reconcile this other side of Petrović with the image of a chancellor who almost daily wades in his fisherman's boots through Danube backwaters, hunting for fish and subsequently playing violin to entertain folks in a tavern. However, there are anecdotes that also suggest that even gentlemen of the highest station at the time were not able to resist the charm of "a fisherman's ball" which Petrović was often organizing. Jelenko Mihailović recorded an interesting anecdote from 1903 involving the famous Finance Minister Lazar Paču and Mika's great catch, a beluga "weighing 200 kilos." Even though the Minister received 10 kilograms of "ajvar" (caviar) from this catch, it was not enough and the same evening he brought the entire government, headed by the Prime Minister, to tavern "Jasenica" to have dinner prepared by Mika Alas. The posts of the chancellor and the president of the Academy, even though they are high posts, are nonetheless only administrative posts and Petrović did



not much regret not occupying them. It is possible that he himself did not want to take on that kind of responsibility because it would interfere with the life he was leading and loving.

Notwithstanding the aforementioned differences, Petrović and Gavrilović shared the same love for science, students and university. They were colleagues and the bedrock of the Mathematical Club between the two World Wars. Their relationship was characterized by friendship. Apart from the Mathematical Club, they also often met in taverns and fishermen's adventures. When Milutin Milanković became a professor at the University of Belgrade, he immediately joined the two of them in every way, both academically and socially. The three scientists were academic and moral stalwarts on which mathematical sciences in Serbia relied until the Second World War and the emergence of a new academic generation. Even though they were great individualists in science, for example none of them had a co-author or a visible collaborator for their papers, they were tied to one another through their work at the University and through

Petrović (violinist with the hat) conducts the musical band "Suz" during a tavern party. (SASA Archive, 14197/1)



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

their friendship. Milanković wrote about it with a lot of sympathy in his biographical novella *Mika Alas – Notes on a Life of a Great Mathematician Mihailo Petrović*. The words of Radivoj Kašanin, Petrović's doctoral student and Gavrilović's assistant and descendant at the Mathematical Department of the Faculty of Technology, can also serve as an illustration: "In addition to their high educational qualifications and original academic work, the three of them had also possessed a feature I appreciate most and consider a human quality of the highest rank: appreciation of younger generations, understanding of young people, selfless and sincere assistance to the young, talented people in their

advancement. They knew how to rejoice and enjoy when young people rise to prominence. *I was lucky to develop and work alongside these great authorities in science and morality. To take pride in their friendship. I do not believe that anywhere else there existed such an atmosphere as the one that was created by Gavrilović, Petrović and Milanković."*

Already in 1894, the Library of the Mathematical Seminar was set up, offering broad possibilities for scholarly work to generations of mathematicians of at the University of Belgrade. Until the First World War, Bogdan Gavrilović and Mihailo Petrović were in charge of the Library. Other mathematicians subsequently also joined. When in 1938 the Mathematical Department moved to a new building next to the building of the Faculty of Philosophy, located in the Mansion of Miša Anastasijević, the Library also moved to the same building. Unfortunately, only two days before the liberation of Belgrade, on October 18, 1944, the enemy army in retreat burned the Library and it was destroyed. Only a couple of books borrowed by individuals survived out of the entire library.

The story about the life of Mihailo Petrović is inseparable from the story about development of the Belgrade University and mathematical sciences in Serbia. The Faculties within the Grand School developed in 1900 into autonomous entities of the Grand School and acquired an organization they would keep until after the Second World War. The same year, the Seminar for Mathematics, Mechanics and Theoretical Physics opened and professors from the Faculty of Philosophy and Technology gave lectures on mathematics, mechanics and astronomy. The most prominent among them were Mihailo Petrović and Bogdan Gavrilović. After many years of preparation and delays, in 1905 the Grand School was transformed into a University as "the highest self-managing body for higher professional education and the pursuit of science." The newly established University consisted of four Faculties: Faculty of Philosophy, Law, Technology and Theology. At the Faculty of Philosophy, one of the first eight full professors was Mihailo Petrović. Until 1909, lectures in theoretical mathematics at the Faculty of Philosophy were held by Mihailo Petrović and occasionally Bogdan Gavrilović as an honorary professor. The same year, at their proposal, the University of Belgrade invited Milutin Milanković from Vienna to take the post of professor of applied mathematics.



Historical photo: Belgrade Mathematical School 1926. Miloš Radojčić, Tadija Pejović, Vjačeslav Žardecki, Anton Bilimović, Petar Zajankovski, (Jelenko Mihailović, the seismologist), Radivoj Kašanin, Jovan Karamata (standing), Nikola Saltikov, Mihailo Petrović, (Pavle Popović, the chancellor), Bogdan Gavrilović, (K. Petković, the chancellor of the Faculty of Philosophy), Milutin Milanković (sitting). (SASA Archive, 14197/16)

In the meantime, science at the University of Belgrade had become advanced so, that the first Doctoral dissertation in mathematical sciences was defended at the University, under the supervision of professor Petrović. A Doctoral dissertation in the field of differential equations was defended in 1912 by Mladen Berić, an assistant to a teacher at the First Belgrade Gymnasium and a teaching assistant to professor Petrović. Already the following



year, Sima Marković defended his Doctoral dissertation on the topic of Riccati differential equation, supervised by professor Petrović. This has marked the emergence of the Belgrade Mathematical School. Unfortunately, the work at the University of Belgrade has often been interrupted due to wars. In academic year 1912/13 the University was closed due to the Balkan wars. In academic 1913/14 the University reopened, but the First World War suddenly interrupted its work and students and professors had to go to war. In August 1914, soon after the war started, a part of the Mansion of Miša Anastasijević was torn down due to bombing. The enemy ransacked the deserted and demolished building. Mihailo Petrović himself participated in the war as a reserve officer.

After the war ended, in early 1920s, the University experienced an accelerated growth for a short period of time. The number of professors increased and among others, mathematicians Nikola Saltikov and Anton Bilimović came from Russia, giving a strong boost to the the Department of Mathematics at the Faculty of Philosophy. Even though Mladen Berić and Sima Marković became lecturers at the Department of Mathematics, they left the University in the mid 1920s. Berić had private reasons to do so, while Marković had to leave because of politics. Even though professor Petrović placed his hopes on his best students, he did not have good fortune with them.

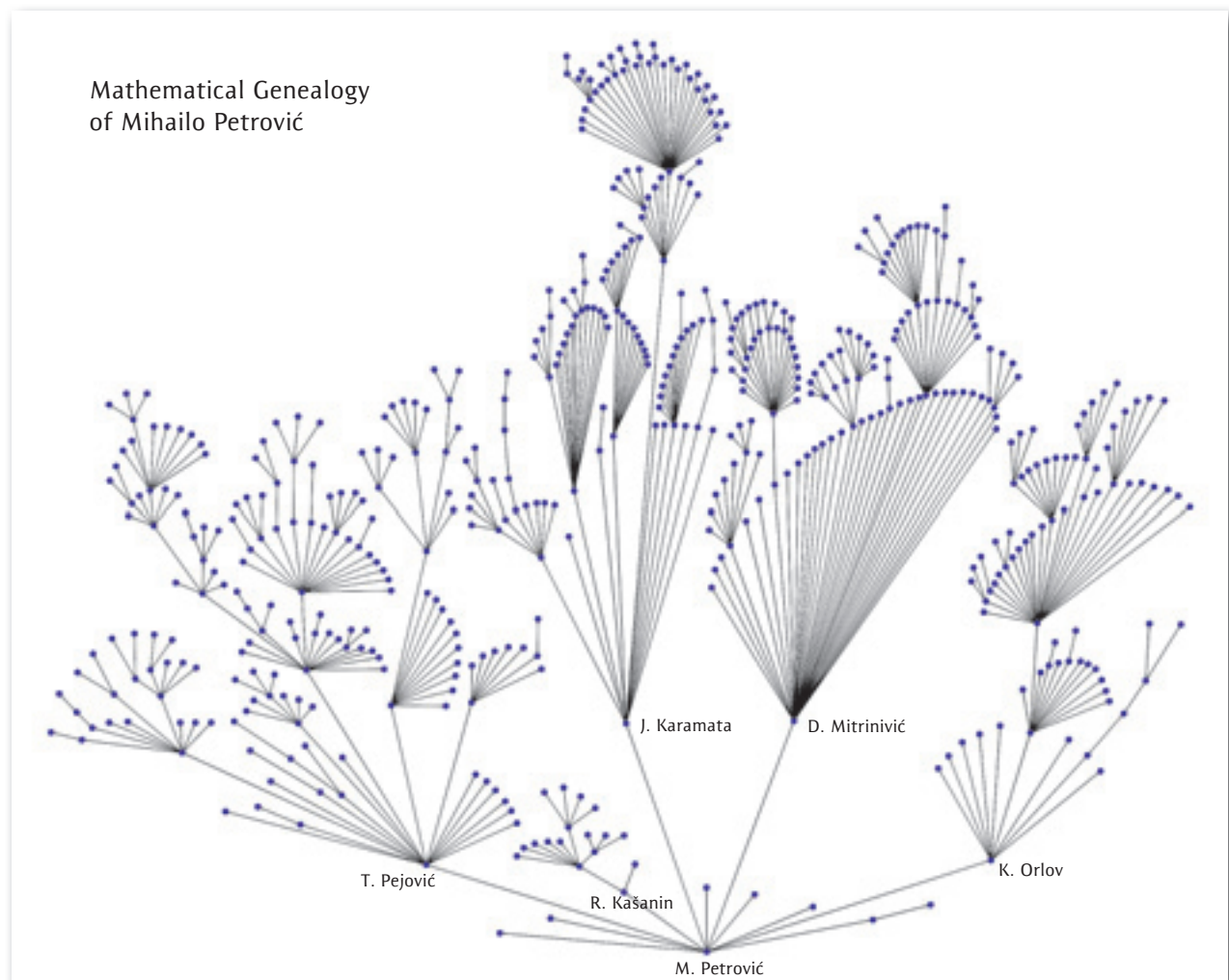
In the mid 1920s, a new generation of mathematicians came of age: Tadija Pejović, Radivoje Kašanin, Jovan Karamata and Miloš Radojčić. They were all graduate and doctoral students of Mihailo Petrović. In the 1930, Dragoslav Mitrinović, Danilo Mihnjević, Konstantin Orlov, Petar Muzen and Dragoljub Marković also defended their doctoral dissertation in front of professor Petrović as their Doctoral supervisor. The figure shows all mathematicians at the University of Belgrade in 1926. The Faculty of Philosophy, the Department for Theoretical Mathematics, 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. At the Faculty of Technology, the Department for Mathematics consisted of: full professors Bogdan Gavrilović and



The expedition of Belgrade astronomers and mathematicians to Fruška Gora in order to choose the site for building of a new observatory. Left to right: R. Kašanin, J. Mihailović, M. Petrović, P. Popović, A. Bilimović, M. Milanković, V. Mišković, V. Mišković, V. Gračanin and the guide (SASA Archive, 14188/7)

Petar Zajončkovski, lecturer Radivoj Kašanin; the Department of Applied Mathematics consisted of: Ivan Arnovljević and Jakov Hlitčijev. All professors and lecturers of theoretical and applied mathematics at the University belonged to the Mathematicians' Club of the University of Belgrade. This seminar actually represents the mathematical school of the Belgrade University and the main gathering place of all Belgrade mathematicians. It can be said that it was the golden era of Serbian mathematics. The club did not have any special rules, except that meetings were held once a month and that at those meetings, papers and academic discussions of the Club's members were featured.

The mathematical heirs of professor Petrović, connected with him through his supervision of their doctoral dissertations, constitute mathematical genealogy made up of around 800 mathematicians. Of that number, around 500 are Serbian mathematicians, the rest are foreigners. The descendants are grouped into eight generations, whereas several last generations encompass some of leading contemporary Serbian mathematicians. If we look closely at the genealogy, we will notice four major clusters, the roots of which are made up of: Tadija Pejović, Jovan Karamata, Dragoslav Mitrinović and Konstantin Orlov. They are all to be credited for introduction of new fields of research in Serbian mathematics or creation of their own



mathematical schools. Professors Pejović, Karamata and Orlov have created a powerful mathematical node at the Department of Mathematics of the Faculty of Mathematics and Natural Sciences in Belgrade, a precursor of today's Faculty of Mathematics. A Doctoral student of Professor Karamata, Professor Bogoljub Stanković, has created his own mathematical school in Novi Sad, while professor Mitrinović should be credited for development of academic mathematical work in Niš and at the Faculty of Electrical Engineering in Belgrade.

Thanks to an endowment by Luka Čelović Trebinjac and at the initiative of Anton Bilimović, with the support of Mihailo Petrović and Milutin Milanković, a new journal was launched in 1932 entitled *Publications de l'Institut Mathématique Université de Belgrade*. The papers were published in Russian, English, French and German. Belgrade mathematicians thus gained a venue to present their academic papers to the worldwide mathematical public. Seven volumes of the journal were published up to World War II. In each volume, Petrović published at least one paper. The last prewar issue, number VIII, printed on the eve of the Second World War, was destroyed in the enemy bombing of Belgrade in 1941. In addition to mathematicians from the University of Belgrade, world-class mathematicians at the time, as well as contemporaries, were publishing in the journal *Publications*, including, for example, Elie Cartan, Waclaw Sierpinski, Paul Montrel, Josip Plemelj, Đuro Kurepa and Paul Erdős.

At the beginning of the 20<sup>th</sup> century, Petrović expressed great interest in the practical side of mathematics. He was deeply preoccupied with the problem of the appearance, and manner of appearance, of mathematics in natural sciences, that is, the way in which mathematics can be applied to a research of natural phenomena. Similarly to Leibnitz, who tried to invent *characteristica universalis*, a universal and formal language that would be able to express all mathematical, scientific and metaphysical notions, Petrović tried to invent a universal method that would be used to solve problems in other sciences. The fundamental place in his discussions was accorded to analogies. He was searching for and citing examples of completely disparate phenomena that can be described by the same differential equations. These efforts produced an original work he is noted for – namely, *mathematical phenomenology*. He published three books on the topic, two in Serbian and one in French, presenting his theory.

Mihailo Petrović retired in 1938 and was given the highest accolades by his students and fellow colleagues. The following year, he received an honorary doctorate of the University of Belgrade and was decorated with the Decoration of St. Sava of the first degree. The proposal submitted to the Council of the Faculty of Philosophy to award the honorary doctorate to Petrović emphasizes his achievements in the creation of the mathematical school in Serbia, stating that: "M. Petrović has created the Mathematical School, the first in Yugoslavia, and with this creative endeavor he elevated the teaching of mathematics at the University of Belgrade to the level of contemporary world-class schools. Our Faculty, University, our state and this entire country owe the highest accolade to Mihailo Petrović." At the same time, members of the Mathematical Seminar made a proposal to single out a section for theoretical mathematics and name it *The Institute for Theoretical Mathematics Mihailo Petrović*. In the justification of their proposal, they wrote the following: "Our Mathematical Seminar is eternally grateful to him, because he was its founder and worked and developed in this Seminar for 44 years. He managed to gather together at this Seminar a large number of young people and to prepare them for an academic work."

Petrović bore a high military rank of a reserve officer, and was an engineering lieutenant-colonel in the reserve. When German forces attacked Serbia in April 1941, he was drafted, although he was 73 at the time. He was immediately arrested and spent one year in captivity. According to some sources, he was released at the initiative of his friend, Prince Đorđe Karađorđević, while according to other sources, it was due to his age and illness. His health soon deteriorated, he ceased to leave his flat and as Milanković had testified, was mostly sitting in his room and writing.

Mihailo Petrović had a rich, interesting and unconventional life. It is difficult to fully enumerate, let alone describe in detail, all the things Petrović engaged in. In addition to his interest in various areas of mathematics, Petrović appears in many other, often unexpected fields. He wrote laws and drafted international agreements, but was also an inventor, holding successful and executed patents. Petrović is considered by many to be one of Serbia's most important philosophers and inventors of an original theory in natural



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

philosophy, namely mathematical phenomenology. His style of writing was beautiful and interesting and some of his novels are among favorite Serbian pieces of youth literature. He wrote academic papers in and studied other natural sciences, primarily astronomy, theory of relativity and chemistry. He created a coding system and was the main cryptographer of the Serbian and Yugoslav Army. He played violin and conducted the musical band "Suz" which up to the onset of the Second World War provided one of the main loci of bohemian life of Belgrade. Finally, he was a great and passionate fisherman, and a great world traveler and seafarer who sailed northern and southern seas. A great mathematician and world traveler died quietly, dreaming about a new and great ocean journey. Mihailo Petrović died in Belgrade on June 8, 1943 at his home in Kosančićev venac street no. 22.

Many Serbian and foreign authors have written about the life and works of Mihailo Petrović. The author who most certainly wrote the most valuable works about him was Dragan Trifunović, a historian of mathematics and a professor of the University of Belgrade. He wrote and edited a large number of books about Petrović and the times in which he lived. Trifunović is to be credited not only for the fact that in the past half century, Petrović's name has been accorded a high and prominent place in Serbian mathematics, but also for discovery of numerous less well known details of his life. *The Collected Works of Mihailo Petrović*, an edition published by the Institute for Textbook Publishing and Teaching Aids, also contains, in addition to all known works by Petrović, complete and comprehensive academic analysis of his work and various contributions by distinguished Serbian mathematicians. Thanks to the engagement of the Serbian Academy of Arts and Sciences and the courtesy of the aforementioned publishing house, *The Collected Works* have been digitalized and are accessible to the public concerned at the Virtual Library of the Faculty of Mathematics in Belgrade and its digital endowment dedicated to Mihailo Petrović.

Žarko MIJAJLOVIĆ







# ACADEMIC ACHIEVEMENTS

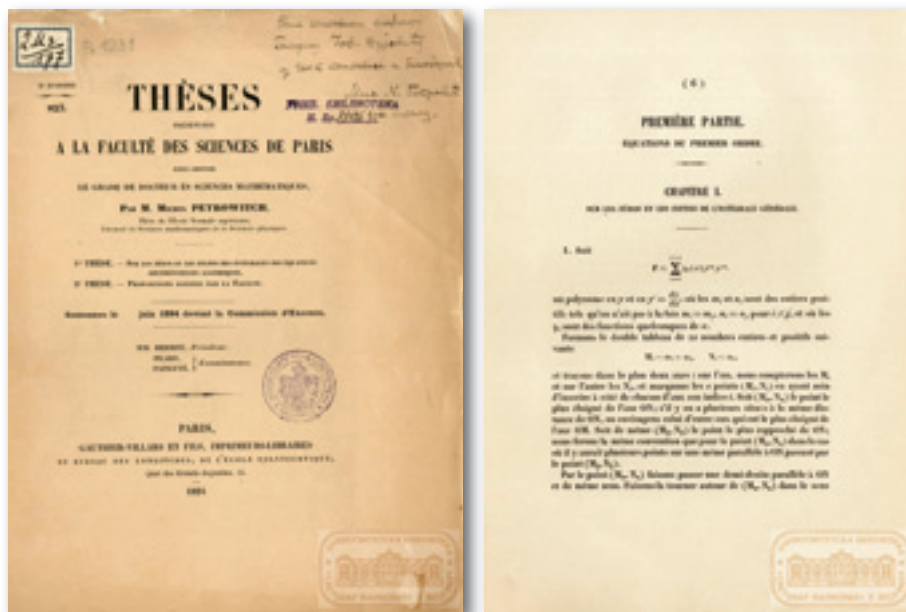
HAVING GRADUATED FROM THE GRAND School in Belgrade, Mihailo Petrović continued studies of mathematics and physics in Paris, acquiring the degree of “licence” for mathematics and physics. He was the first foreign doctoral student in mathematics at the L’Ecole Normale Supérieure which, at the time and now, is the most famous educational center for mathematics in the world. Petrović’s professors there were the most illustrious mathematicians of that time, including Henri Poincaré, Jean Gaston Darboux, Paul Émile Appel, Paul Tannery, Charles Hermite and Paul Painlevé. In such an environment, the main requirements for success in mathematics were talent, originality of ideas and persistence. Young Mihailo Petrović had all three of these qualities, and this was confirmed by the recognition he received as the best student of his generation. He defended his PhD dissertation in 1894, and his co-supervisors were Charles Hermite and Charles Émile Picard. To show his appreciation, Petrović dedicated his dissertation to Tannery and Painlevé. He thus entered the world of great mathematicians of his time. The Serbian translation of Petrović’s dissertation has been made by the Serbian Academy of Arts and Sciences member Bogoljub Stanković.

Some of the most important results Petrović obtained were already in his doctoral dissertation, therefore we will describe in short the topic of this dissertation and its main result. In his thesis, Petrović studied a class of non-linear first order differential equations, as well as a class of non-linear second order differential equations; the latter are well-known as *Painlevé equations*. This topic was very popular at the time. In the late 19<sup>th</sup> century, the most well-known names in French and world mathematics, Picard, Painlevé and Fuchs, studied non-linear second-order equations with no movable branch points. In

that context, Painlevé, later Fuchs, and even later (1910) Gambier described the sub-class of these equations which take the following form:

$$y'' = F(x, y, y')$$

whereby  $F$  is the quotient of two polynomials with respect to  $y$  and  $y'$  with holomorphic functions as coefficients. Painlevé has found fifty general forms which have immovable branch points which he, with the assistance of Fuchs and Gambier, reduced to six essentially new equations. These are the equations that cannot be solved in terms of familiar special functions such as elliptic functions, those that cannot be solved in terms of linear equations and that also cannot be transformed from one into the other. These six equations bear the name Painlevé transcendents. These six generic cases today have a great significance in many areas of analysis, algebra and geometry, but also in applications such as statistical mechanics, physics of plasmas, non-linear wave theory, quantum gravity theory, quantum field theory, theory of relativity and nonlinear optics. Painlevé obtained his first results in papers published in 1887 and 1895. This problem had also been addressed by the other greatest mathematicians of that time, Poincaré and Picard. We particularly emphasize this fact, considering that Mihailo Petrović had defended his doctoral dissertation in front of a commission consisting precisely of Picard and Painlevé.



The front cover and  
the first page of Petrović's  
doctoral thesis  
(University Library  
"Svetozar Marković")

The doctoral dissertation of Mihailo Petrović is dedicated to the immovability of zeros, poles and essential singularities in solutions of algebraic first- and second-order differential equations. In accordance with the definition, singularities of solution consist of their poles, essential singularities, final and logarithmic branch points, while movability is defined as a property according to which zeros and singularities are constantly changing as initial conditions of a given equations change. In other words, the property of movability determines whether a problem behaves “well,” unlike the problem which behaves “badly” and which often does not have a solution if initial conditions change. Mihailo Petrović studied problems for which solutions of equations often have singularities independent of the change of initial conditions.

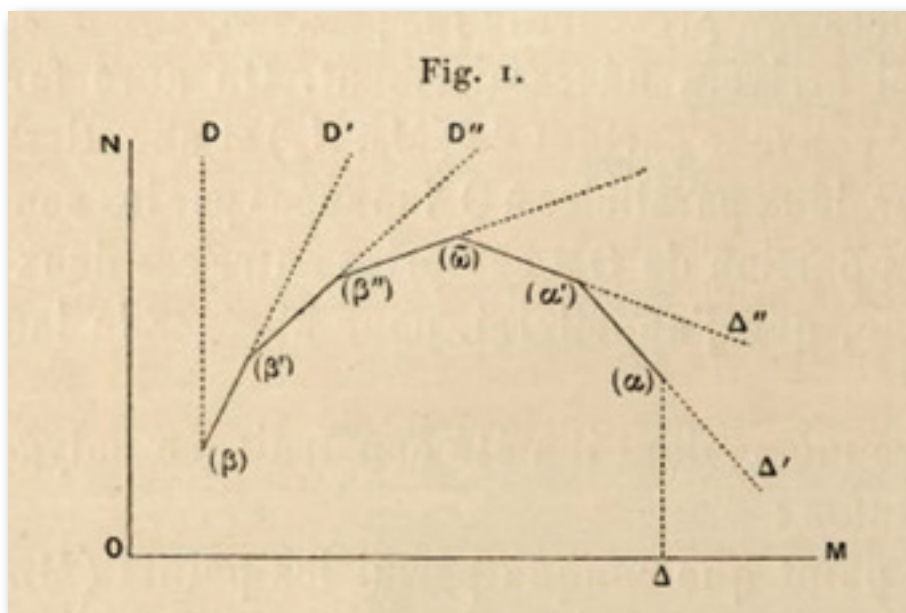
In this first part of his doctoral dissertation, Mihailo Petrović analyzes first-order equations in which one has products of powers of an unknown function  $y$ , powers of its derivative  $y'$  and of holomorphic functions with respect to the independent variable  $x$ :

$$F(x, y, y') \equiv \sum_{i=1}^s \phi_i(x) y^{m_i} (y')^{n_i} = 0.$$

In the statement of the main result of his thesis, an important role is played by a polygon  $P$  which Petrović constructs in the following way. Polygon  $P$  has an  $s$  vertices  $(M_i, N_i)$   $N_i = n_i$ ,  $M_i = m_i + n_i$ ,  $i = 1, \dots, s$ , which have been done according to certain rules, while it designates with  $(M_\alpha, N_\alpha)$ , that is,  $(M_\beta, N_\beta)$ , the most distant i.e. the most proximate vertices to the axis  $ON$ , while  $\lambda$  designates coefficients of the direction of the sides of the polygon. His results subsequently is: Poles and essential singularities of the general solution of the first-order equation  $F(x, y, y') = 0$  do not change with the constant of integration if and only if the adjacent polygon does not have any vertex right of the highest elevated vertex of the polygon. For the existence of a movable zero of an  $\lambda$  order, it is necessary and sufficient for the polygon to have a side with an  $\lambda$ , inclination and to have the moveable pole of an  $\lambda$  order, if and only if the polygon has a side with an inclination  $-\lambda$ .

According to the data analyzed by the historian Dr. Dragan Trifunović, Petrović published 393 papers of which 328 are mathematical manuscripts from twelve different areas in the most prominent journals of that time, as well as today. In academic

Polygon R, a drawing from  
Petrović's dissertation  
(University Library  
"Svetozar Marković")



journal *Comptes Rendus*, in which, in the opinion of French mathematicians, the very best papers appear, Mihailo Petrović published as much as thirty papers. He has also published his work in *Acta mathematica*, *Mathematische Annalen* (two papers), *Bulletin de la Société mathématique de France* (fourteen papers), *American Journal of Mathematics* (three papers), as well as in numerous other Swiss, German, Czech and Polish journals. In terms of the number of published manuscripts in leading international journals, Petrović is still one of the most productive Serbian mathematicians of all times.

Petrović's first paper anticipated the topic of his doctoral dissertation and the papers which followed subsequently build up on the results from his dissertation. Independence with respect to constants, of singularities, zeros, extremes and some other properties of a general solution dominates in all these papers as the clear determinant of Petrović's academic work. This property is the essential, constitutive characteristic of the model he is studying, that is, the equation that describes this model. When he describes the residuum of function, studies the so-called binomial equations of the first order, the asymptotics of the solution, writes about "one class of second-order differential equations" or the nature of the solution, to paraphrase titles of some of his papers, internal structural relation between the dependent and the

independent variable depicted by the very equation remains the central goal of his explorations. A great creative potential in academic work, displayed in his doctoral dissertation, is also visible in papers written and published in the period of the First World War when Picard, Appel and Hadamard were publishing them in *Comptes Rendus*. During the First World War, he resided in Switzerland, where he worked as a cryptographer of the Serbian Army Command. Despite this engagement, he has had sufficient energy to also delve in serious mathematical problems.

A quantitative analysis of solutions of differential equations, without solving the equation itself, as well as solving certain classes of equations, represent a significant part of the mathematical opus of Mihailo Petrović. In time, as he started to spend more and more time in Serbia and less and less time at the Sorbonne, we can notice that Petrović was engrafting new ideas on the ideas from his doctoral dissertation, as well as on his extraordinary knowledge of the theory of analytical functions. In most of his initial papers from the late 19<sup>th</sup> and early 20<sup>th</sup> century, he mostly elaborated the ideas he has developed during his residence and his scholarly work in France. Naturally, the advantages of residing in France had been great and numerous. There, Petrović had access to the latest and crucial literature, and in addition he had immediate contacts with the greatest mathematicians of that time, with whom he could exchange his ideas and results and discuss them. Considering that in his thesis he particularly studied solutions of the equation  $y' = R(t, y)$  with the Painlevé property, he explored in particular various forms of Riccati's equation

$$z'(t) = 2\alpha(t)z(t) + b(t) - c(t)z^2(t).$$

which can be solved with integrations and familiar special functions. Fuchs has shown that first-order equations, which were also studied by Petrović and solutions of which contain immovable branch points, boil down to matrix form of the Ricotta equation. Several dissertations by his doctoral students used this fact as a starting point. Petrović's mathematical achievements are not exhausted with and do not rely exclusively on aforementioned ideas and methods. To him, but also to his doctoral students, comparison theorems for solutions of equations with respect to comparison of coefficients or right-hand side of equations, the so-called Sturm type theorems frequently provided an

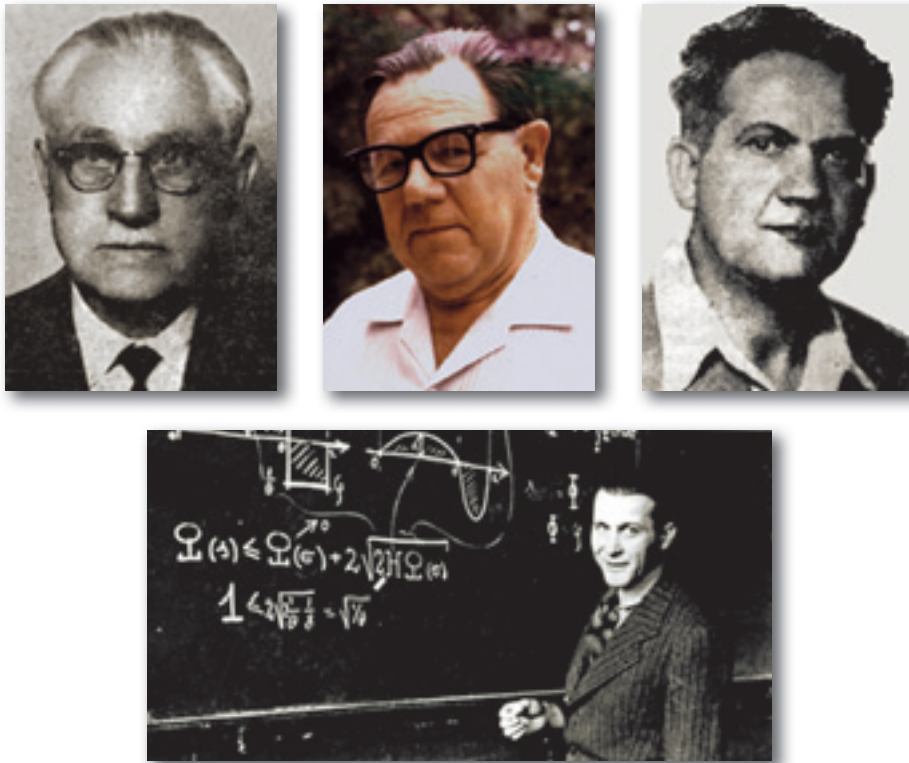
inspiration. His research often features simple but fine mathematical witticism with which he managed to obtain results of a general character for various classes of linear and nonlinear equations. Asymptotics of the solution, mostly of nonlinear Riccati-type equations, has also occupied an important place in his analysis of equations.

Petrović's papers belong primarily to the following areas of analysis: differential equations, complex and real analysis. In numerical mathematics, he has given an important contribution, a monograph *An Analysis of Number Intervals*. With this monograph, interval numerical analysis has received an stimulus. At the very beginning of the 20<sup>th</sup> century, in the era of analytic theory of functions, Petrović studied functions the Taylor series of which do not have zeros in appropriate circle of convergence. Renowned mathematicians Landau, Hardy Fejér, Montel, Pólya, were very interested and have studied the solutions Petrović had obtained in this field, while German mathematician Jentsch has elaborated these results further in his doctoral dissertation. The well-known Petrović's inequality is the result associated with convex functions. It served as an inspiration to several of his pupils to study inequalities and to achieve significant success in this area. The textbook monograph *Elliptic Functions* is even today a favorite read in this important area of analysis. This does not exhaust the range of Petrović's mathematical interests. For example, in several papers he engaged in determining – computing integrals with the use of series.

Petrović also produced work in the field of algebraic equations. In this area, particularly interesting is his work on geometry of zeros of a polynomial, which was also studied by the said group of famous mathematicians Landau, Hardy Fejér, Montel, Pólya. He determined a circle in which an algebraic equation has at least one root without using Rouché's theorem. His paper from 1899, published in *Comptes Rendus*, is the first paper which determines the number of zeros contained in the given circle.

Reading academic papers by Mihailo Petrović in the period after the Great War, a gradual decline in quality is noticeable. Papers are less deep, but still bear certain ideas that have perhaps been already propounded, but which are nevertheless instilled

with new energy. Contrary to contemporary style, Mihailo Petrović exhibits his results going from the specific towards the general. He had an ease of writing and in his manuscripts, as in a tale, he would first expound simple conclusions which he would gradually generalize and finally fully explain and transform into axioms. Such an approach has enabled a reader to easily follow his argument and understand the goals of the manuscript from its starting point.



Doctoral students of Professor Petrović: Tadija Pejović, Konstantin Orlov,  
Dragoljub Marković and Jovan Karamata  
(Faculty of Mathematics, University of Belgrade)

Among his academic achievements, the monograph *Mathematical Specters* (which is not related to contemporary, very developed, spectral theory of operators) in which Petrović, analogous to the light spectrums, develops a theory of mathematical specters. This very comprehensive, voluminous and original work by Petrović does not belong to analysis, but is closer to theory of numbers and cryptography, the disciplines he also showed an interest in. The basic idea

of this theory of his is to code infinite series of data with infinite decimal developments of real numbers and then to translate mathematical operations with data into certain numerical or combinatory procedures with numbers – their codes. Petrović was particularly interested in repetitions in groups of numbers and he has seen an analogy in that with physical spectrums. Even though he had written the book in French, had received praise by some French mathematicians, and held one semester of lectures at the Sorbonne, this theory nevertheless did not significantly take root. An interesting view on it is expressed by French mathematician Bul, who in his review of this work at one point says that “such analogies are risky and like arches of the shiniest rainbow can be very seductive, but also illusionary.” On the other hand, contemporary digital computers, as implied by their very name, do not do anything else but precisely employ elementary arithmetical and basic combinatory operations over binary codes of series of data, even though the semantics of our problem concerning data and the resolving algorithm is found at some utterly different place. Therefore we can consider this work by Petrović as simply a work that appeared ahead of its time. His student, professor Konstantin Orlov, one of the most prominent heirs of professor Petrović in the field of differential equations and numerical analysis, has dedicated some attention to this area in his dissertation.

The contributions which pertain to application of differential equations, given in his famous work *Phenomenology*, as well as in a series of papers describing models in physics and chemistry, are portrayed in separate texts in this Catalogue.

Mihailo Petrović belonged to the generation of the greatest mathematicians in the fields of analytical theory of differential equations, which was then at the pinnacle of development and in that context one should perceive an extremely high academic level his research was managing to attain. Most of his doctoral students in their dissertations dealt with topics associated with qualitative analysis of certain classes of equations. However, there are not too many of their works which in the theoretical sense had gone further than what Mihailo Petrović had already done. In the late 19<sup>th</sup> and early 20<sup>th</sup> century, unlike the methods of classical theory of equations, new abstract theories based on essentially new approaches in the analysis in the creation of mathematical models began to appear. The lineage of Mihailo Petrović, and subsequently his pupils in the fields of differential equations, seems



to have followed less the development of mathematical physics or other branches of mathematics in which results of Painlevé and Picard have become dominant. The theory of partial differential equations has been insufficiently followed, which developed very quickly both in theoretical sense and in the sense of applications in almost all natural and technical sciences. Even Petrović himself did not follow new lines of development of theory of partial differential equations with altogether new methods stemming from areas topical at the time, namely set-theoretic topology and algebraic topology, geometry and algebra and in particular functional analysis. The results of Hilbert, Lebesgue, Dirac, Banach, Sobolev and many others have brought about completely new perspectives on mathematical investigations and their connection with other fields of science. This advance and development of mathematics globally was particularly intensive after the First World War. Certainly one should take into account that Mihailo Petrović was already fifty at the time, and that for a long time he remained outside the scientific mainstream, and could not stay abreast of the currents in science at the time due to complicated circumstances in Serbia after the Great War.

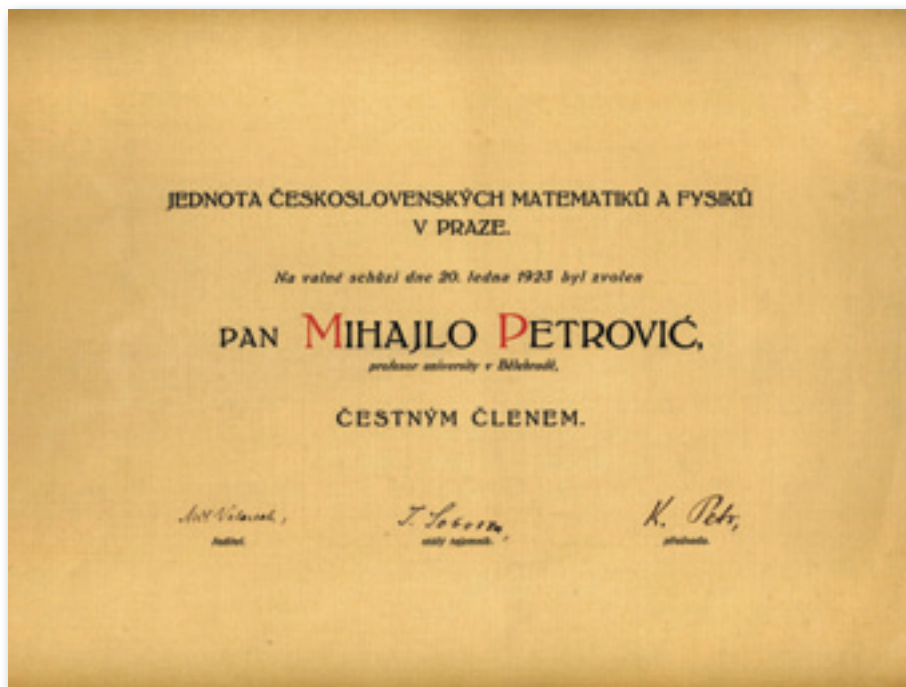
Mihailo Petrović was rather a ‘loner’ as a scholar. All papers, except one together with Karamata, he authored alone. The sole collaboration is interesting because it corrects one mistake made by Poincaré. The reason for this is his extreme individuality. He did not always elaborate ideas to the end, so that others, taking into account his results and ideas, have written more profound papers which, among other things, have also been more often quoted. Among colleagues, there were none who particularly promoted him also due to the fact that all of them, and here I refer to mathematicians in France, primarily sought after and were primarily aspiring to personal prestige, despite Petrović’s generous nature and propensity to form genial friendships. Given that at the time there were few mathematicians in Serbia and that Petrović was our first mathematician who addressed these problems, he could not experience significant mathematical support in Serbia, especially in the period between the two World Wars.

Mihailo Petrović was not very interested in being referenced by other authors and it did not interest him whether other mathematicians read his work or not. On the other hand, mathematicians at the end of the 19<sup>th</sup> and the beginning of the 20<sup>th</sup> century



Mihailo Petrović Alas  
in his late years  
(SASA Archive, 14188/21)

Certificate of membership  
in the Czechoslovakian  
Mathematical Society  
(SASA Archive, 14188/31)



did not have many possibilities for quoting other authors, and did not have the habit of such mutual academic behavior. In the dissertation of Mihailo Petrović, as well as in his other papers, quoting of results of other mathematicians does not appear in the form which is generally established today. In the field in which Petrović worked, citations most often referred to results of Picard, Fuchs and certainly unparalleled, Painlevé. Mihailo Petrović himself in his dissertation has quoted very few sources, giving only eight references. The papers by Mihailo Petrović were quoted at the time close to the period in which he wrote them, but we think it was too insufficient. The papers in *Acta Mathematica*, *Mathematical Annals* (*Matematički anali*) and a series of other journals, dedicated to the problematics addressed in his doctoral dissertation, as well as most other papers, were quoted in late 19<sup>th</sup> and early 20<sup>th</sup> century. The results of Petrović's first paper published in *Comptes Rendus* are cited in full in the famous and most highly acclaimed monographic book by Picard at the time, while the results of the doctoral dissertation are cited in *Encyclopedia of Mathematics*. However, in the vortex of events of the Balkan wars and the First World War, Mihailo Petrović slowly became less and less present

in France, which also meant in world circles in which new science was created and developed.

Mihailo Petrović presented his work at a series of important international congresses of mathematics in Paris, Rome, Cambridge, Toronto and a conference of academic federations of France (a dozen times), Romania, Italy, Slavic countries and Balkan countries.

Petrović was appreciated and valued-esteemed as a scientist not only in Serbia but also in all of Europe. He was a member of Yugoslav Academy of Sciences and Arts, Czech Royal Academy, Polish Academy of Sciences in Krakow, Academy of Sciences in Warsaw, Romanian Academy of Sciences and a whole series of mathematical societies in Paris, Palermo, Bucharest, Leipzig, Prague, Lviv and in Paris he was a member of several scientific societies and academic associations.

## His contribution in the area of teaching and education

Acting in the role he assumed due to fortunate circumstance, academician Petrović was of first-rate importance for the development of university teaching of mathematics in Serbia. In the period up to the First World War, as well as in the inter-war period, Professor Petrović was developing, almost alone, the university system of mathematical education of Serbia. He was a full professor of mathematics since 1894 at the Grand School at the Faculty of Philosophy and since 1905 at the University of Belgrade. He was the only one who supervised mathematical PhDs at the University of Belgrade from 1912 to 1941. He did not publish a lot of textbooks, only three, but his hand-written manuscripts are of extraordinary quality and a genuine pleasure to read even today. He held as much as 16 different courses: 10 courses in analysis and differential equations, 2 courses in algebra, 3 courses in numerical mathematics and a special course in phenomenology. He wrote eight manuscripts. He was a member of the commission for taking the professorship exam, was an envoy of the Ministry for the maturity exams, the president of the Supreme Educational Council of Serbia, a reviewer of high-school textbooks and published several papers dedicated to teaching methods.



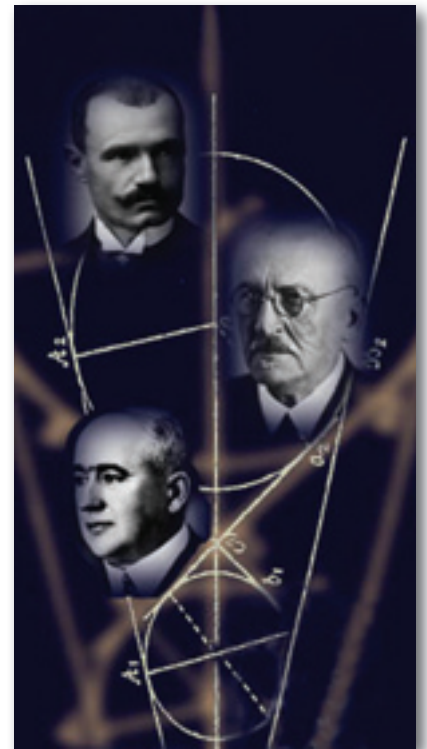
Mathematical offspring of Professor Petrović:  
 academician Slobodan Aljančić (Archive of the Mathematical Institute of SASA  
 (MISASA)), academician Bogoljub Stanković (author: Dragan Aćimović, 2016)  
 and professor Slaviša Prešić (author: Dragi Radojević, 2006)

Mihailo Petrović was a strict and principled professor. It has been noted that he held not a single public speech, although this is not unusual for a mathematician. With Milutin Milanković and Anton Bilimović in 1932, he established a journal entitled *Publications de l'Institut Mathématique*. The results of a greater engagement in his teaching work remains unknown for many of our mathematicians, who are mathematical heirs of Professor Petrović. A great number of mathematicians in Serbia have Mihailo Petrović Alas as their mathematical predecessor. In addition to students of academician Đura Kurepa and Serbian mathematicians who graduated abroad under the supervision of various professors, as well as geometricians whose predecessor was Danilo Blanuša, a great number among us have Mihailo Petrović as their close mathematical ancestor. Let us enumerate the names of his students of the first generation: professors Miroslav Berić, Sima Marković, Dragoljub Mitrinović, Konstantin Orlov, Tadija Pejović, Danilo Mihnjević, Miloš Radojčić. Among the first generation are also academicians Radivoj Kašanin and Jovan Karamata, and academicians among the second generation are Vojislav Avakumović, Miodrag Tomić, Slobodan Aljančić, Vojislav Marić, Milosav Marjanović, Dragoš Cvetković, Gradimir Milovanović, and among the third generation members of the Academy include Ivan Gutman, the correspondent member Miodrag Mateljević and the author of this article.

I feel greatly obliged to acknowledge our very renowned deceased mathematicians who are descendents of academician Petrović, namely professors Manojlo Marović, Ernest Stipanić, Tatomir Anđelić, Milorad Bertolino, Milica Dajović and Vojin Dajović, Petar Vasić, Slaviša Prešič, Milivoj Lazić, Zagorka Šnajder, Svetozar Milić, Zoran Ivković, Janez Ušan, Dušan Adamović, Dragoljub Arandelović, Vladeta Vučković, Bogdan Bajšanski, Ranko Vojanić, Tatjana Ostrogorski, Zoran Popstojanović, Ljuba Protić, Rade Dacić... All of them have had a connection with academician Mihailo Petrović. Many names have not been mentioned. The information about them, as well as about those who are still active, can be found in the mathematical genealogy of academician Petrović, which is a part of this Catalogue.

## His work in the Academy of Sciences and Arts

As has already been stated, Mihailo Petrović Alas became a correspondent member of the Serbian Royal Academy in 1897 and a full member in 1899. The ceremonial reception was given in 1900, the same year when Jovan Cvijić became a full member of the Serbian Royal Academy. Academician Petrović engaged very actively in Academy's work. He was a secretary of the Department of Natural Sciences as well as a member of the Executive Board of the Academy. He wrote reviews of mathematical papers published in *Glas Akademije* (*Academy Gazette*) and presented new candidates for membership in the Academy. In *Glas Srpske kraljevske akademije* (*Serbian Royal Academy Gazette*) he published some sixty papers, thus significantly raising the reputation of the Academy. In accordance with the tradition we still pursue and honor today, and which has been assumed from the tradition of the French Academy, works by authors outside the Academy were referred to by Academy members. In these activities, Mihailo Petrović was very active, particularly due to the fact that his students published a great number of their most important papers precisely in *Glas Srpske kraljevske akademije*. He promoted an entire series of academicians, for example Bogdan Gavrilović in 1900, Milutin Milanković, Anton Bilinović and Jovan Karamata.



Academicians  
Mihailo Petrović,  
Bogdan Gavrilović and  
Milutin Milanković  
(Faculty of Mathematics,  
University of Belgrade)

Jovan Cvijić, Mihailo Petrović and Bogdan Gavrilović invited in 1909 Milutin Milanković to transfer from Vienna to the University of Belgrade, which he accepted. They proposed Milanković for correspondent member of the Academy in 1920 and for full member in 1925. When Jovan Cvijić died in 1927, Petrović was the most serious candidate for the president of the Serbian Royal Academy, however Slobodan Jovanović was eventually elected.



The Academy building,  
constructed in 1924,  
designed by Dragutin  
Đorđević and Andre  
Stevanović in the style of  
academic realism, with  
elements of art nouveau  
(author: Dragan  
Aćimović, 2018)

Jovan Karamata was promoted to an Academy member in 1939. To his teacher, Mihailo Petrović, he provided great assistance in systematizing academic publications. It is owing to him and to the great desire of Mihailo Petrović to catalogue his papers and his legacy that today we have a comparative wealth of data about his life and work.

*Stevan PILIPOVIĆ*

# MIHAILO PETROVIĆ AND THE PHILOSOPHY OF SCIENCE

AN IMPORTANT PLACE IN THE RECORDS of Mihailo Petrović, the founder of the mathematical school of Serbia, is occupied by some twenty papers; discussions about the representation of natural and social phenomena by mathematical means. He continually published them during his entire career as a professor and as a rule, in a desire to make them accessible to as many readers as possible, he prepared the majority of these papers in both Serbian and French versions. Petrović was inspired by natural phenomena, but always had in mind a very general science which encompassed all phenomena, natural and social, real and imaginary, including many phenomena in literature and art. He considered such science capable of becoming "a guiding principle in individual sciences" and capable of shedding a light on "great problem of natural philosophy, the solution of which is an ideal asymptotic goal of all sciences, which consists in the fact that all that has to be assumed in order to understand natural phenomena, as well as a certain number of propositions that encompass everything that occurs in nature, should be reduced to the least possible measure."

Petrović began forming his viewpoint on the role of mathematics in phenomena of nature and the world at an age



The front cover page of the book  
*Elements of Mathematical  
Phenomenology*,  
published in 1911.  
(Digital Legacy  
of Mihailo Petrović)

of the sudden blossoming of natural sciences, and at the same time the increasing presence of mathematics in them. Similarly to many philosophers and scientists at the time, he believed in the unlimited power of natural sciences, and thus of mathematics, given that mathematics played such an important role in their success. In terms of his education, Petrović was not only a mathematician, but also graduated in physics at the Sorbonne in 1893 and engaged in the study of chemistry and other sciences, so he had an opportunity to directly testify that mathematics permeates and connects science and contributes to its unity. He notices that in quite disparate areas of science, the same analytical apparatus appears, that “disparate phenomena” can be “analogous,” that is, represented by the same mathematics. “One of the most important such analogies [...] exists among phenomena of electric current, heat transfer and the flow of fluids. It is so complete that these three kinds of phenomena, with their numerous and various variations, represent from an analytical point of view one and the same problem, the solution of which only needs to be interpreted in three different ways.”

He maintained that mathematical analogies of natural phenomena is not accidental and tried to explain regularities and patterns. Autonomously and without following any predecessors, he gathered a huge body of material with great patience, and subsequently established a branch of science which he termed *mathematical phenomenology*. He defined the terminology of that science, which is similar to that of mathematics and in accordance with which groups of analogous phenomena can be determined “from which the mechanism of this or that phenomena could be extrapolated directly as the terms which figure in them assume this or that concrete meaning. A set of such analogies, once there is sufficient number of them, will make up a separate branch of natural philosophy, a kind of a general mechanics of causes which, just like other mathematical disciplines, in addition to its great general application, will work with a small number of general basic definitions.” Therefore the basic problem of phenomenology is “mathematical explication of particularities of disparate phenomena of all kinds and all concrete natures as necessary consequences of similarities of (their) mechanisms.” He introduced his theory in a voluminous work of around eight hundred pages, entitled *The Elements of Mathematical Phenomenology*, published in 1911. He believed that it could be truly fruitful in other disciplines as well, because it could help reconstruct the plausible mathematical models for natural and social phenomena.

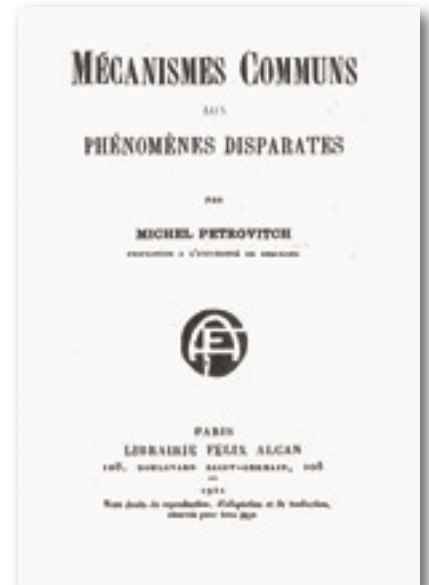


The front cover page of the book  
*Mécanismes communs  
aux phénomènes disparates*,  
published in 1921.  
(Library of SASA, 687/120)

In order to cast phenomena into a mathematical form, he developed and elaborated a method of phenomenological referencing: when “the mechanism of the phenomena” is established, it is represented by a “figurative point” in a multidimensional space and then its mechanism mathematically described in a way mechanisms of phenomena are described in classical mechanics. He expounded this method in the monograph *Phenomenological Copying (Fenomenološko preslikavanje)* published in 1933. However, he did not stop at phenomena in nature and some phenomena in society, but also invested a great deal of effort to confirm the universality of his method in literature as well. The material he gathered for the accomplishment of this goal was published in 1967 in the book *Metaphors and Allegories*.

Natural sciences more or less aspire to base and present their research in the framework of some mathematical model. The more elaborate and perfected it seems, we consider its results more complete, reliable and ultimately closer to reality. It also applies to a great number of social sciences, the contemporary development of which greatly relies on the presence of mathematics. Mathematics is ubiquitous in science and the greater its presence, the more perfect the particular branch of science is considered to be. Science believes that every phenomena, everything that changes in the world, can be given an appropriate mathematical framework. The usefulness of such clothing can sometimes be nil, or it can even happen that this framework should generate a completely distorted image about some phenomena, but in the main, the advantages brought by mathematics are immeasurable.

The front cover page of the book  
*Phenomenological Transposition*,  
published in 1933.  
(Digital Legacy of  
Mihailo Petrović)





The front cover page of the book  
*Metaphors and Allegories*,  
published in 1967.  
(Library of SASA, C6\_120/405)

Mathematical representation of a phenomenon usually emerges quite independently of formal mathematics, in concrete individual endeavors by scientists to explain that phenomenon. With time, this representation is corrected through results in mathematics: already existing results and theories are used, or mathematics is implemented to obtain new results on its own and to develop new theories. Such a relationship between mathematics and other sciences has existed since antiquity and is a quite natural practice.

Petrović's aspirations were to provide foundations for a science, which for each phenomenon could tailor an appropriate mathematical framework, as well as his faith that the entire world is structured according to unique mathematical laws, assumptions of which, that can precisely be determined, has still not found its confirmation in science. Contemporary logic has undoubtedly proved that every language, even the universal language of mathematics, has a limited expressive power. To the extent on which science today relies on mathematics, in which such limitations have been proven, naturally one has to face the limited power of science. No justification exists for its omnipotence. One could rather say that this power is insufficient for a comprehensive description of complex natural phenomena, that it is indeed possible in some ideal cases, but by no means can a complete description of the entirety of nature ever be provided.

Mathematical phenomenology has to be understood as a separate project in the total opus of Mihailo Petrović. Philosophers and scientists often work on several independent projects, for a certain time only on one, and then shift to another, and often some of the projects remain unfinished. In parallel with working on mathematics and philosophy, Leibnitz worked his entire life simultaneously on four such projects: logic, ideal language, encyclopedia of knowledge and a general scientific method. They have all remained

Portrait of Mihailo Petrović Alas  
(by Uroš Predić, oil on canvas,  
Belgrade, 1943 –  
Library of SASA)



incomplete, and except for logic, the remaining three great projects by Leibnitz strikingly overlap and permeate with Petrović's mathematical phenomenology. The ideal language is conceived as a universal symbolical language for science, mathematics and metaphysics, which would be "a basis of the calculation or the algebra of thinking," and a kind of encyclopedia of knowledge was his systematic collection intended to enable realization of the project of the ideal language; while within the project of the general scientific method, Leibnitz tried to formulate a procedure for an accelerated expansion of knowledge. Unlike Leibnitz, who found the cornerstone of his grand project of commonality of science in logic, but not necessarily in the logic of his time, Petrović sought the foundation stone of his science in classical mechanics. To him logic seemed empty, and the relationship between the cause and the consequence too abstract, so he tried to formulate the notion of a cause in "concrete sciences" in which it "always appears inseparable from its substratum and its material nature." He has given his notion of cause "a natural-science-like form" implying that the cause is "every phenomenon which aspires to change such a state of affairs or to introduce perturbation in some other phenomenon." At the time when he was laying his groundwork for mathematical phenomenology, contemporary logic was in its infancy; so logic reduced to Aristotle's teachings about the four types of categorical statements. He had every reason to turn his back on such logic; and ground mathematical phenomenology "closer to nature." He made a conceptual apparatus that is not entirely articulated by "active causes" and "necessary consequences" and on which he built a kind of general mechanics of phenomena modeled on classical mechanics. It is entirely possible that Leibnitz's and Petrović's attempts to reinstate unity in science and knowledge have not yielded expected results for the same reasons: collision with Aristotelian logic. Petrović did not want to rely on that logic due to its perceived shallowness, but with this he also rejected contemporary logic and philosophy of mathematics. They had suddenly developed in parallel with his phenomenology, and perhaps could have been more useful to him. Leibnitz



Gottfried Wilhelm Leibniz  
(1646–1716), German  
philosopher, painted by  
Christoph Bernard Francke,  
before 1729 (Herzog Anton  
Ulrich-Museum, Braunschweig)

formulated the first contemporary logical systems and was the first to identify the significance of language for logic and science. Therefore it can be said he tried to realize his project with some of the tools of contemporary logic, whose godfather he had been, but his hands were tied by the scholastic legacy in logic from which he could not free himself. Therefore in the case of Petrović, equally as in the case of Leibniz, the problem was that, at the time when they were beginning their project of description of all phenomena, mathematics did not have its own language. Neither had an existing language to use and build with. Searching for a language, Petrović finally relied in the end on the language of classical mechanics, the expressive power of which lags far behind the power exerted by contemporary language of mathematics. Leibniz did try to establish such a language, but he did have problems with its inherent logical basis.

When Petrović began his project of mathematical phenomenology, the process of division of the existing branches of science, and the emergence of new disciplines, was in full swing. He considered that for the benefit of science this process should not go too far, and believed that this fragmentation of science could be counteracted, and its former unity restored. According to Petrović, mathematics ought to play a key role in that unification and become the main counterweight to the process of auto-fragmentation of science and knowledge in general. He was partially right in the sense that the language of mathematics, its syntax, created in the first years of the twentieth century in contemporary logic, has become the theoretical basis for the development of the syntax of programming languages, and has enabled the realization of contemporary digital computers; through which mathematics has openly invaded all sciences, and possibly created conditions for the resurrection of the idea of unity of science; the goal towards which Petrović so longingly aspired.

*Slobodan VUJOŠEVIĆ*

# ABOUT FISHING AND LITERARY WORKS OF MIHAILO PETROVIĆ ALAS

PEOPLE LIKE ALAS ARE FEW AND RARE.

Among all his occupations and interests, and there were enough of them to fill up two lifetimes to the brim, Mihailo Petrović Alas attached undeniable importance to his primordial passion – fishing. After all, it is fishing that earned him his nickname, by which he has been permanently remembered in Serbian history, science and culture. (According to some testimonies, the nickname was initially ironically coined by Milutin Milanković, another tremendous Serbian scientist of that time. However, later on it became his standard hypocorism, which, as is the custom of the Serbian cultural environment, underlined broad popularity and affection that Alas generated; it is enough to say – Alas – and right away everyone knows.)

Petrović's passion for fishing eventually grew into a specific worldview, and became a distinctive, practiced and defined "philosophy of life." Numerous available data and records, and certain outright gestures of Alas's (eccentric, in the true master river fisherman, the "*alas*", vein). evidence of the power of such passion. Publicist Predrag Đuričić, son of Alas's friend Mladen St. Đuričić who remembered the great Serbian scientist from his childhood, wrote in

Portrait of Mihailo Petrović  
from 1921.  
(*Collected Works*, Book 14)  
(Digital Legacy of  
Mihailo Petrović)



*Стари рибар.*

*Михаило Пејровић је већину својих нематематичких радова потписивао псеудонимима рибарског порекла: Рибарски мајстор, Мајстор Мика, Стари мајстор, Стари рибар (в. уџивограф Пејровићевог потписа) и други. – Професоров лик из 1921. године, када је највише радио на проучавању и искоришћавању Охридског и Пресјанског језера*

his article "Personality of Mihailo Petrović Alas in Memories and Anecdotes" that it was his father who brought his attention to Alas's unusual nature. One day his father showed him "Mihailo Petrović's study, and on the wall above the typewriter stood only one diploma. It was a master's letter, written in rough, unskilled handwriting of a river master fisherman, and signed by the president of the commission, that Mihailo Petrović, a professor, has passed the master's exam for a master river fishermen, and is now certified in the fisherman trade, which the undersigned members of commission recognize and confirm." Besides all his academic honors, honorary doctorates, and membership in the world's most renowned scientific associations, Alas saw himself, first and foremost, as a hardcore master fisherman, his life oriented towards water and the brotherhood of men united in their enthusiasm for fishing.

His highly extensive and diverse interdisciplinary scientific work has been systematized on several occasions, yet constant study and re-examination are still required, now supported by the publication of *The Collected Works*, a most comprehensive presentation so far (15 volumes, editor-in-chief Dragan Trifunović, 1997). In addition to this, throughout his life, Mihailo Petrović Alas dedicated his time to the theoretical and practical aspects of ichthyology, the fish science. Permanently, almost providentially fascinated by the fish world, he was familiar with the tiniest details of nature, tradition and all the techniques of river fishing, especially on the Danube and Sava. As an aficionado and a practitioner, a member of the trade circle, Alas relentlessly – even obsessively – explored, described and interpreted customs, language, tools, the mundane as well as the extraordinary scenes from the life of this seemingly marginal, but a very picturesque and authentic social stratum at the turn of the centuries, and also before and after the Great War.

Mihailo Petrović Alas's writings about fishing can be divided into four groups, conditionally speaking. The first group is ichthyological in the strict sense of the term (listing and describing fish species). The second deals with the fishing skill and methods, displaying and mapping fishing locations, cataloging different tools and baits, as well as technologies for fish storing and processing, and finally, instructions for fish breeding. The third group is about the history of fishing in Serbia. Starting from the ancient era, he writes

about the times under the Ottoman Turks, when fishing was very developed (Turks held the deeds over river fishing), and all the way to Alas's time, including also the history of the fishing guild, and regulations pertinent to the fishing industry. The fourth group includes literary expressions of his existentially privileged passion (travel books, reportages, popular articles, such as "Do Fish Sleep?", or the strange historical fragments, such as: "An Unusual Fish Adventure in the Court of Emperor Napoleon III").

A separate group, indirectly linked with fishing, includes Petrović's papers on hydrography and oceanography. Standing out in this group is his most detailed and most famous popular science novel, *The Eel Novel*. Indicating genre in this, at first glance, unusual title, does not so much refer to this most widespread fictional form, as it implies its broader meaning. Labeled as a "novel," Petrović's books presents an exciting, realistic but also mysterious, stylized and well-shaped account, with a defined theme, time, space and narrative instinct.

*The Eel Novel* begins with an explanation as to why the author wrote it. Alas notes: "Once, the eels were regarded as creatures with no known beginning or end. The question of how an



The Belgrade Fishery Association  
confers a diploma to its  
founder Mihailo Petrović  
on July 12, 1942.  
(SASA Archive, 14188/33)

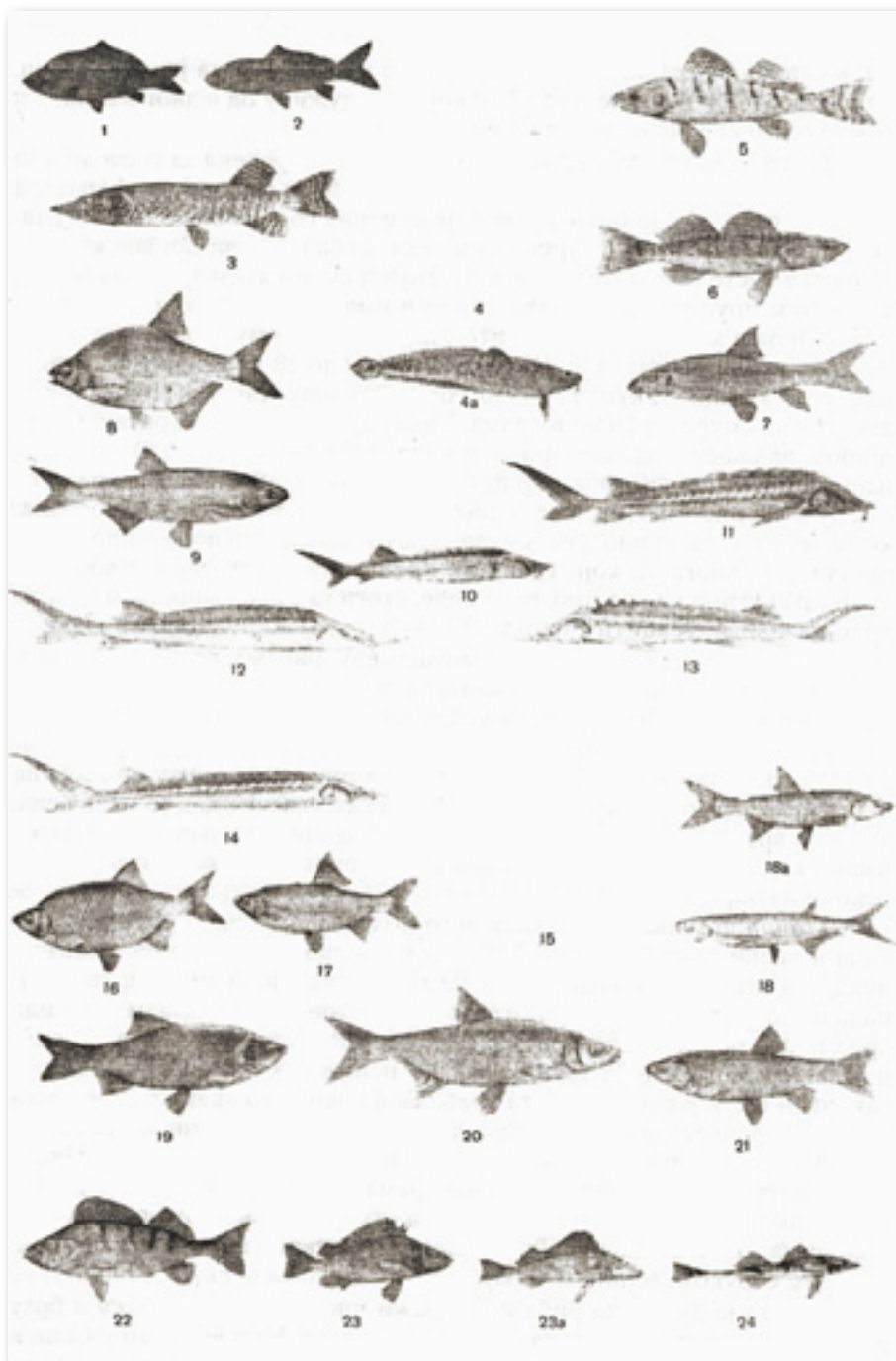


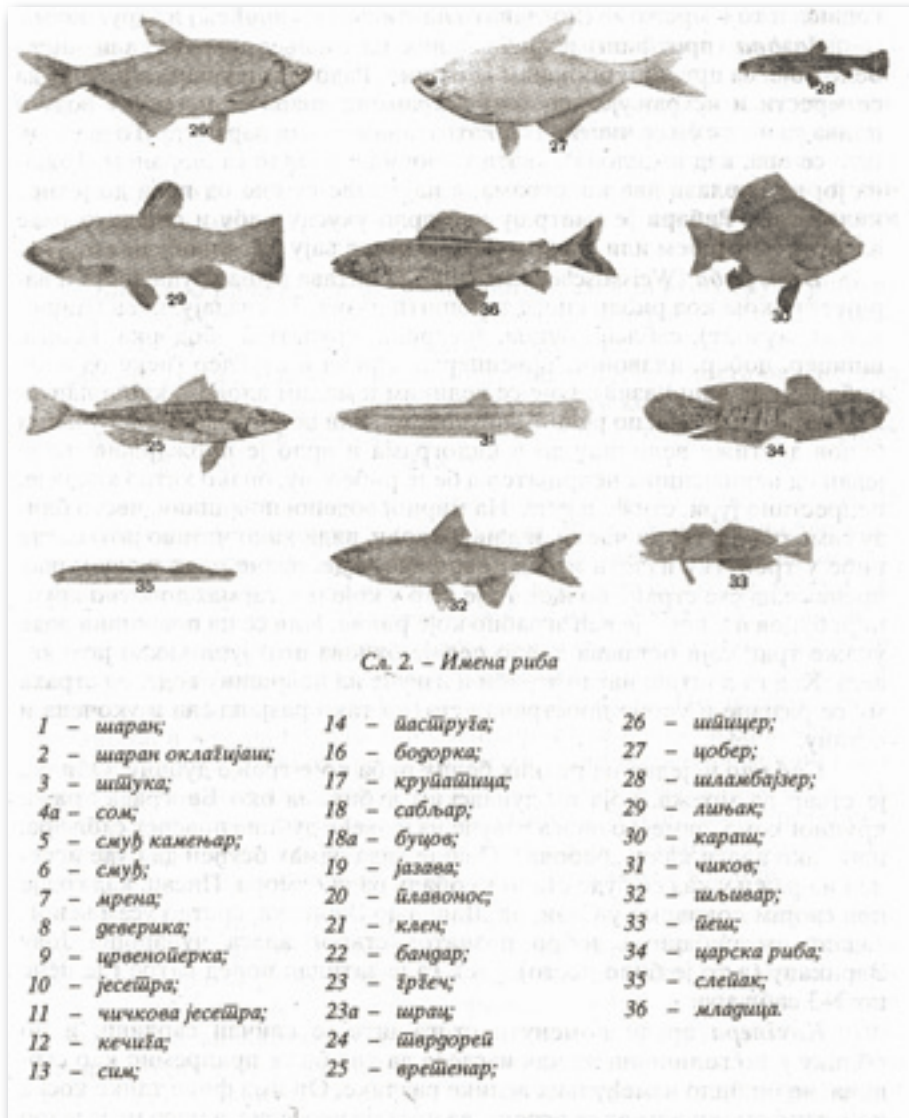
eel was born was a puzzle that exasperated the curiosity and imagination of both naturalists and philosophers. It also intrigued Aristotle, who found that eels were an unsolvable puzzle, and could not grasp how an eel's life ended. This mystery confounded the world to such an extent that, once it appeared that no one was able to say anything about it, general opinion formed that it was unsolvable, forever inaccessible to human reasoning, and extending into the realm of religious mysteries. Writing about eels, Herodotus said that it was a sacred creature that only the divine could look after."

In the Middle Ages, Petrović writes, eels continued to be viewed as evidence of the divine. Such evidence, he asserts, "must be compelling even for the most pungent of atheist". And it is a long time common understanding that every mystery, not just that of an eel, must have a poetic overtone; otherwise, it would not be a mystery. Izaak Walton, in *The Compleat Angler* (1653), undoubtedly the most famous book in the world which tackles the topic of fishing in a literary fashion, in an attempt to shed light on the mystery of eel propagation, states, among other, that eels are "bred of mud, as some worms [...] or out of putrefaction of the earth [...] similar to certain bees and wasps"; that eels are "spawned of a particular dew descending in the months of May or June on the banks of some particular lakes or rivers [...] and the ancient peoples called them the offspring of Jove", adding that "eel's spawn is born alive, and that tiny live eels, no bigger than a pin, come out of an eel."

Petrović's Eel Novel offers the reading public a retrospective of the solutions proposed to the two-millennium-old eel mystery in a lucid, accessible manner. He starts with the discoveries made by the naturalists Redi and Mondini in the 17<sup>th</sup> century, refers to Sirevi and Jakobi from the second half of the 19<sup>th</sup> century, and Grasi and Fezersen in the late 19<sup>th</sup> century. He finishes with the famous Johannes Schmitt, whose research in the first half of the twentieth century took twenty-five years. After all the confusion, temptation and enigma, Schmidt produced an exhaustive scientific description of the breeding process of this mysterious fish. Eels might not be of a divine origin, but they undeniably illustrate the immense and inexhaustible imagination of the divine mother nature, inaccessible to the human mind. Seeking to scrupulously present and interpret many questions

Types of fish in Belgrade  
hunting areas  
(*Collected Works*, Book 14)  
(Digital Legacy of  
Mihailo Petrović)





which ichthyology encountered in shedding light on the eel secret, Mihailo Petrović Alas traveled to the eel breeding waters in the Atlantic Ocean. In his “novel” he offers a series of extraordinary reports about those places, filled with unusual, intriguing, sometimes almost incredible but always striking details, corroborated by experience and also scientifically. It is such impressions that push Petrović’s writing beyond the boundaries of the documentary genre, revealing it as attractive for



Cover page of *The Eel Novel*,  
published in 1940.  
(eLibrary Faculty  
of Mathematics,  
University of Belgrade)

a reader, linguistically inspired outlook, rooted in individual experience, with an appropriate, recognizable, nuanced, narrative tone of an experienced author. This also opens up the question of whether Petrović's prose of this type, at least at the secondary level, can be read and regarded in the context of literary art.

By all means so. Being a declared rationalist, a scientist who believes in facts and practical evidence, Mihailo Petrović Alas never consider himself a writer, and rejected the thought that others saw him as such, demonstrating suspicion towards the human need for imagination, and in particular for the banal "poetry" and the overtly artificial "theater." At the same time, a significant part of his opus was shaped in line with the literary requirements and using literary means, complying with an inherent rule that an author's writing style influences the image presented. Not only in his many travel journals, which are eminently literary in genre, Petrović is also a writer of a striking style in his other non-scientific texts. His style is neither expressive nor lyrical in the way of the best writers of his time, but it manages to be very suggestive. The subject matter is communicated quickly and easily to the reader.

By preferring credibility and "objectivity" in his writing, Alas approaches realistic tradition, which he particularly appreciates. He makes direct mention of this in his well-known text, "An Unfinished or Lost Narrative by Stevan Sremac." According to Petrović, this epitome of Serbian literary realism, a personal friend of Petrović's, had every intention of writing a story about a river fisherman way of life. Sremac visited this world, made notes about it, but only his concept remains to this day, thanks to Alas.

Many critics have written about the literary quality of Petrović's texts (among them: Milan Bogdanović, Mihailo Pavlović, Dragan Trifunović, Slobodanka Peković). All share a prevailing opinion that Petrović is a master of a functional, reporting style, an engaging narrator, focused on precisely presenting the theme. He is in complete control of the form and the narrative rhythm, skillfully managing the relationship, and proportion, between the main topic and digressions, finding a balance between the document and his own experience. All that points to his rational, scientific nature, his emotionally



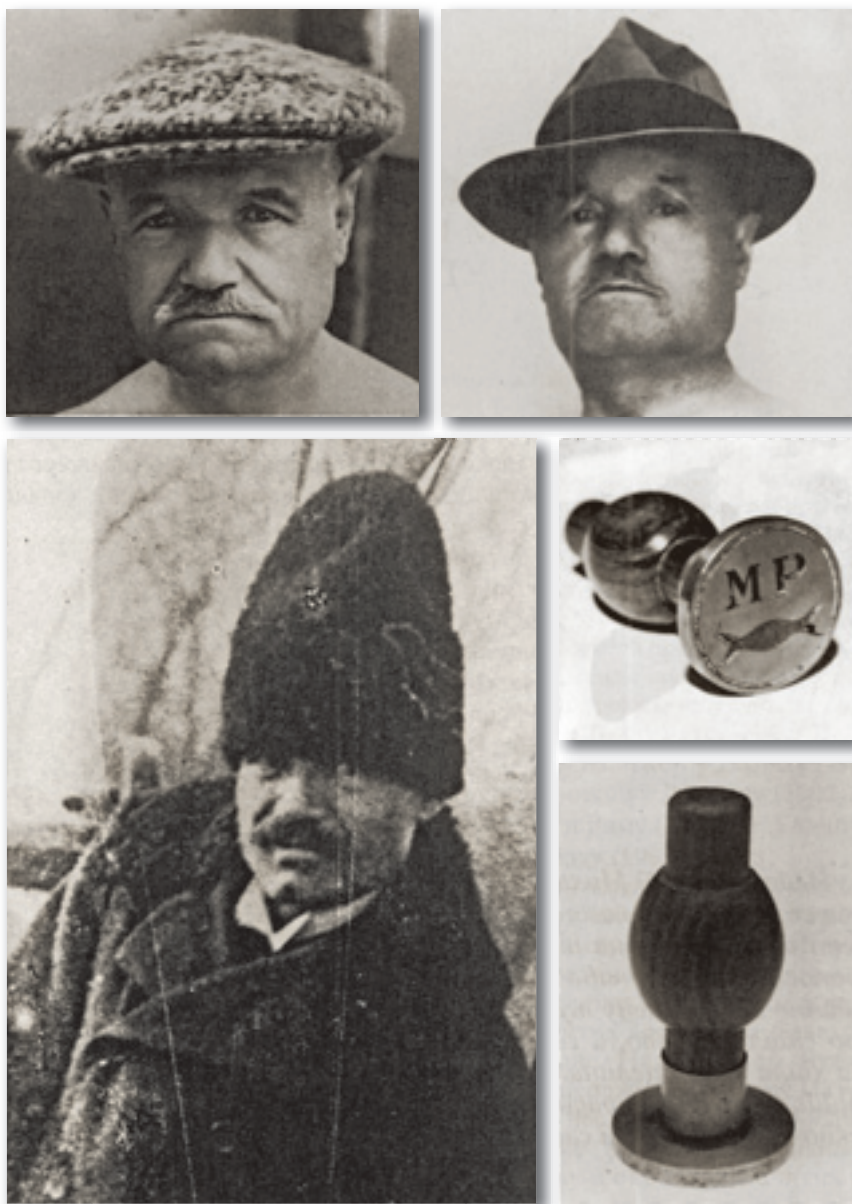
Folding of a large fishing net  
(a dragnet, *alov*) into a boat  
(SASA Archive, 14197/6)

balanced presentation, and clear, positivist-influenced tendency towards the exact, rational facts. (This can also be somewhat disputed: Mihailo Petrović Alas was also a passionate reader of adventurous and science fiction novels, and he was especially interested in the relation between science and poetry, and has written a study on that very subject.) Alas's language is precise, occasionally with mildly archaic overtones. Particularly precious is his vocabulary, well suited to his subject matter, professional and academic in tone when required, but also colloquial when describing life itself (for example, river fishermen's nicknames, tools, professional jargon, etc.). This is true for his travelogues, his texts on fishing, but also for some of his essays and articles, several of which are in fact full-fledged stories, without the excessive poetic stylization ("One Great Muslim Pirate," "Gymnasium Time Memories," "One Iron Gate Gorge Experience," "Mija Jagodinac, the Music Maker").

Standing apart from the rest, but remaining an indirect relationship with other scientific and existential interests of Mihailo Petrović, is his unfinished phenomenological study *Metaphors and Allegories (Metafore i alegorije)*, posthumously published in 1967 by



Mihailo Petrović with a caught catfish, weighing 124 kilograms  
(December 5, 1913)  
(SASA Archive, 14188/28)



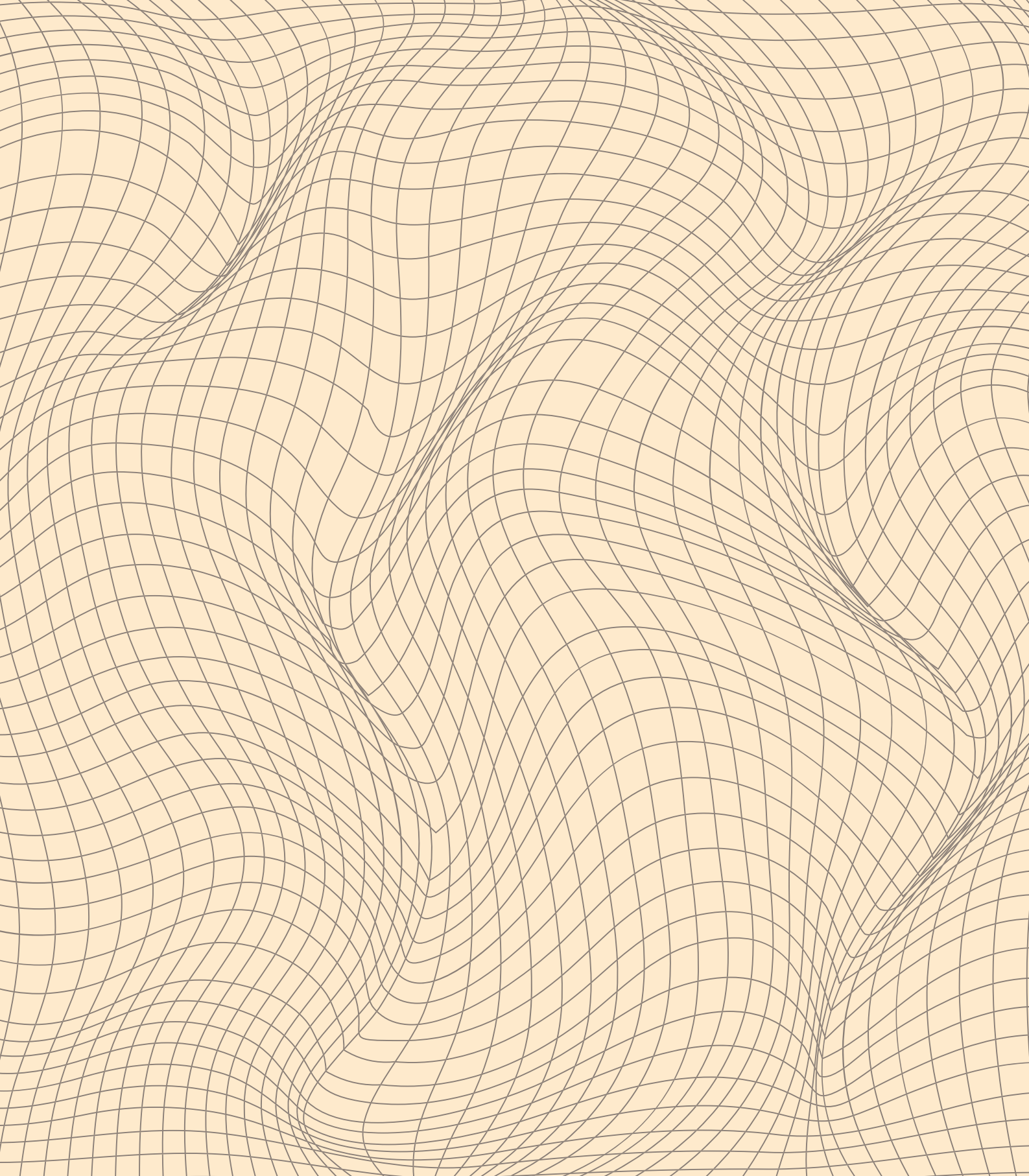
Three faces of Mihailo Petrović as a fishery master on the Sava and the Danube rivers. Petrović maintained an extensive correspondence with the world. He used his own seal to secure a postal package or an envelope. His stamp depicts a "fish eating a fish" with MP initials, hardly a coincidence (the stamp was made in Paris, of silver and yew tree wood, *Taxus baccata*, in 1898). (Collected Works, Book 14) (Digital Legacy of Mihailo Petrović)

the Serbian Literary Cooperative, otherwise publisher of many Alas's books. He begins by describing the properties of metaphor, that universal, generative literary stylistic tool, and also of allegory as a particular artistic tool for conveying and crystallizing meaning. Petrović then goes on to address the issue extensively, and looks into the types of transposing and conversion, in other words, of establishing a network of analogies which is then used as a basis for both scientific and creative thinking. His paper finishes with the systematization of typical usages and roles, in an attempt to get as close as possible to the otherwise unattainable principle of phenomenological "absolute adequacy." In the words of Dragan Trifunović, the editor of the first edition of the *"Metaphors and Allegories,"* "Petrović successfully uses these literary figures of speech and develops a compelling theory of similarity, as yet another contribution to his "extended mathematics."

Let us go back to the beginning. Looking back from a distance in time, during which the world rapidly accelerated and transformed in the way that our ancestors could never have dreamed of, Petrović's unique creative personality is an instance of harmonious, optimal realization of all potentials of an individual, incomparable by any standard. Equal importance should be attached here to the roles played by his reason and his passion. Petrović's passion, fishing, harked back to the deepest, archetypal, collective forces of the humankind. Having fulfilled the hunting instinct, this passion comes back to focus on the general, mysterious laws which are at work behind the entire existence of the living world, and it both becomes and remains an integral part of it. There are few of its enchanted captives who managed to gain conscious control over it, and shed as much light on it as possible, and to the extent accessible to humans. Petrović is, beyond any doubt, a representative of this minority.

After all is said and done, it is worth repeating – men like Alas are few and rare.

*Mihajlo PANTIĆ*





# MIKA ALAS, THE ICHTHYOLOGIST

FAMOUS MATHEMATICIAN AND ACADEMICIAN Mihailo Petrović was remembered as a person with a somewhat unusual secondary calling – fishing. Some even knew him only by his nickname, Mika Alas, which he got from spending time in the company of fishermen from the Belgrade riverbanks wasteland. It is less widely known that behind this familiar nickname lie not only his fishing glory, his popularity in bohemian circles, and a hobby of a somewhat eccentric mathematician, but also a long and systematically developed career of a fishery expert, a fishing entrepreneur, and an oceanographic researcher. This part of the personality and work of Mihailo Petrović is the least known to the public, in part because of his inherent modesty. His work in the field of fishery is important for the history of the fish diversity studies.

Mihailo Petrović first became an *alas*, a master river fisherman, and only then was he a mathematician. From an early age, at the insistence of his grandfather Novica, for reasons of his health as was a sickly child, Mika Alas spent a considerable part of his time on the Sava and the Danube rivers. He began apprenticing with Master Gašpar in 1889, as a third-year student of the High School. Later on he became a fishing journeyman, working with the Arsa Ilić Ciganin. When he graduated from the Faculty of Philosophy of the Great School in 1895, he passed the exam for a master fisherman and could establish his first professional fishing company of men. He owned fishing nets and had his own apprentices and journeymen who fished with his fishing gear. Mika introduced new fishing techniques, using the most up-to-date nets, as well as the *laptaš* fishing net, some of them 60 and even 80 meters long. Whenever possible, he spent his days and nights fishing with his company of men. There are records of him taking several weeks-long fishing trips, multiple times a year, sometimes catching genuine rarities. Some of these catches he donated to the Museum of



Academician Petar S. Pavlović, geologist and Director of the Natural History Museum of the Serbian Land (today Museum of Natural History in Belgrade), around 1895.



Burbot, eelpout – *Lotta, lotta*;  
Danube, April 1904.  
(Museum of Natural History  
in Belgrade, a collection of  
Dr. Mihailo Petrović,  
inventory number 3)

the Serbian Land (today's Museum of Natural History), but only a small portion has been preserved in the museum archives and collections today. He founded the first ichthyology collection in the Museum, in cooperation with P. Pavlović, the then Director of the Museum of the Serbian Land. This collection exists even today in the Museum of Natural History, registered under reference number 597.02.

Only later, as part of his extended university studies, did Mihailo Petrović decide to study mathematics in Paris. At that time, biology studies were not separated, which meant that Mihailo Petrović received the same academic naturalist education as did the then university professors, zoologists, who taught ichthyology. It was only much later, when Mihailo Petrović already established himself as a celebrated connoisseur of fishery, that giants such as Stanko Karman and Siniša Stanković appeared, giving their capital contributions to ichthyology. However, being modest, Mihailo Petrović frequently published his professional and popular articles in the field of fishery under the pseudonym "The Old Fisherman," and maintained that when it came to fish, he only had his master fisherman certificate. In any case, Mika Alas, although primarily a mathematician, was one of the rare, and at times our only expert on fishery. Owing to his papers on ichthyology, today we have information about the centennial changes of the diversity of fish in Serbia.

When Mika Alas first entered the secret world of fish, the vast expanses of ponds, lakes, swamps, flooded terrains with forests, provided perfect conditions for the fish breeding. He was born at the confluence of two great European rivers, with an extremely rich fish fauna that he very much kept in his memory. But then began the human engineered regulation of the river flows, and the drying of the soil. Mika Alas noticed dramatic changes taking place, and considered it one of his most important scientific tasks to leave behind authentic and documented records. Thanks to his work, today it is possible to reconstruct that referential state of affairs before introducing capital anthropogenic changes that are necessary for adopting the program of reverse reconstructing freshwater fish diversity. He published two seminal works, both in 1940: *Beograd, negdašnji centar velikoga ribarstva* (Belgrade, the Former Center of Great Fishery) and *Đerdapski ribolovi u prošlosti i sadašnjosti* (The Iron Gates Fishing in the Past and Present). In these valuable studies, he described the state of fishery in Serbia before the Danube river flow was regulated, that is, before the Đerdap hydroelectric power plant was built. Mihailo Petrović also wrote about



A fishing memento  
(SASA Archive, 14197/24)

the decline of the numbers of the Atlantic sturgeon, which no longer swam up to the Đerdap (the Iron Gates Gorge) part of the Danube. He compiled the first inventory and included scientific descriptions of the species of the fish living in the Belgrade river area. His overview is very detailed and includes commercially important species, known to everyone, but also those that are primarily of scientific value, bolstering the fledgling science of ichthyology in Serbia. In 1900 he published a paper on fish species found in the Drina river in *Lovac* (The Hunter) magazine, listing all the mountain and lowland freshwater fish species, and commenting noting that such a variety of fish fauna is of outstanding importance. Very soon after publishing his first work on fishing in *Lovac* magazine, in 1897, he started artificial breeding of the carp.

Perhaps the most important are his expert papers and reports on the fish-fauna found in the Macedonian lakes, especially the Skadar Lake and Ohrid Lake. In these papers, for example those published in the magazines *Ekonomist* (the Economist) and *Trgovski glasnik* (The Trader's Gazette), in Belgrade, 1913, Petrović was the first to justify the use of statistical method in conducting an economic analysis of fishing on the Ohrid Lake. Using his knowledge of mathematics, he was the first person in our region to merge two sciences – mathematics and fishery – to build statistical models in order to calculate the possibility of sustainable use of the fish fund of the Ohrid Lake. His extensive personal experience of rivers and his knowledge of ichthyology resulted in his, for that time, very progressive and realistic understanding that

the fish funds needed to be preserved, and that this must be done by taking into account the interests of the local population making their living from the traditional manners of exploitation of the fish resources.

At the time when he lived, Mika Alas was one of the rare fishery experts. In 1898, he participated in the adoption of the first law on fishing in Serbia. Owing to his merits (knowledge of ecology and his understanding of the extent of endangerment of fish, along with his direct river fishing experience), the enacted law contained provisions that made it applicable to fishery in Serbia, despite the fact that it had been compiled based on the laws applied in other countries. In 1900, Serbian government commissioned Petrović to take part in international negotiations, held for the purpose of signing a convention on fishing with Austro-Hungary, in order to regulate fishing on the Sava and Danube rivers. Seven years later, Petrović again represented the interests of our country and successfully completed negotiations with Romanian representatives. Another convention was signed, and for his merits in consolidating the economic ties, especially fishery between Romania and Serbia, he received a medal, the Order of the Romanian Crown of the Third Order.

At the beginning of the previous century, Mika Alas worked on the affirmation of Serbian fishery in the world. He wanted



Mihailo Petrović owned his own fishing nets, and had apprentices and journeymen who fished with his equipment. (SASA Archive 14197/30)

to show the extraordinary diversity of Serbian fish fauna in the European metropolises. He organized international exhibitions – in London in 1907 and in Turin in 1911. The very modern exhibition concept won him the first prize for exhibiting. He authored of the first exhibitions in the history of our fishing industry. Sponsored by the Serbian Agricultural Society, and in cooperation with the Director of the Museum of the Serbian Land, P. Pavlović, an exhibition of fish opened in Belgrade on September 28, 1908. The exhibition contained 75 fish samples from all our main rivers, to illustrate their diversity. Mika Alas himself caught most of these fish and prepared them for exhibiting, along with the famous taxidermist Dušan Stojadinović, Uncle Doša. In addition to the prepared fish, live fish were also exhibited, in a tank. Among the taxidermist preparations of barbell, carp, pike and thorn sturgeon, a capital sample of a catfish, weighing 83 kilograms, again caught by Mika Alas personally, was also exhibited. Especially impressive was the eel taxidermist preparation, again caught by Mika Alas personally around the time of the exhibition, an act otherwise rarely possible because this type of fish is very rarely found in the Sava and the Danube. This taxidermist mount is preserved in the Natural History Museum to this day. The exhibition also had an educational character, and was use to present the law on fishing, along with the international conventions on fishery, and the plans for future efforts in fish protection.

Mihailo Petrović contributed to the development of marine biology and oceanography in several expert papers, and he also participated in the establishment of the first Yugoslav Oceanographic Institute in the city of Split. At a time when modern scientific research of the seas was in its early days, Mihailo Petrović was one of the few world explorers who sailed to the North and South Poles, and in the Atlantic and Indian oceans. Though we have his travelogues from these expeditions, showing his outstanding gift of storytelling, the essence of his travels continued to be ichthyological research. He participated in the fishing with of huge nets, and studied catches to determine the netted marine species. He was particularly interested, as he said himself, in the mystery of the death of an eel.

Since 1934, Petrović has fully occupied with the problem of eel breeding. Being aware that nothing is known about the phenomenon of fish spawning, except that it takes place at great depths of the Sargasso Sea, and that these small eel larvae chose there and then to which side to swim, American or European, he wanted to capture and document this momentum of transmission and present it for the first



Mihailo Petrović and Crown Prince Đorđe Karađorđević, with the caught fish, Belgrade 1906. (Foundation "Mihailo Petrović")

Mihailo Petrović  
with a caught fish.  
(SASA Archive, 14188)



time to the global scientific public. He took part in a marine expedition, where he used special fishing nets in the Sargasso Sea at depths exceeding 1,000 meters, with the objective of catching small eel fry, and thus prove that indeed it was where they hatched. No one had been able to catch the eel larvae before that, and it was known that adult eels ended their last migration in that location, and it was assumed that it was where they spawned. He did not succeed in catching them, although after each failure he constructed a brand new net. He repeated the expedition in 1939. When everything promised success, and the desired depth was finally reached, the cord broke and the net remained lying at the bottom of the sea, forever preserving the possibly spawned eels. However, failure of that expedition did not discourage him, and he was determined to try again next year with a backup net. But the naval blockades imposed during the Second World War postponed the journey, and in 1943 Mika Alas died in Belgrade, not fulfilling his great desire to solve the mystery of the eel.

Mika Alas died in his house in the Kosančićev Venac, the crescent street, in Belgrade, his master fishermen friends, *alases* of the Danube and Sava carried his coffin to the nearby Cathedral Church and thus paid their last respect to a fishing master. He was buried in the family tomb at the New Cemetery.

*Dubravka VUČIĆ*

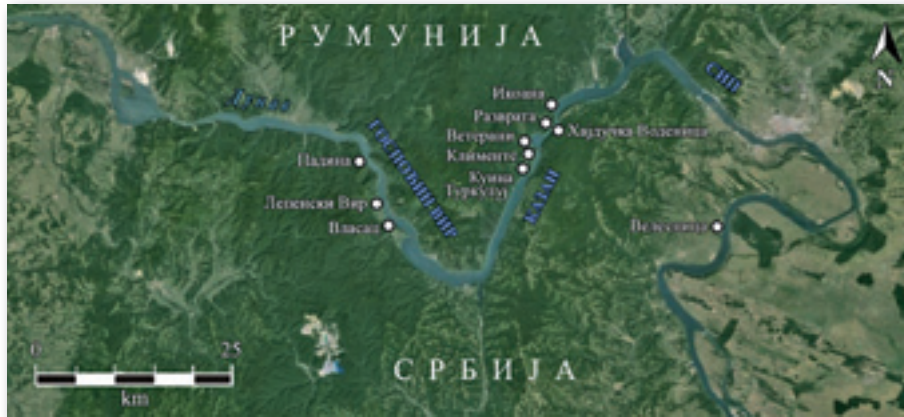
# THE INFLUENCE OF MIHAILO PETROVIĆ ALAS ON ARCHEOLOGY

IN ADDITION TO HIS IMMEASURABLE contributions to mathematics and the development of this science at the Belgrade University, as well as to ichthyology and commercial fishing, and indeed to the genre of travelogue, it is less known that Mihailo Petrovic Alas also left his mark in archeology. At first glance, this connection does not appear obvious, nor is there too much data. However, it is important to note that Alas' passion for fishing not only took him across the seas and oceans but also into the past. His minute studies of the written records, and the interviews he conducted with the old fishermen, he sought to preserve the memory of the old fishing techniques, which he first became interested in already as a boy, and grew even more so during his adult life. The historical dimension of Alas's work was especially evident in such works as *Beograd, negdašnji centar velikoga ribarstva* (Belgrade, the Former Center of Great Fishery, 1940) and *Đerdapski ribolovi u prošlosti i sadašnjosti* (The Iron Gates Fishing in the Past and Present Times, 1941). In the former, he refers to various travel writers who visited this region starting from the 16<sup>th</sup> century, and writes about the formerly highly developed trade in local and migratory fish, the aspirations of different sides to exert control over the region throughout its turbulent history, about the picturesque Belgrade riverbank wastelands, and the early beginnings of the organized fishing industry in Serbia.

His other piece of archeology related writing, *The Iron Gates Fishing in the Past and Present Times*, was dedicated to specific fishing methods applied in the Iron Gates Gorge (*Đerdap*), a landscape that held particular importance for Alas, and where he always happily returned. According to Alas, fishing in the Iron Gates was entirely based on exploiting the obstacles in water and the river currents that directed the movement of fish – especially large sturgeons and other species from the beluga family, in their seasonal migrations from the Black Sea. As a particularly opportune place for fishing in the gorge, Alas emphasizes *Gospođin Vir* (The Lady's Whirlpool), where the waters collided with rocks and formed a deep and noisy whirlpool, the strongest one in the entire course of the Danube river. Carried by the current, large sturgeons (which could grow up to five meters long), belugas, catfish and other fish flew right into the "setovi" (anchored ships with fishing nets), strategically positioned nearby the whirlpools. Except for the gorge, and the *Gospođin Vir*, whirlpool fishing was practiced in the downstream gorges, in the Kazan (the *Caldron*) and Sip sections of the Iron Gate, all the way to the Negotin Krajina. However, people also used other techniques downstream, such as the "beluga fishlines" (dense webs of fish hooks) and "garde" (elongated wicker baskets). The link between a specific fishing technique and a location within the Iron Gates was very important, and, according to Alas, it was possible to trace it back to the Middle Ages, the Turkish period, up until the time of Alas's writing. However, after regulating the flow of the Danube river in the Iron Gates Gorge in the late XIX century, such methods of fishing increasingly disappeared, and Alas considered it his duty to document and preserve them from oblivion.

Twenty or more years after Alas' death (in the sixties and seventies of the XX century), yet another immense transformation stormed the Danube river: the construction of the Iron Gates Gorge dam and power plant. The idea behind this project was to exploit the hydroelectric potential of the river and facilitate navigation, but at the same time it significantly elevated the water level, affecting a drastic change in the landscape, and flooding both the then existing human settlements and the archaeological sites appearing throughout the coastal area. As a result, extensive archaeological research was undertaken in order to preserve and collect as much information as possible about the history of this area, previously known primarily by the remains from the Roman period. It included the right riverbank (the Serbian side, but at





Map of the *Derdap Gorge* (the Iron Gates Gorge), depicting the archaeological sites dating from the Mesolithic and Neolithic periods (9500–5500 BC) which are mentioned here.

the time, the Yugoslav side) and left (Romanian side). However, during these campaigns, unexpected discoveries were made: numerous prehistoric (mesolithic and neolithic) sites (Figure 1) appeared, tracing local human presence back to between 9500 BC and 5500 BC. On the Serbian side, it was indeed the area of the *Gospodin vir* that was most closely explored. Settlements such as Lepenski Vir, Padina and Vlasac were discovered there, exhibiting previously unknown forms of architecture, sculpture, and traces of complex and varied funeral practices. Particularly sensational was the discovery of Lepenski Vir (Figure 2), a settlement



Archaeological research at Lepenski Vir in 1968 (National Museum in Belgrade)

distinctive by a large number of trapezoid building structures found, with solid red limestone floors, rectangular hearths, and representational sculptures.

From the very beginning of archeological research, the prevailing hypothesis was that the prehistoric humans settled in Iron Gates Gorge precisely because of the fishing, and that fish was the most vital food, as well as an important symbolic resource. Such hypothesis was corroborated by large quantities of discovered fish bones, fishing tools, sculptures of “fish-like” creatures, artifacts with depictions of fish, but also the very position of these settlements – on the river terraces, nearby powerful whirlpools. In his monograph about his research conducted at Lepenski Vir (1969), the famous archaeologist Dragoslav

A comparison of the anatomical characteristics of a beluga sturgeon (large, bent mouth and a row of bone plates on the back, a-b) with a sculpture found in the building 57/XLIV at Lepenski Vir. (Sculpture “Danubius”, National Museum in Belgrade, inventory number 2/38; Stuffed Beluga Sturgeon, Jonathan Cardy, 2014; Huso, huso. Jakob Heckel & Rudolf Kner, 1858)



Srejović (Photo 3) stated that the fish (sturgeon, thorn sturgeon, catfish, carp, zander) formed the basis of nutrition, and that the Lepenski Vir fishermen probably used traps in the shallow waters to hunt for fish stranded by the river current and strong whirlpools, near their settlement. It is interesting to note that Srejović's descriptions are unusually reminiscent of those of Alas's, which seem to have served as an inspiration. Moreover, at the time of Srejović's writing, the fish bones from Lepenski Vir have not been thoroughly analyzed to determine the specific species, and it is possible that he got his clues about the fish from reading Alas's books. Archaeologist Ivana Radovanović indeed interpreted some of the sculptures found in Lepenski Vir (with characteristic curved mouths, pronounced gills and a rows of sculpted bone plates on the back) as representations of sturgeons (Figure 4). Subsequent analyzes of fish bones found that, indeed, many were that of sturgeon and related beluga species, which the inhabitants of Lepenski Vir and other Iron Gates Gorge settlements intensively hunted during their spring and autumn migrations from the Black Sea.

When, in 1978, Srejović published a monograph about his research conducted at the Vlasac site, together with Zagorka Letić, Alas's name was mentioned in the Introduction, when discussing the excellent conditions for fishing that the *Gospođin vir* in the gorge provided. It becomes clear that Alas was "present" in archeology from the very beginnings of the research of Iron Gates Gorge, and that his work had already served both as a tool for interpretation and as a medium to present the ancient past more vividly.

The later generations of archeologists who worked on the phenomenon of the Iron Gates Gorge mesolithic and neolithic past, made explicit use and abundant references to Alas's work on fishing. Thus, Dušan Borić noticed incredible coincidence between the best fishing places listed by Alas and locations of archaeological sites. As already mentioned, Alas specifically highlighted fishing in *Gospođin vir* (which corresponds to the sites of Padina, Lepenski Vir and Vlasac), the Kazan section of the gorge (with the sites of Kuina Turkuluj, Klimente and Veterani), near Ogradene (with the Hajdučka Vodenica, Razvrata and Ikoana sites) and Velesnica (with the archaeological site of Velesnica discovered in its vicinity). Inspired by Alas's descriptions of seasonal migration of large sturgeons, this author noted that humans in prehistoric time of the Iron Gates Gorge experienced time

Lazar Trifunović and  
Dragoslav Srejskić  
at Lepenski Vir.  
(National Museum  
in Belgrade. Ownership of  
the Trifunović family).



as a series of cyclical fishing practices, and that autumn as a season had pivotal role in social memory. Dušan Borić and Dragana Antonović relied on Alas's data to reconstruct fishing techniques used in prehistoric times. Thus, rock made hammers found in the archeological the sites in Iron Gates Gorge were interpreted as "fish dazers," while the stone tools with wedges were used as weights for securing fishing nets, similar to the tools Alas described.

Starting with Srejskić, as well as in the work of later researchers, Alas's Đerdap (the Iron Gates Gorge) "was put on the map" in terms of its archaeological past, and inextricably linked to human presence in the mesolithic and early neolith past, in both archaeological community and the general public. In other words, our present perception of Lepenski Vir and other prehistoric settlements has been largely shaped by *The Iron Gates Fishing in the Past and Present*. The past described by Alas encompassed primarily his youth and childhood, as well as the times of the Turkish presence in the region, all the way to the Middle Ages. Seeking to preserve it from oblivion, he certainly did not expect that his records would be used to archaeologically reconstruct and revive such distant past of many thousands of years.

# GRAND TRAVELS

AT THE TIME WHEN THE PLAN OF THIS exhibition was first drawn up, the editor of the exhibition catalogue, Professor Mijajlović, titled this segment GRAND TRAVELS, and, to me at least, that seemed compelling enough. At first sight, nothing appeared to be out of the ordinary or unusual. Mika Alas simply published several books about his travels to the distant parts of the globe, partly as his debt to the progeny, and partly by way of justifying such far and wide travels. Among his Collected Works, Alas's travel books and his novel comprise two thick volumes. Then, in a sudden flash of revelation, I realized that he actually traveled tirelessly and endlessly throughout his life: whether it was the backwaters of the Danube River, where he both fished and made his living, or the world wars, where he either did his best to keep his head on his shoulders, or else occupied an important state office, or if it was Paris where he received his education. Only then did the title "Grand Travels" gain meaning, because, if nothing else, those travels took Mika as far as to the North and South Pole of the globe. Perhaps the adjective "grand" was a bit pretentious, but the journeys were certainly far and long.

Even today it is hardly customary for a person to visit the polar caps above and below, and it definitely was not an ordinary affair back then, almost a hundred years ago. Additional secrecy shrouding Mika's travels – the Serbs are a people with a great love for secrets and conspiracies – comes from the fact that he called these "scientific expeditions."

On the other hand, Mika Alas left us countless letters, memos, and records of his correspondence with friends, relatives, colleagues – whether in the scientific or fishermen circles –



A Lapponian, around 1930.  
(SASA Archive, 14188/13)



The Eskimo shamans, around 1931. (SASA Archive, 14197/3)

state authorities and semi-formal authorities, and God only knows who else. However, these journeys produced thick volumes of travelogues, neatly published at the time, in between the two world wars, and afterward, in late 20<sup>th</sup> century, as his *Collected Works*.

However, not even the best policeman – and most Serbs believe they could do a great job as heads of the State Security, or at least as “lowly” police commissioners – could figure out how he got there. Dragan Trifunović, the most famous among Alas’s biographers, liked to believe that Mika took these travels for scientific, and therefore also, state-important reasons, such as unraveling the secret of the Earth’s magnetic field, or resolving the movement of ice on polar caps in order to “examine the capability of sailing by ship.” Naturally, the question immediately arises as to the role of a country with such limited finances and influence as Serbia – back then, it was called Yugoslavia, and it even was a kingdom – in such an important research that required massive funding and was of no actual use for his country in the first place.

A more “down to earth” conspiracy theory speculates that Mika certainly made many friends, primarily from

studying abroad, in Paris, and they, naturally, in their adult years, were sufficiently wealthy to be able to afford a visit the polar caps, and some of them remembered to also invite their friend, Mihailo Petrović. Such a theory is reasonably supported by the fact that, for example, the first trip to the North Pole set off from Dunkirk. It was a French expedition of six, including Mika, who then joined the Norwegian team, which counted twenty people. For those less familiar with the history of that period, France at that time was still a superpower, yet undefeated by Hitler, while Norway was a massive stain on the map, that no one could be certain whether it was in Sweden or Switzerland. The fact that people in Beijing or New Delhi today think of France as some blurry part of the European Union is of little significance. Back then it was a genuine power.

Perhaps this down to earth conspiracy theory is true, but I would personally prefer it if Mika used those journeys to do some serious preparations for the war that eventually cost Hitler his life. Even if he was not the case, Alas handed down to his progeny a large volume of travelogue books with most diverse commentaries. Should anyone start to think that this is not such a great achievement, they should consider more closely the fact that the Serbs do not seem to be a nation intent on traveling. We even keep a safe distance from the two rivers that have their meeting point in Belgrade, which is why only several rafts and some taverns can be seen on the riverbanks, nothing more, and the capital itself continued to spread into the inland, away from the rivers.

### **The First Travel** (summer 1931)

Northward Ho!

From France to Greenland and almost all the way to the North Pole.

The first expedition heads off from the historically famous Dunkirk, from whence we fell back in 1940, with our tails tucked between our legs. Of course, I use “we” rather conditionally, implying those who take pride in their anti-fascist heritage. The journey itself is well documented, given that Mika demonstrates a degree of diligence, typical of natural scientists and less characteristic of mathematicians. In a way, he also reveals his other nature, consistently inspired by his scientific curiosity about the material world surrounding him. Whenever he set off for a journey, Mika had a picture of him taken, wearing the reserve officer’s uniform, boots and all, with binoculars



The cover page of the book *On the Remote Islands* in which Mihailo Petrović describes the path of the scientific expedition undertaken in the southern polar region, in 1934–1935. (Library of SASA, C7/120/9).



Mapping of the route traveled  
from the French coast  
to Madagascar in 1935.

around his neck. His travels took him on daredevil tracks, even measured by today's standards. Indeed, they went beyond the modern standards, because nowadays, living people would be replaced by drones and satellites, thus avoiding crippling claims by insurance companies.

In his travelogue, used later on as a basis to reconstruct the precise route map of the journey, Mika first provided a short overview of the route. Then he dedicated his attention to the images that made the most significant impression on him. He writes about the icebergs, polar bears, daily tasks of a scientific expedition. With almost the passion of an anthropologist, Mika focuses on the Eskimos, their economy and way of life. Finally, in the third layer of his writing, he provides us with the thorough explanations of the different and varied phenomena studied by the polar expeditions and a detailed overview of the main expeditions hitherto undertaken to the North Pole, which took place less than half a century before the time of writing. This travelogue is a veritable textbook on the geography, demography, and economy of the region that he visited. As an author, Mika resorts to the similar and very pedantic method in his other works. A possible alternative title that comes to mind is the "Arctic Circle Encyclopedia."

It should be emphasized that Mika Alas took the first of his travels quite late in his life, already in his sixties, an age when people back in the epoch, and good many even today, rarely dared to wander far from their hearth and home.

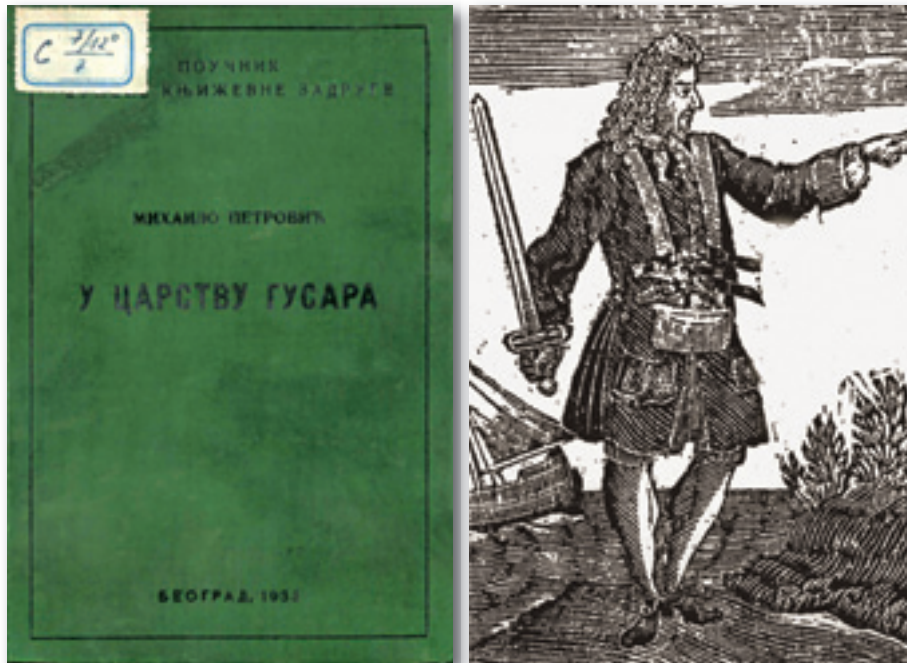
### **The Second Travel** (summer 1932)

Eastward Ho!

Across the Atlantic, to the Sargasso Sea, the Caribbean Islands, Antilles, and Bermuda.

Even in today's literature, this journey would be considered a "pleasure trip." Mika and his friends traveled to the islands of Central America, the Azores, Haiti, and Bermuda. At the same time, being a good travel writer, he felt that he had to offer something to pique the interest of his readers. Beyond his graphic and vivid descriptions, the most interesting detail, which I remember from my childhood, is that marine marauders were divided into regular and irregular kind, namely the state pirates and the ordinary ones. The





In his book *In the Empire of Pirates*, Mihailo Petrović writes about notorious pirates, such as Charles Vane, who plundered the West Indies, the Antilles, Bahamas and Bermuda islands (Library of SASA, C7/120/7)

state pirates – which is how I first read about the famous Sir Francis Drake, who eventually became Vice Admiral and defeated the Spanish Great Armada in their attempt to invade England – had the job of looting the enemy, and fighting a kind of “trade war.” For sure, they resorted to slightly more violent means than those employed today, but the consequences are still very much the same.

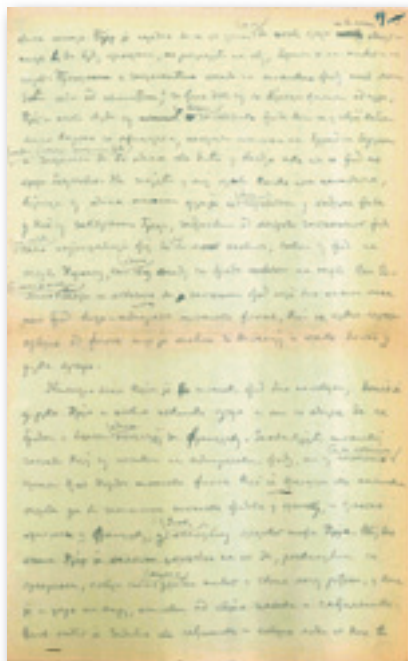
Of course, he uses the opportunity to provide a detailed account of the fishing industry, the economy of the islands of Central America, so much so that he went on to publish two travelogues from this travel.

### **The Third Travel** (summer 1933)

Northwestward Ho!

To Labrador and the Newfoundland.

This route again took him far out into the north. However, it is much warmer here, the land is inhabited by



Manuscript of Mihail Petrović,  
in his own handwriting,  
of the book  
*In the Empire of Pirates*  
(Adligat Society)

people and there is economy, mainly fishing and whaling. Being a passionate fisherman, Mika does not miss on the most important products of the region – codfish. While the description of the “purely” northern route abounded with ice, the freezing cold and dangers, Mika uses much more human colors to paint this one.

#### **The Fourth Travel** (summer 1934)

Southward Ho!

Via the Atlantic route down to the Antarctic.

If you thought that it was warm in the south, and cold in the north, you were mistaken. Truth be told, it depends on how far south you intend to go. A little bit to the south is nice and warm, but all the way down is the South Pole. During his journey to the Horn of Africa, Mika came across the penguins and paid a visit to Saint Helena, the famous island of Napoleon’s banishment in his last days. He had “bad luck” of having missed the island’s turtle which dated back to Napoleon’s time. The creature had lived for two hundred and fifty years and died a year before Mika’s expedition arrived.

#### **The Fifth Travel** (summer 1935)

Westward Ho!

To the Indian Ocean.

Passing through the Suez Canal, the fifth expedition set off for the Indian Ocean. Similar to the rest of them, the expedition mainly kept to the French colonies, nowadays all independent countries. However, they also visited some truly remote islands, which is how the travelogue got its title. Some of those islands could easily be featured today in some of the BBC’s top-notch nature-science programs, captivating audiences worldwide. Again, as if gifted with the instinct of a movie director, Mika focused on both flora and fauna. He seems to understand that Madagascar is *de facto* a small-scale continent, populated by numerous creatures that could be found nowhere else on the Earth. He employs his extraordinary gift to describe exactly what we feel should be described. We can only imagine what Petrović

would have done if instead of his photo camera he had been equipped with modern multimedia devices! He would fit seamlessly into the image of the modern day producer and documentary series maker.

### The Sixth and the Last Travel (summer 1939) Warward Ho!

The intermission between travels lasted four years. We do not know why. Was it fatigue, finances, or the crisis in Europe on the eve of the war? The sixth trip was somewhat shorter. It ended in the Azores, 1,500 kilometers northwest of Portugal. Mika again took it with the French expedition team, with whom he traveled around the world. As this journey took him “on the eel route,” we can reasonably assume that, along with the second journey, it served as the basis and inspiration for *The Eel Novel*. Coming back from this travel, Mika returned to his homeland, the war and his last days.

Travelogues, along with Mika’s other works, have been digitally uploaded and stored in the Virtual Library of the Faculty of Mathematics.

Mika Alas took almost all his grand travels in the first half of the fourth decade of the 20<sup>th</sup> century. Already after returning from the first travel, in 1931, Mika approached his friend



In his book *With the Ocean Fishermen* Mihailo Petrović writes about the endurance, perseverance, and sobriety of the ocean anglers (SASA Archive, 14197/19)



Pavel Popović, President of the Serbian Literary Cooperative, and suggested that his travelogue be published “for the amusement of the Serbian nation.” Pavle himself, a university provost and an academician among other things, did not hesitate and printed the first travelogue in the literary edition of *Matica*, as part of the regular series, in the “Contemporist” library, and thus immortalized Mika in yet another, unexpected way. Thus, along with being a travel writer, Mika Alas became a literary author.



Personal possessions of Mihailo Petrović, his faithful friends on the road: a leather suitcase with initials; his metal cup in a leather casing, with his initials; the mechanically powered dynamo flashlight (“Luzy”); a photo camera (Hutig A:G Dresden, 1908). I. Marković, 2018 (“Mihailo Petrović” Foundation)

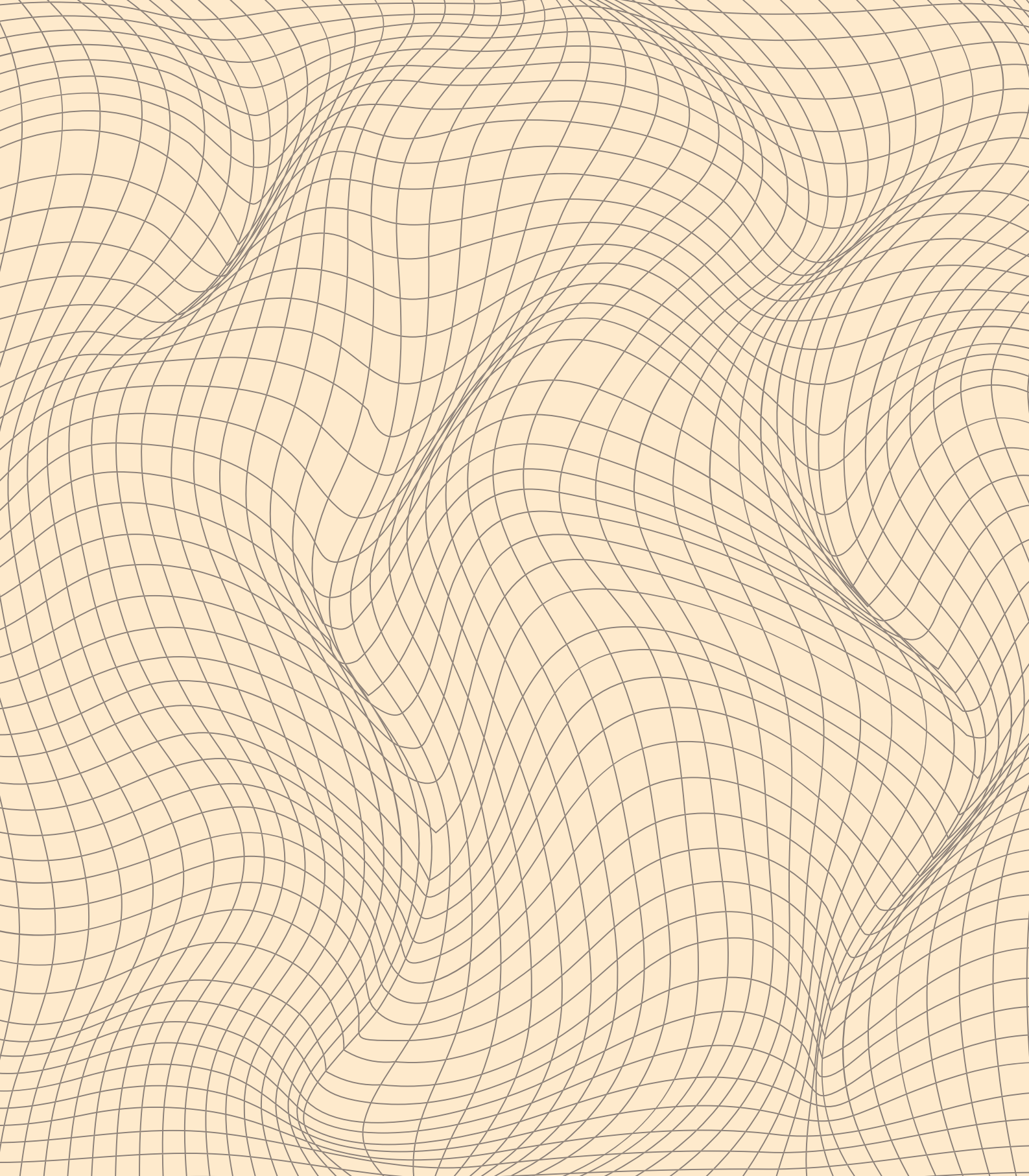


Mihailo Petrović's passport.  
I. Marković, 2018  
("Mihailo Petrović" Foundation)

Their cooperation continued, and the Serbian Literary Co-operative published Mika's five books: *Through the Polar Regions* (1932), *In the Empire of Pirates* (1933), *With the Ocean Fishermen* (1936), *Sailing in the Remote Islands* (1936) and *The Eel Novel* (1940). Except for *The Eel Novel*, all are travel books. The first one describes the first journey, "pirates and fishermen" are from the second, and "remote islands" portray the third journey.

As a descendant of people whose reading culture was developed on Mika's travel books, I read all his travel writings already as a child. My colleague Mihailo Pantić, who contributed to this catalog on the topics of fishing and Petrović's literary work, suggested that Mika's literary activity and works be presented in more in-depth manner. The deadline is too short to complete it for this exhibition, but I certainly think that Pantić is absolutely right and that this requires a separate "project," to use a modern catchphrase.

Milan BOŽIĆ



# MIHAILO PETROVIĆ ALAS'S HYDRO INTEGRATOR

## The Hydro Integrator

THE HYDRO INTEGRATOR MADE BY MIHAILO Petrović Alas is the first analogue computing machine operating according to the principle of capillary flow of fluids. Petrović's work on this machine was announced in 1896 by Professor of Mechanics at the Grand School in Belgrade, Ljubomir Klerić. The first paper on the topic of hydraulic integration Petrović published in 1897 in *Comptes rendus de l'Académie des Sciences de Paris*, and its Serbian translation with additional explanation of certain details appeared in 1898 in *Srpski tehnički list (Serbian Technical Journal)*, the journal of the association of Serbian engineers and architects. He published on this topic again the same year, in the French language, in *American Journal of Mathematics*. A perfected version, which is considered to be the highest development of the hydro integrator, was described in the same *Journal* a year later. The work on the hydro integrator can be considered a result of research which Petrović called materialization of mathematics ensuing from studies of mathematical phenomenology. Mathematical phenomenology was one of several academic disciplines Petrović intensely engaged in. According to Petrović, the central stage in this academic branch is occupied by establishment of analogies between physically often disparate phenomena and their reduction to the same abstract essence, the so-called phenomenological type of fact. By introducing mathematical apparatus, Petrović has shown that certain mathematical problems can be solved in this way.

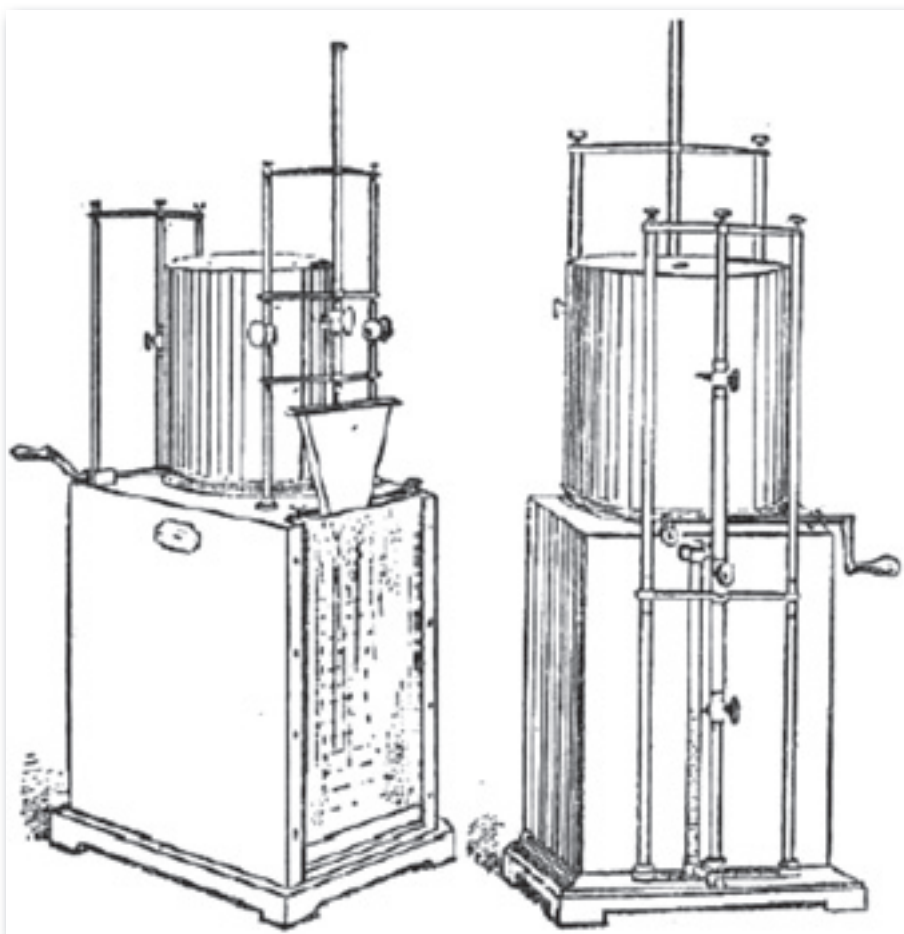


Figure 1  
Petrović's sketch of  
a hydro integrator  
(Digital Legacy  
of Mihailo Petrović Alas)

Materialization of analytical (mathematical) problems for Petrović implied that one should find for a given problem some concrete physical phenomenon for which the same relations and the same laws hold, and which would be then resolved by analysis of the observed, related, problem and phenomenon. From this point of view, the hydro integrator made by Mihailo Petrović was based on an analogy between properties of solution of certain classes of differential equations and behavior of fluids when a body is dipped into a vessel filled with fluid.

Figure 2 shows a 3D model of a hydro integrator. The author of the 3D model shown in Figures 2 and 4 is Petar Vranić of the SASA Mathematical Institute.



## The Hydro Integrator's Construction

The hydro integrator made by Mihailo Petrović consists of two fundamental entities – the *arithmetic device* and the *input-output unit*.

*The arithmetical device* consists of a vessel of a certain shape filled with fluid, body also of a precisely defined shape, and a float.

*The input unit* is made up of a body of a certain shape with or without the rotating cylinder. In the first variant, input data are represented by the function of a body shape. In the second variant, these are the function of a body shape and the function determined by its graph on the input rotating cylinder.



Figure 2  
3D model of the hydro integrator, the author of the 3D model Petar Vranić (Mathematical Institute of SASA, Belgrade)

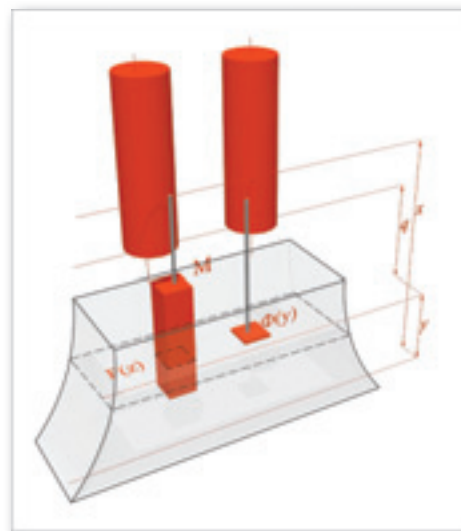


Figure 3  
Illustration of the principle by which the device works, the author of the 3D model Petar Vranić (Mathematical Institute of SASA, Belgrade)



The final version of the integrator uses a clock mechanism with permanent angular velocity in order to harmonize the work of the input and output cylinders which are connected kinematically. This enables that the data on the input cylinder should cross an equal distance in the same time. Owing to that, the device can be considered a combination of a machine of a kinematic and of a hydraulic type which for the developed input mechanism solves one specific differential equation. In Figures 1 and 2, it can be seen that the construction of the hydro integrator enables the vessel with the fluid, and the body being dipped in it, to be added on the exterior side of the device, so that their replacement is simple. Therefore the same device with the choice of the vessel and the body of various shapes can be used for solving several equations.

## The principle of work of the hydro integrator

The principle of work of the hydro integrator is depicted in Figure 4 and is based on the following consideration.

What determines the alteration of the level of the fluid in vessel  $B$  due to the dipping of a body  $M$  in it is the shape of both body  $M$  and the vessel  $B$ . If  $\phi(y)$  and  $F(z)$  of the surfaces of the horizontal intersection in the same plane of vessel  $B$  and body  $M$ , then the factor  $x$  related to the position of the body when being dipped changes into  $x - dx$ , while the level of fluid rises from  $y$  to  $y + dy$ , which makes volume of fluids which had shifted from  $y$  to  $y + dy$  equal  $(\phi(y) - F(z))dy$ . Given that the volume of the fluid squeezed out is equal to the volume of fluid which is occupied by the body  $M$  dipped for the factor of  $z$ , that is,  $F(z)dz$ , consequently we have

$$(\phi(y) - F(z))dy = F(z)dz,$$

or expressed differently, when the relation  $z = x - y$  holds, then

$$\frac{dy}{dx} = \frac{F(x - y)}{\phi(y)}.$$

By choice of various intersections of the body  $M$  and the vessel  $B$ , the hydro integrator can be used for solving a broader class of differential equations. As Petrović had said, each manner of realization of the hydro integrator corresponds to entire classes of the first-order differential equations that can be integrated with it, and the entire classes of curves that can be continually constructed.

From the point of view of contemporary computers, the pair (*body, vessel*) corresponds to sub-programs the choice of which can perform integrating of the broader class of equations. By choosing the input data, one obtains a list or a library of equations that can be solved in this way. The hydro integrator, the way it was initially proposed by Mihailo Petrović, could solve two classes of differential equations.

$$P(x, y)dx + Q(x, y)dy.$$

Петровић наводи да би исти уређај могао Petrović stated the same device could solve both classes of equations by changing the vessel and the shape of the body being dipped by applying several vessels and integral cylinders, which was the reason for the construction that is shown on Figure 1 with the aim to enable the simple replacement of the vessel and the body as the basic elements of the arithmetic unit of the device.

$$\frac{dy}{dx} = X(t) - \lambda^2 y^2,$$

The class (1) contains the Riccati's equation as well as some other types of equations.

Let us be reminded that for example, Jacob's integrator could solve only the first-order Riccati's equation, so the advantages of the solution proposed by Petrović can clearly be seen.

## The scientific-academic promotion of the hydro integrator

The hydro integrator made by Mihailo Petrović was shown at the World Exhibition in Paris in 1900 in the Pavilion of Serbia, designed by architect Milan Kapetanović, a professor of descriptive geometry at the Technical Faculty of the Belgrade's Grand School. At this exhibition the hydro integrator made by Mihailo Petrović was awarded by the gold medal. The device was constructed by a French specialist in precise mechanisms whose name has not been recorded, although the information about the contracting of a craftsman is contained in the letter which Mihailo Petrović had sent to the Minister of National Economy, in which he pleaded financial support for the construction of the device, equaling one thousand and five hundred dinars at the time.

The device exhibited at the World Exhibition had full functionality and its operation was shown to the visitors of the exhibition. It is considered to be the most fully executed example of the hydro integrator ever built. The reconstruction of the device was done by Professor Dragan Trifunović in 1980, and its physical realization was carried out with the assistance of the architect Gradimir Bosnić. This reconstruction is situated in the Mathematical Office of the Faculty of Forestry in Belgrade. Considering that during the World Exhibition in Paris the International Congress of Mathematicians was being held in Paris from August 6 to August 12, 1900, the participants could inform themselves about this way of solving differential equations, and be assured about the records of its success and accuracy. This was concurrently the first congress of mathematicians in the work of which Mihailo Petrović took part.

## The contribution of Mihailo Petrović

The original contribution of Petrović to world science in the field of devices for solving analytical problems is the hydro-dynamic model for solving various classes of differential equations, which was already the topic of his first description of a hydro integrator in the *Serbian Technical Journal-Srpski tehnički list* in 1898. Subsequently, special contribution is made by the application of elements of calculation regarding the shape of the body dipped into water. Furthermore, it is important to mention also the combination of the hydraulic principle and the kinematic connection in the final version of the hydro integrator.

Petrović also talks about the connection between analytical facts associated with line integrals and geometrical facts from the theory of minimal surface with capillary action. The idea is that a hydro integrator can consist of several vessels in the arithmetic device that would be equipped with capillary tubes. Such a solution was later used in the hydro integrator from 1936 proposed by Lukyanov, for solving Fourier's partial differential equation in accordance with the principle of analogy between thermal conductivity and the model of circulation of fluid in capillary tubes.

The work on the hydro integrator is among the most-often cited mathematical accomplishments of Mihailo Petrović. It is considered to be the first device for solving differential equations in accordance with hydraulic principles, and to facilitate solving a broader class of equations. In addition to the gold medal awarded in Paris, this invention was honored with other international awards. Petrović was thus in 1907 awarded with the honorary diploma of the London Mathematical Society.

*Radomir S. STANKOVIĆ*

# PATENTS

Not only do true poetry and true science have common points, but they also display deep common properties. One such property, so much so that it is sometimes difficult to tell where science stops and where poetry begins, consists in *revealing and utilizing similarities among disparate elements and facts*.

Mihailo Petrović, 1925.

VIEWED FROM THIS TEMPORAL PERSPECTIVE, we can claim that progress in Serbia, not only in mathematical sciences, but also in other natural and social, as well as technical sciences, was given a new impetus by various works by Mihailo Petrović in various areas of science and engineering. Most writings on Petrović stress his work as a mathematician, while these other aspects of his life and work are somewhat neglected in historical records. We may assume that Petrović began to be interested in the practical side of science in the period 1889–1894, when he resided in Paris where he acquired profound knowledge not only of mathematics, but also of other sciences, particularly physics. At the Sorbonne, as an excellent student, he earned degrees in mathematics and physics and a doctoral degree in mathematical sciences under the supervision of illustrious mathematicians: Poincaré, Hermite, Painlevé, Picard, Appel and others. He returned to Belgrade in 1894 and soon began to display his rich talent in a broad range of academic results and practical discoveries, inventions and patents. In his practical work, Petrović was, as he had himself stressed on several occasions, inspired by his important work in natural philosophy – *mathematical phenomenology*. In that regard, every invention and patent was for him an example of a *materialized idea*.

## Patented and executed models and devices of Mihailo Petrović

Mihailo Petrović has often stressed the phrase *materialization of differential equations*. The engineers love this term, because if an idea exists that can make a difference in science, it can raise real living standards only if it is realized into a concrete device, mechanism or machine. Mihailo Petrović was a theoretician and a scientist, but also an experimenter who knew how to apply his mathematical knowledge to such a degree that it was ready to be handed over to engineers for realization. Some examples of such practically oriented discussions and realized ideas are: his work on *mathematical modelling and analogue calculating machines*, on the *hydraulic integrator – hydro integrator* and on the *depth measurer* made specifically for the Military-Technical Institute in Kragujevac. Here we will present several inventions and patents which have had interesting and important applications. Each of these inventions and devices testify to the high level of Petrović's creativity and capability to transform abstract ideas and drafts into very useful devices and inventions.

From the bibliography of works as well as archive documents of the Institute for Patents in France and United Kingdom, we can establish that Mihailo Petrović had patented ten inventions. For nine he was granted a patent in France and for one in Great Britain.



RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

## BREVET D'INVENTION.

XII. — Instruments de précision, électricité.

3. — Pous et bascu, instruments de mesure, comparés N° 413.730  
et modifié d'après.

Télégraphe à sextant.

Mons. PETROVITCH et Micasa TERZITCH résidant en Serbie.

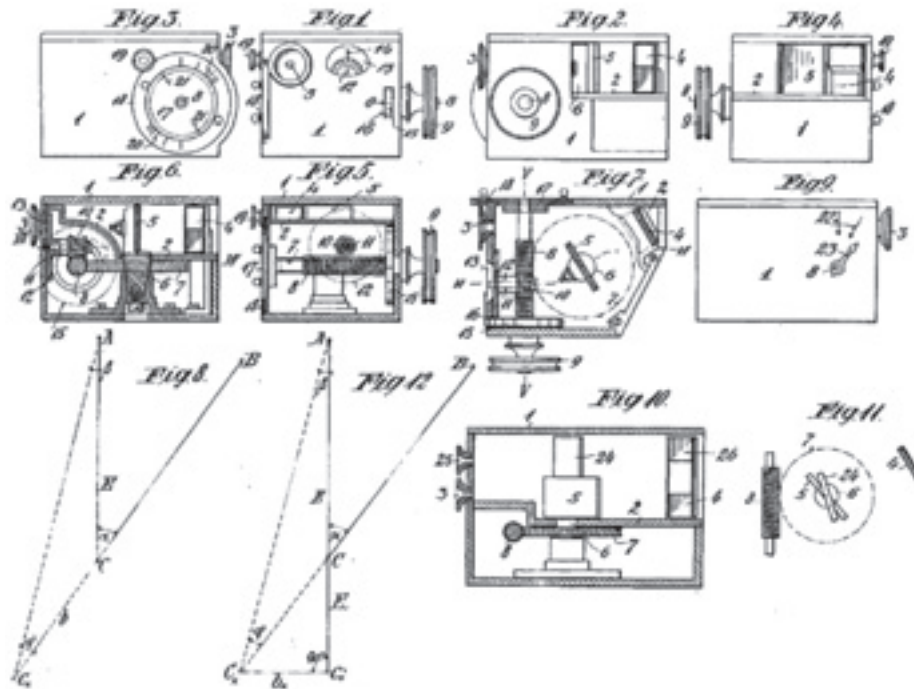
Demandé le 11 février 1910.

Delivré le 2 juin 1910. — Publié le 17 août 1910.

N° 413.730

MR. Petrovitch et Terzitch

Pl. unique



A sketch of the part of the mechanism  
of the **depth measurer** – patent no. 413.730  
(Espacenet European Patent Office, FR413730 A)

The first patent is the *depth measurer*, constructed specifically for the Military-Technical Institute in Kragujevac. This device was constructed together with the General of the Serbian Army Milorad Terzić. The patent was bought and executed in Serbia and Russia (Paris 1910; No. 413730). The application for this patent Petrović had submitted to the French Institute for Patents on

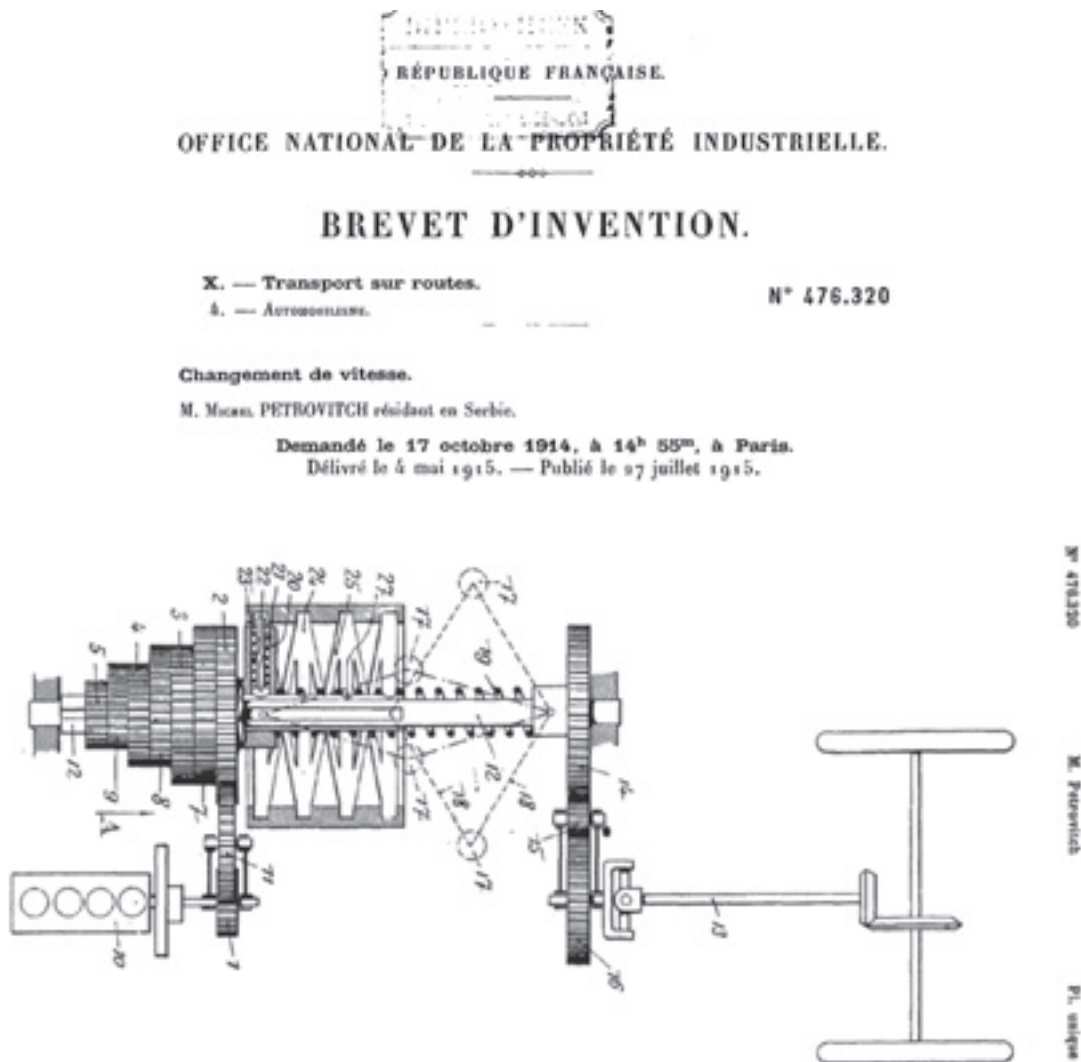


The depth measurer of the land artillery

February 11, 1910, and the patent no. 413.730 was granted to him on August 17, the same year.

The next invention is *the construction of the cogwheel transmitter* (Paris-1913; No. 463082) which, according to Dr. D. Trifunović, is a precursor of automatic gears of cars and enables that transmission of the number of revolutions per minute should remain constant. He registered this patent together with Svetolik Popović,

a machine nautical engineer of the Serbian Nautical Society. The registration for the patent was submitted to the French Institute for Patents on September 29, 1913, and patent No. 463.082 was issued to him on February 13, the following year.



The sketch of a **automobile gear** – patent no. 476.320  
(Espacenet European Patent Office, FR476320 A)

Petrović's *Eternal Calender* was registered as an original authorial contribution into his bibliography and was made official as a patent under the number 480.788, issued on September 21, 1916 by the French Institute for Patents on the basis of the documentation and application submitted on January 27, 1916.

The following invention by Petrović also belongs to this group of cogwheel transmitters of the number of revolutions per minute. It was patented under the name *automobile gear* under the patent number 476.320 on the basis of application of October 17, 1914 and the patent was granted on June 27, the following year, in 1915.

To these patents one should also add the model of *the efficient avoidance of a mine field* (Mémoire No. 120, 1920). Also in France, Petrović protected with a patent his device entitled *The Means for Assuring Buoyancy of Ships following Damage Made by Crash, Mine, Torpedo or Stranding*. This device consists of a large number of bodies in the form of a baloon with appropriate sources of gases under pressure for inflation, that can be handled manually, remotely or automatically with the help of an appropriate electromagnetic device. The inflation of the component parts of this device results in prevention or slowing down of sinking of a floating vessel (a boat). The application for a patent for this device Petrović submitted to the French Institute for Patents on November 24, 1917 and patent number 515.072 was issued to him only on March 24, 1921. This patent he also protected in Great Britain in 1918 under the number 121.279.

The last patented invention we find recorded in Petrović's bibliography represents a model of *the motor with a piston of alternating impact*, the main spindle of which was made with the coil for the transmission of the movement of the piston. Petrović made an application for patenting this model of the motor on February 15, 1918 and the patent number 495.040 was granted the following year on September 26.

RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ

BREVET D'INVENTION.



V. — Machines.  
8. — Moteurs divers.

N° 495.040

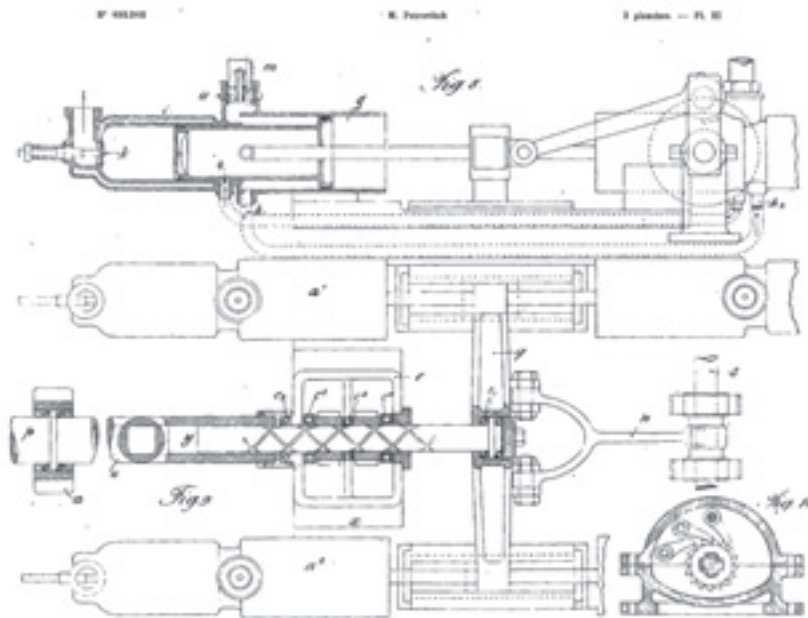
Moteur.

M. MICHAËL PETROVITCH résidant en Serbie.

Demandé le 15 février 1918, à 15<sup>h</sup> 56<sup>m</sup>, à Paris.

Déposé le 15 juin 1919. — Publié le 26 septembre 1919.

[Brevet d'invention dont la délivrance a été ajournée en exécution de l'art. 11 § 7 de la loi du 5 juillet 1844 modifiée par la loi du 7 avril 1902.]



The sketch of a model of a motor with the piston of alternating impact,  
patent no. 495.040  
(Espacenet European Patent Office, FR495040 A)

In addition to the technical devices protected by a patent, Mihailo Petrović is also an author of a series of inventions for which there is no record that they had been protected by a patent. One of those devices is the hydraulic integrator, about which there is a separate article of this Catalogue. Here we will describe several other devices, on the basis of information from the original feasibility study and information available in electronic form.

*The depth measurer* is Petrović's invention intended for measuring depth at which a body partially (for example, a boat) or fully dipped (for example, a submarine) into the water. In literature, we can find an information that this patent cites number 96371 from 1918, as well as that "*English Admiralty has issued a positive opinion about it.*" According to some sources, Petrović received an invitation of British admirals regarding this invention, but there are no written documents about it. It is possible that the number mentioned with this invention represents a number of the submitted application to the French Institute for Industrial Property (Institut national de la propriété Industrielle) or some other patent institution.

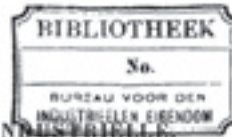
The device for *rapid launching and rapid determination of fire* was an invention by Petrović important for military use. The application for this invention Petrović submitted on December 7, 1917 to the French Institute for Patents and the French patent number 493.774 was granted to him on August 21, 1919.

The *device for ejecting and launching a missile* is Petrović's second invention of a similar kind. It was intended for the use both in water and in air, as well as on the ground and in the sea. It was protected with the French patent number 503.321 on the basis of the application submitted on February 22, 1918 and granted two years later, on June 8, 1920.

RÉPUBLIQUE FRANÇAISE.

OFFICE NATIONAL DE LA PROPRIÉTÉ INDUSTRIELLE.

**BREVET D'INVENTION.**



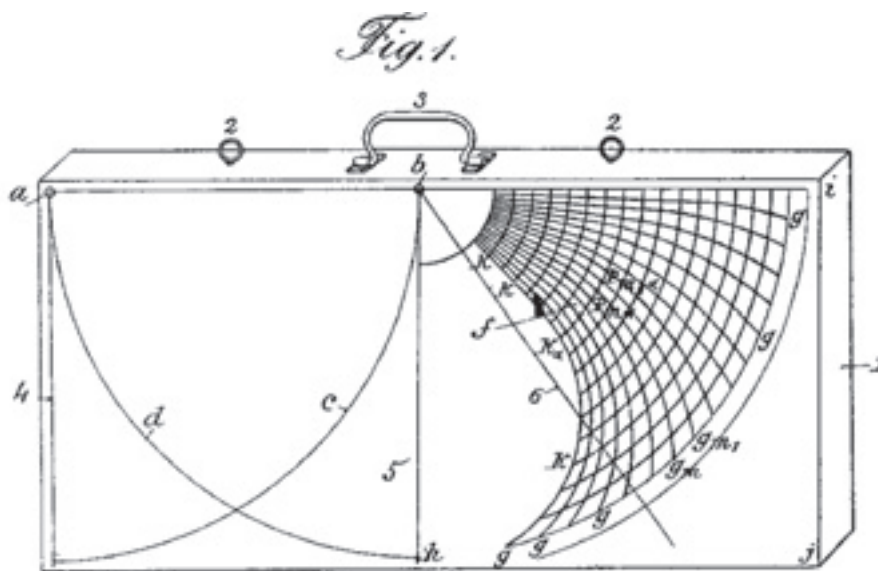
XI. — Arquebuserie et artillerie.  
2. — Canon.

N° 493.774

Appareil pour la détermination rapide des éléments de tir sur aéronefs.

M. MIHAÏL PETROVITCH résidant en Serbie.

Demandé le 7 décembre 1917, à 15<sup>h</sup> 10<sup>m</sup>, à Paris.  
Délivré le 13 mai 1919. — Publié le 21 août 1919.



The device for quick launching and quick determination  
of elements of fire,  
patent no. 493.774  
(Espacenet European Patent Office, FR495040 A)

The table of patented inventions of Mihailo Petrović

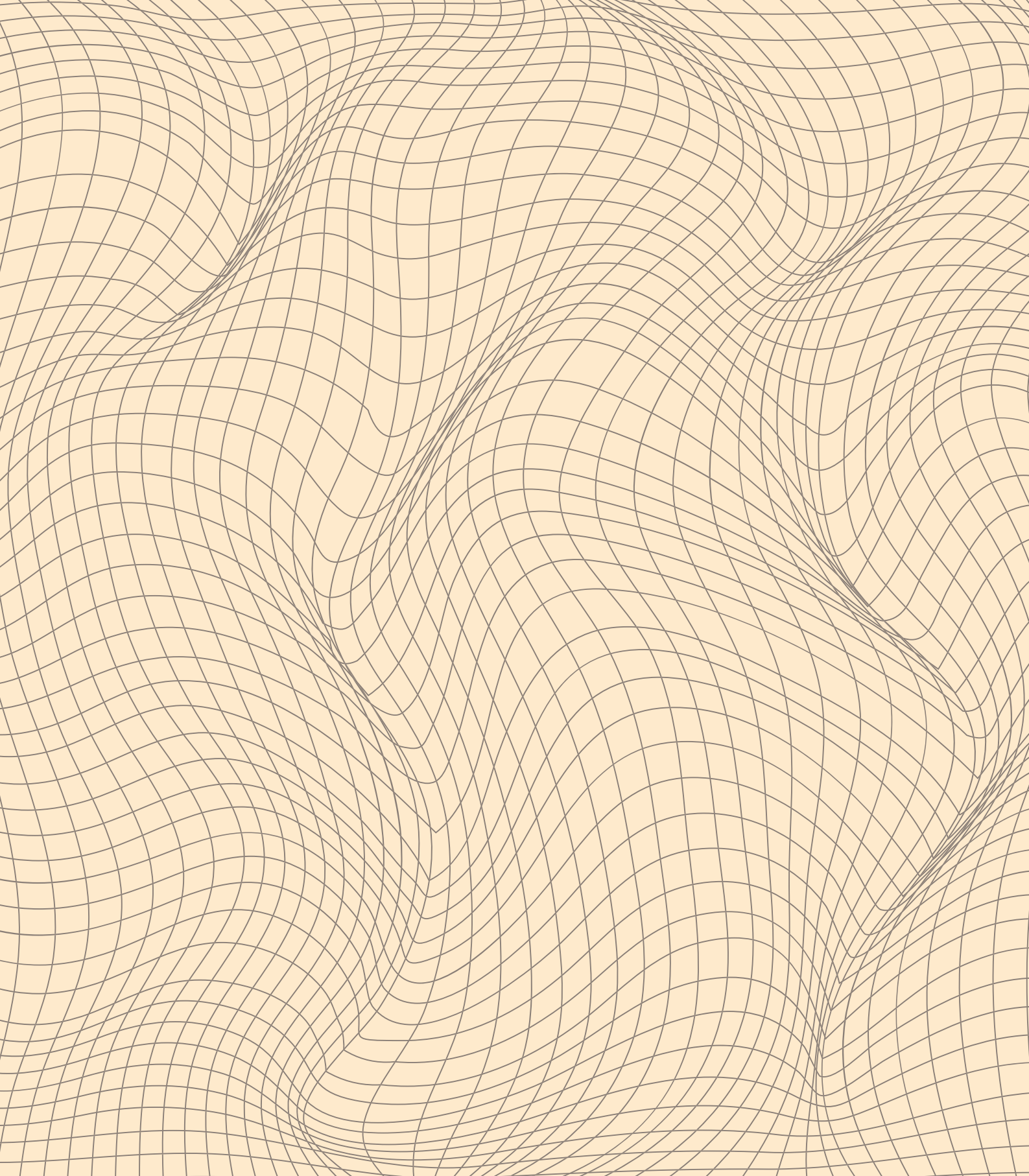
	Patent number	Original title of the patent	Translation of the title of the patent	Date of submission of the application	Date of granting of patent	Co-applicant of the patent application
1	FR 1413.730	Télémetre a sextant	Depth measurer	11.2.1910.	17.8.1910.	Terzić Milorad
2	FR 447.861	Changement de vitesse avec pignons étagés recordés par des engrenages en hélice conique	Multiple compression ration cogwheel transmitter with bending conical cogwheels	31.8.1912.	17.1.1919.	Popović Svetolik
3	FR 463.082	Changement de vitess	Construction of the cogwheel transmitter	29.9.1913.	13.2.1914.	
4	FR 476.320	Changement de vitess	Car gear	17.10.1914.	27.7.1915.	
5	FR 480.788	Cadran calendrier pour objets d'horlogerie, de bijouterie et autres	Eternal calendar	27.1.1916.	21.9.1916.	
6	FR 515.072	Dispositif pour assurer la flottabilité des navires en danger	The Means for Assuring Buoyoncy of Ships following Damage Made by Crash, Mine, Torpedo or Stranding	24.11.1917.	24.3.1921.	
7	FR 493.774	Appareil pour la détermination rapide des elements de tir sur aéronefs	Device for fast launching and fast determination of fire	7.12.1917.	21.8.1919.	
8	FR 495.040	Moteut	Motor with a piston of alternating impact	15.2.1918.	26.9.1919.	
9	FR 503.321	Appareil imprimant un mouvement rapide aux bombes, mines aériennes et torpilles aériennes lancées par un canin lisse	Device for ejecting and launching missiles	22.2.1918.	8.6.1920.	
10	GB 121.279	Means for Assuring the Buoyancy of Ships	Means for Assuring Buoyoncy of Ships following Damage Made by Crash, Mine, Torpedo or Stranding.	23.19.1918.		

**FR** and **GB** represent two-letter designations for France and Great Britain in accordance with the appropriate standard of the **World Intellectual Property Organization, WIPO**.



Having done a researching of patents registered by Petrović, Snežana Šarboh, M.Phil, searched available patent databases. Particularly useful in that regard were the database of the European Patent Office (ESPACENET) and the German Patent and Trade Mark Office. Dr. Ivana Atanasovska continued the search of the patent database of the European Patent Office ESPACENET and has found patent documentation for all ten patents by Petrović. The confirm a total of 10 (ten) granted patents of Petrović and on the basis of that, the above table has been made. Nine patents were registered in France and one in Great Britain. However, we cannot in all certainty claim that it is the final number of patented inventions by Mihailo Petrović.

*Katica R. (STEVANOVIĆ) HEDRIH*



# MIHAILO PETROVIĆ ALAS – CHIEF OF STAFF OF STATE CRYPTOGRAPHY BETWEEN THE TWO WORLD WARS

HISTORY RECOGNIZES EVIDENCE OF THE work of Mihailo Petrović Alas made in the field of cryptography, used for state intelligence purposes between the two World Wars, and that evidence will gain even greater future prominence due to the increasing importance of the area in which he left it. About Petrović's work and results in the field of ciphers there are no public records, which is not surprising, given that even academic results concerning codes between the two World Wars were considered military and state secrets. Documents available to us, and which originate from the Chief of Staff prior to the Second World War, show that M. Petrović made significant achievements in the design and analysis of coding systems, taking into account the totality of knowledge available at the time, as well as in the education of agents working in the fields of coding for state intelligence.

## Cryptography and coding

Cryptography has developed for more than two millennia as a skill which enables protection of secrecy of contents (information), and is today one of the basic approaches for ensuring security and privacy in the digital space. Over centuries, a great number of methods for achieving cryptographic protection or coding have been developed. Figure 1 shows a copy of a document from the time of Mihailo Petrović which “explains cryptography and coding.” Until the 1950s, coding was based on a combination of skill and mathematical methods. From the mid twentieth century onward, establishment and intensive development of cryptography began as a mathematically oriented academic discipline, providing a basis for ensuring security and privacy in the digital space where cryptography and coding are key elements.

Contemporary cryptography is built on modern knowledge, technology, and procedures, compared to which the stock of knowledge, and methods of ciphering, in the 1930s is more than modest, and therefore could not be the foundation for designs that could have long-term use and a high degree of security. Petrović was aware of this already: he indicates such in an introduction to ciphering (see the last sentence of the text on Figure 1 which indicates that all techniques of ciphering used in the First World War were shown to have been unreliable). Therefore we hold that it is necessary to frequently change the methods of ciphering used in the field.

## У В О Д

Изуз тајне преписке није никаква новина. Криптографија води своје порекло још из праистарог времена само с том разликом, што су ондашњи методи, системи и начини употребе, били сасвим другојачији него ли данас.

У колико се човек-култура постепено развијала и усавршавала, у толико су се и начини, методи, системи и системи тајног преписивања мењали, односно усавршавали тако, да данас имамо неограничен број најмодернијих начина тајног преписивања.

Суштина тајне преписке види се из самога њенога назива. Другим речима, ако две особе хоће и желе једно другом нешто да јаве, саопште или поруче, а да то остане тајна за сваког другог, они ће међусобно морати утврдити и начин којим ће се послужити, те да то остане апсолутна тајна за остале.

Жела, а врло често и прека потреба трећег лица да у туђу тајну по сваку цену продре, натераће га да употреби сва могућа и немогућа средства, док у овом на било који начин не успе, о чему ће бити говора довије.

Природно је, да је свака тајна престала бити таква, чим се за њу сазна. С тога ће она чија је тајност преписке откривена, одмах тражити други нови начин тајне преписке, ако већ ове у резерви немају.

Криптографија или тајно писање, постало је од грчке речи криптос (κρυπτος) што значи сакрива, и графи (γραφω) што значи писати.

Криптографија или тајна преписка по својој суштини и намењеној јој задатку и улози коју има, врло је осетљива и јако деликатна.

Осетљива због тога, што прецизност у раду мора бити апсолутно потпуно загарантована, а деликатна због тога, што је сама садржина онога, што се њоме преноси најповољније природе, чије откривање у већини случајева може да има тежких и кобних последица. Организација, раду и тајности ове преписке, мора се посветити прва и највећа брига.

Тајном преписком служе се редовно војне установе како за време мира, тако и у толико пре за време рата.

Дипломатски претставници свакодневно морају јављати својим владама нарочито важне и поверљиве ствари, за које су сазнали у државима у којима су акредитовани, што редовно чине тајним писмом — шифром.

Најзад, тајним писмом или тајним разговорима највише се служе разни злочинци, нарочито политички. Ово се најбоље може запазити по казеним заводима.

Свака од напред побројаних има свој начин, свој систем, свој метод тајног договарања.

У случају да тајна преписка дође у руке ненадлежног лица, зашто се он истом не може користити?

Зато — што није посвећен у тајну преписке.

У чему се састоји та тајна?

У уговореном кључу између две стране, и све дотле, док се не дође до кључа, тајну преписку је врло тешко, али не и немогуће одломити.

Међутим, мало је ко успео да за дуже време потпуно очува тајну своје шифре.

Поуздано се зна, да за време последњег светског рата ни један метод, начин или систем тајне преписке, није се могао дуже времена употребљавати,

Figure 1  
Explanation of cryptography  
and ciphering in a General  
Staff document from the  
1930s (Adligat Society)

## Cryptography in the Chief of Staff Head Office

Petrović's achievements in the field of cryptography and ciphering are documented in 15 volumes of the Department for Ciphering of the Intelligence Service of the General Staff Head Office of the Kingdom of Yugoslavia, under the title "Cryptography – school for training in ciphering" as well as in 24 volumes entitled "The System" (of coding). In these documents, it was recorded that Petrović's work and results of that work are to be found in: (a) ciphering methods; (b) methods for "cracking" codes and (c) training in ciphering techniques and cracking of messages that had been coded. Among the volumes of the series "Cryptography – school for training in ciphering" the following has been emphasized as particularly interesting:

Figure 2

Covers of a document on cryptography (ciphering) showing a high level of this field at the time when Mihailo Petrović lived



Volume no. 1  
(on ciphering using the replacement  
method or analysis of these ciphers) –  
as an illustration, see text in Figure 3;



Volume no. 12:  
“Coding and decoding methods  
using special devices” –  
as an illustration see text in figure 4;



Volume no. 14:  
“Introduction into Coding Methods using a Codebook –  
A Dictionary for Secret Correspondence” –  
as an illustration see text in Figure 5.

— 7 —

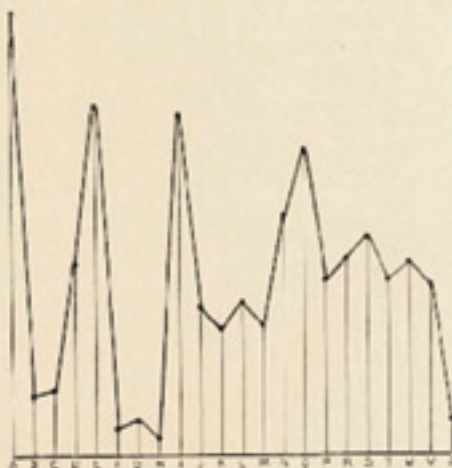
Пажљивим разгледањем овог графика латиницом, можемо добити до закључка, да се наша латиница може да састоје од 30 на 22 слова, када извештајно двојна слова и најчешћа слова које имају су: **С, Ћ, З, В, Лј, Њ, Ш, Дј**.

Та слова се провучено, специјално у телеграфском општењу и не јављају. Она се изражавају својим основним словима. Због тога ми би и нашој учесталост придати њиховим основним словима, добићемо нову фреквенцију, која у дешифровању неће бити у никаквој мери да крене светоме.

Ако би сад ову нову фреквенцију латиницом изражали графички, добили би графикам упростиљене фреквенције:

### III ГРАФИКОН

упростиљен латиницом на 1000 слова



У досадашњих изазивања извести сви закони о фреквенцији и утврђивање графика фреквенције, које служи дешифреру као помоћно средство при откривању шифара шифрованих различитим врстама шифра. Међутим, дешифрер ће врло често увидети, да сви његови изгледи на том пољу не дају само никакве резултате, већ ће бити у недоумици, у чему је ствар.

У криптографији не постоје непроменљиви закони, управо постоје такви закони, само што они нису увек применљиви услед честог недостатка довољних примерака за дешифровање.

Зато сва од дешифрера приликом дешифровања мора да се у складној мери на:

1. — Закон фреквенције, закона богиња и фонетичне особине језика на коме се ради, и

2. — На претпоставки, могућности надокнаде општем принципима логике.

#### Фреквенција почетних слова речи

Врло фреквентна слова су: П, С и Д.

Фреквентна: И, И, Ј, О, К, Т, У, М, З, В и Б.

#### Фреквенција последњих слова речи

Фреквентна: М, Х, Ј, Г, И и Т.

Ретки: К, Д, Р, В, С, Ш и Ђ.

Напомена: овде нису показане фреквенције самогласника, јоште се у нашем језику 30% речи завршава на самогласнике, од којих су најфреквентнија А и Е, а после њих долазе И, У и О.

Figure 3  
Excerpt from Volume 1  
illustrating knowledge  
on the possibilities of cracking  
codes through replacement  
on the basis of a technique of  
frequency of the cipher symbols  
(Adligat Society)



## М Е Т О Д

### ШИФРОВАЊА И ДЕШИФРОВАЊА ПОМОЋУ НАРОЧИТИХ СПРАВА

#### А) Рад реглетом:

У овој схеми употребљено се са једним специјалним начелом шифровања — познатим Сен Сирским (Sain Sire) методом, који у суштини не представља ништа друго, до механичку прилику Вигенеровог метода на једном специјалном начину.

Дакле, и овде ће се радити са словеним знаковом.

Реглет је који је реч у својој најобичнијој конструкцији изгледа тако, да у себи садржи два покретна нормална или испретурна постављена алфавета на једној димензији, горе и доле, или само горе или доле, а кроз средину ове димензије покретан ленарић, на коме се такође налази истиском нормалан или испретурни алфабет.

Алфавети на непокретној димензији морају бити дупли, а тако исто и на покретној ленарићу.

Одмах да напоменемо, да испретурни алфабет знатно јаче комбинујеју шифру, но они поређани нормалним редом, што је усталом и сасвим поједнако.

Узмемо да имамо једну такву реглету са дуплим алфабетом нормалним редом написаним. У том случају кад се слово „А“ покретног ленарића постави према слову „Л“ непокретног димензије, онда ће се и сва друга слова међусобно поставити. Ако пак слово „А“ ленарића поставимо према слову „Б“ димензије, онда ће се и сва остала слова ленарића померити за једно место у десно, на ћемо имати да слово „Б“ ленарића буде према слову „В“ димензије, слово „В“ ленарића према слову „Г“ димензије итд.

У вези са овом помераче буде веће, у толико ће се и међусобни односи слова покретног ленарића и димензије све више и више менјати. Комбинација промена места може бити оваква, каоко и ангажованих слова има, тј. биће их за алфабет од 22 слова: 22 × 22 комбинације, за алфабет од 30 слова: 30 × 30 комбинација итд.

Тако један ленарић са дуплим алфабетом и са нормално поређаним словима и нормалном покретношћу изгледаће, као што се то види из слике бр. 1.

Слика бр. 1

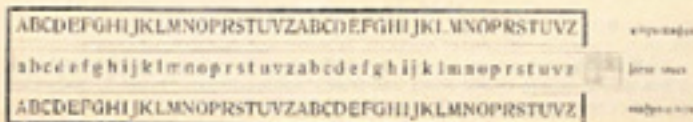


Figure 4  
Excerpt from Volume 12  
illustrating that certain  
devices were using  
for ciphering  
(Adligat Society)

## УВОД У МЕТОДЕ ШИФРОВАЊА ПОМОЋУ КОДЕКСА — РЕЧНИКА ЗА ТАЈНУ КОРЕСПОНДЕНЦИЈУ.

### 1. — Општи појмови

У овој свесци изнећемо једну од најинтереснијих и најразвијенијих начина шифровања, из којих која се дотиче пренио и на састављање сложних коdexа — речника за тајну кореспонденцију.

Тај начин шифровања састоји се у следећем:

Установљена се једна стално одређена листа или таблица, што је у суштини једна кста, у којој су алфаветним поретком узета слова, слогови, одвојени речи, целе речи и изрази који су важни у употреби једног језика.

У другој правили исто ове листе или таблице, саставља се кста специјално од повољних листића, у којој су такође алфаветним поретком узимани појединачна слова, безгради, тригради, слогови, изрази, предлози, слови или веће одломци на и целе речи.

Свако слово, реч или јасног текста шифрује се обично групом од по 2—5 слова, или групом од 2—5 цифара.

Сам начин шифровања састоји се у томе, што се извесни елементи јасног текста пролазе у овој листи, таблари или специјалу, па добија се исти нају, замењују се у шифру одговарајућим шифром — двоцифреним бројем.

И ако је прилично за овај начин шифровања исти, ипак има некадашње начине шифровања овим методом.

Ми ћемо се претходно усредити и овде јавити најједноставнији и највероватнији начин, то јест помоћу таблице у којој су слова, слогови, одвојени речи, итд. која се имену пореданим редом алфавета у таблицу, претстављени двоцифреним бројевима који означавају шифру за свако од њих.

Када се извесни шифровање целог јасног текста, тада се добија шифра дати на шифарској групи тако, да у сваком групи буде четара шифре, па се јасни текст шифре отарача коме је намењена.

Напомена једног примера:

Листа или таблица за шифровање произвољно узета изгледала би овако: (види слику бр. 1, на страни 4.)

Ако сада доведемо неки јасни текст да шифрујемо по овој таблери, поступилићемо на следећи начин:

Прву реч јасног текста уводимо у таблицу. Ако исту нађемо, ону записујемо њеним одговарајућим бројем и то, прво узимамо број вертикалног, а затим хоризонталног реда и на овој начин добијемо двоцифрени број добијемо шифру за прву реч јасног текста. Ако се пак desi, да прву реч јасног текста у таблери некамо, тада ћемо исту саставити помоћу осталих слова и слогова из исте таблице, из овоко узето слово или слог ове рети, записујемо њему одговарајућим двоцифреним бројем. Када смо на овој начин извршили шифровање прве рети јасног текста, прелазимо на шифровање друге рети на исти начин и тако редом до краја. Када смо са овим извршили, добијемо шифру деловно на шифарској групи од по четри шифре у сваком групи, а томе смо и исаво на шифарској дарили.

Figure 5  
Illustration of a coding  
technique at the time of  
Mihailo Petrović which was  
used in its advanced form  
in Yugoslavia even after  
World War II  
(Adligat Society)

# MIHAILO PETROVIĆ ALAS AND MUSIC

THE LIFE OF MIHAILO PETROVIĆ ALAS was rich not only scientifically but also socially speaking. Among other things, including the fishing, he was known as a lead violinist, a lover of the urban folk music of his epoch and he actively played with his own music band, *Suz*.

As a student of the First Belgrade Gymnasium, in 1880 he started teaching himself to play the instrument. However, Jelenko Mihailović wrote that Petrović was taught by a tavern violin player, one Arsa Jovanović “Škembonja,” whom he later honored by paying him twenty-five dinar every month and sometimes passing on to him a used suit, or a pair of footwear. Many years of music making, which continued during his stay in the Paris boarding school for his university studies, led to the need to establish “music playing society” in 1893 (in the middle of the grape harvest season). In January 1896 this society gave birth to a bigger orchestra, called *Suz*, which counted one dozen men and included several violins and basprims [*traditional string instrument of the tamburitza family*], cellos, a double bass and possibly some other instruments. Once they founded said music society, Primaš Petrović insisted on solid music-making technique and the *sevdah* approach to music, but also on preserving honest reputation of the orchestra, as evidenced by the memories of Mladen Đuričić and



Members of the Musical Society  
"SUZ" celebrating their patron  
saint day, St. Apostle Philemon,  
which occurs on December 5  
(SASA Archive, 14188/6)

Mihailović. Joint rehearsals were held at homes of individual members. Soon after they started playing, the band adopted St. Apostle Philemon as their patron saint day, which they tended to celebrate for two days (including *patarice*). These celebrations were attended by a large crowd of invitees (sometimes the number exceeded five hundred). The hearty dinner, which always included "Mika's Master Fisherman Soup" (*Mikina alaska čorba*), was preceded by the ceremonial cutting of the saint patron bread-cake and it was followed by a bash and a ball. The band performed in Serbia (Mladenovac, Aranđelovac, Palanka, Trstenik, Vranje, Vranjska Banja, Dimitrovgrad, Pirot, Ristovac, Čuprija, Smederevo, Veliko Gradište, Zemun, Stara Pazova, Sremski Karlovci, Fruška Gora, Novi Sad, Vrbas, Bačka Palanka, Srbobran), and also visited Bulgaria (Sofia). Petrović, the Suz band, and their friends compiled a multi-volume book, *Proper Wit and Wag of this World (Cjelomudrenija ovog sveta)* made up of the clippings of advertisements they found amusing.

The orchestra sang and played by ear, and it is interesting to note that it collaborated with the popular singer, a lawyer by vocation, Mijat Mijatović (*picture 1*). Petrović's playing intonation was higher than the tones of the standard notation system. He

used five tonalities which he dubbed: *suz* (similar in tonality to C-major, and the name also used as the title of the orchestra), *krkaleska* (D-major), *rep* (E-major), *repov rep* (F-major), major (G-major).

Urban folk music at the time of Mihailo Petrović, i.e. from the mid-nineteenth century until the Second World War, was performed mostly in the taverns (*kafana*) by the tamburitza or the string bands (the latter could include, for example, a piano or an accordion). In addition to the Western origin harmony, urban folk music was also characterized by a melody of broader scope in comparison to rural folk music, and abounded in conspicuous musical embellishments, often oriental in style. Being a genre of popular music, it constituted the mainstream music content of the then media industry (songbooks, radio-broadcasts and gramophone records), but also received much academic (ethno-)musicological criticism that perceived it as corrupting the folklore music and denounced its shallowness, in terms of aesthetics and content, in comparison to the artistic music. Its manifesting forms were called: a *sevdah* song (*sevdalinka*), a "small town ditty" (*varoška popevka*), gipsy music, a romantic tune (*romansa*); in certain contexts, such music could be found in the framework of dancing and parlour music. The musical activity of Mika Alas entirely



The second day of the patron saint celebration, the *patarice*, of the music society "Suz", 1913. (SASA Archive, 14197/9)

belongs to the tradition of urban folk music, as evidenced by a press article Petrović wrote for the *Politika* daily in 1940, about Mija Seferović “Jagodinac”, a Roma violinist who was famous before the First World War. Completely unperturbed by the elitist concepts of music, Petrović noted: “[...] Whether playing folk or artistic music, a Gypsy musician cannot help himself and always must add a bit of “*gypsyism*” to a tune. He feels compelled to additionally embellish it in his own way, emphasize what he feels is beautiful, add even more musical ornaments, all of which our folk finds both likable and winsome. It is that *gypsy* element in music which our folk loves and feels more deeply at their core than they love any proper or healthy, higher music; this is what touches our people, what they enjoy, what makes them enthusiastic and sometimes, even ecstatic, and that is why such music will always remain the music for the masses.” From the above newspaper article, we learn about the Roma music ensembles (*kapela*) in Serbia, about Belgrade’s taverns, and we learn even more about the music technique, his orchestra, their repertoire, his creed and teachings, and also about the life of folk musician, Mija Jagodinac (an almost unknown individual in the world of ethnomusicology).

Famous for his affection of the *sevдах* songs, Petrović was a frequent guest in Belgrade’s taverns – for example, in



Mihailo Petrović (in a hat)  
“Suz” and the atmosphere  
of a tavern (*kafana*)  
(SASA Archive, 14188)



Music Society "Suz"  
in a tavern (Petrović  
playing the violin)  
(SASA Archive, 14197/1)

the "Serbian Crown" (*Srpska kruna*) where foreign entertainers performed. He would sometimes play in some of them – for example, in the "Borča" tavern, in the Jewish district (*mahala*) in the Belgrade borough of Dorćol (also the seat of the Fishermen's Association). Numerous anecdotes link him to some of these places. One day in 1878, in the Hotel Thessaloniki (*Hotel Solun*), situated in the Nemanjina Street, performers at the restaurant left their musical instruments on stage during their break. Petrović's musicians grabbed the instruments and played so well that they received ovations, after which the musicians learned never again to leave their instruments unattended. Another anecdote has to do with a Roma ensemble which often played in the "Struga" tavern in the Belgrade borough of Čubura. One day the owner, not knowing who Petrović was, invited him to play with his orchestra that evening. According to the information passed on by Vidoje Golubović, Petrović accepted with a smile but later failed to collect his fee because of the riot caused by the drunken guests. A similar thing also happened in the "Czech Crown" (*Češka kruna*) tavern, where Petrović's orchestra again spontaneously found themselves among the guests who felt they had every right to "order a song" from the band. They also played in private festivities, such as the one which took place at the Hotel Bristol on February 19, 1939, seventieth birthday

celebration of Jelenko Mihailović, a member of the *Suz* band and the Provost at the Higher School of Pedagogy.

According to the *Annals (Letopis)* by Dragan Trifunović, Petrović's repertoire included over seven hundred folk dance melodies (of which over three hundred of the more complicated ones survived only owing to being performed by *Suz*), two hundred forty folk song melodies, and some ninety tunes from different parts of Yugoslavia. The 1934 article in the *Politika* daily cites the following instrumental tracks as repertoire curiosities: *Čobansko kokonješte*, *Vujčino kolo*, *Karaman kolo*, *Mečke*, *Rapino kolo*, *Trapađoz*, *Krivka*, *Prevrtaljka*, *Sveti Pavle*, with the comment that musicians could play as many as twenty-three variants of *Kukunješće* and twelve variants of *Vlajna*. It is interesting that they included the *Meljak Matraljez* (or "gypsied" Marzellez) in their repertoire, along with other poetic mishmashes, which they obviously found amusing. In literature, one often comes across comments about Petrović also being a collector of folk melodies, and that in the autumn of 1940, he and the *Suz* cut a gramophone record with Radio Belgrade. Unfortunately, even if they existed, these notations and sound recordings have not been preserved.

Marija DUMNIĆ



# MIHAILO PETROVIĆ ALAS IN AUDIO-VISUAL MEDIA

AN OBSERVER FOLLOWING AUDIO-VISUAL media representing integral records of a time, and containing simultaneously images, words and sounds, is familiarized with such motion pictures as may also be taken as documents and testimonies of a specific time period, even an epoch. Such recordings, which have woven into their form and structure the name, and works of, Mihailo Petrović Alas are but few. Movies, shows and series about Petrović are important to us not only because of their informative value, but also due to reproduction and their conjuring, or rather creating, a picture-image of the time in which Mihailo Petrović lived and worked.

In the history of video material commemorating Petrović, one of the first recordings, made on the occasion of the centennial of Petrović's birth, is the short documentary film *Mika Alas* made in 1968, based on a script by Professor Dr. Dragan Trifunović and Miodrag Mija Jakšić. The film, directed by Miodrag Mija Jakšić, was made under the auspices of the Center for Scientific-Research Film of Television Belgrade, and assumes a documentary approach in the manner of its presentation. The film shows archive photographs and dramatizes the biography of Petrović, but also depicts his passion towards both science and mathematics, and for fishing, travels, nature

and music. A year later, in 1969, Miodrag Mija Jakšić wrote the script for, and directed, another short documentary on the musical band *SUZ* of which Petrović was a founding member.

The 1971 feature film *Šešir profesora Koste Vujića* (*Professor Kosta Vujić's Hat*) is a Yugoslav television drama, directed by Vladimir Andrić; Milovan Vitezović wrote the script, which was adapted by Bojana Andrić. Subsequently, even though it had been originally written as a novel, the movie had its premiere on February 24, 1972 and has been shown on TV six times since then, being the most popular TV drama of Television Belgrade. It was included in *The Anthology of Television Drama* in 1975. The script for the TV drama was subsequently turned into a novel of the same title by Milovan Vitezović in 1983. The movie portrays the famous generation of graduates of the First Male Gymnasium in Belgrade in 1878–1885. A TV series was made in 2012, which is itself a remake of *Professor Kosta Vujić's Hat*; and subsequently the feature film directed by Zdravko Šotra.



A shot from a movie  
*Professor Kosta Vujić's Hat*,  
1971, Vladimir Andrić,  
Graduates of Professor  
Kosta Vujić in the First  
Belgrade Gymnasium.  
(Source: Program Archives  
of Television Belgrade)

The generation of graduates of the German language professor Kosta Vujić produced great names in Serbian science and culture. In the 1971 movie, the character of professor Kosta Vujić was portrayed by Pavle Vujisić, while the roles of graduates were played by: Vojislav Brajović as Mihailo Petrović Alas, Goran Sultanovića as Jovan Cvijić, Milan Mihailović as Milorad Mitrović, Miroslav Aleksić as Pavle Popović, Josif Tatić as Jaša Prodanović and Mihailo Viktorović as Đura Kozarac, the director of the First Belgrade Gymnasium.



Graduates of the First  
Belgrade Gymnasium,  
June 1885  
(SASA Archive, 14197/15)

On occasion of the centenary of the First Belgrade Gymnasium (1939), Mihailo Petrović wrote about his generation:

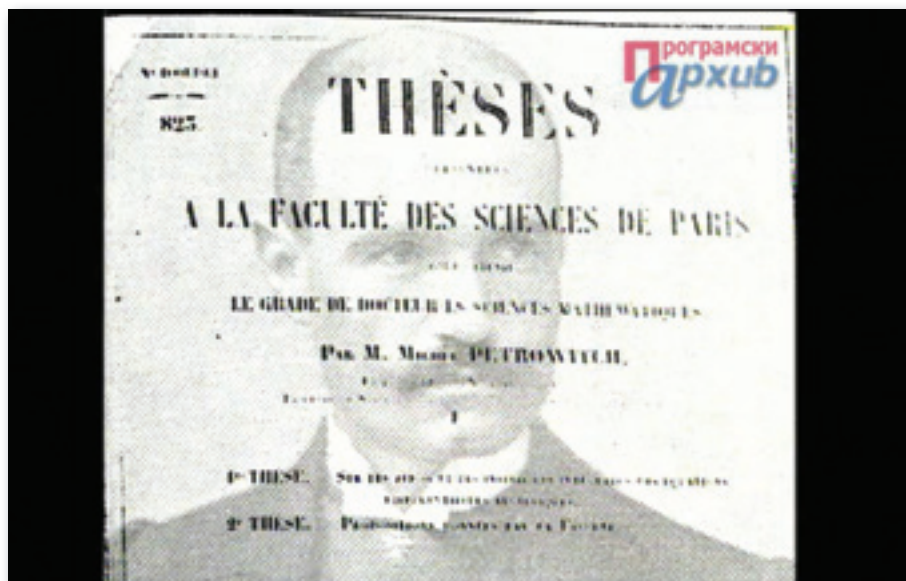
“Some of us whom our teachers had utterly given up on, and of whom even our own friends said would come to no good, later became what could not possibly have been expected of them: excellent writers, first-class journalists, or other things. Conversely, among those who had excellent marks at school, there were many who

did not turn out to become what they were forecasted to be, and they left a trace in life much weaker than those depended on for nothing.”

Of the television shows which were part of the scientific-research program of Radio Television Serbia, there are a couple of series which portray the life and works of Mihailo Petrović. One of them is 1989's *The Scientific Feuilleton: History of Mathematics in Serbia*. The five episodes of the series, entitled respectively: *The Origin*, *The Party Politics*, *The Return to Serbia*, *On the Right Track* and *Maturity*, portray, as their titles suggest, the history of mathematics in Serbia. The episodes concisely and accurately depict the history of science and culture, providing a rich material tapestry, as well as the origins and birth of mathematics in our country. They were based upon the ideas of professor Dr. Dragan Trifunović, prepared and supervised by professor Dr. Milan Božić, and directed by Pavle Grujičić. The last episode, *Maturity*, wraps up the series, and featured the life and work of Mihailo Petrović.

From the television series *Then and Now* created by Branko Milovanović, we single out the thirty-minute program *The Three Lives of Mihailo Petrović*, directed by Nikola Stanković in 1984. It shows Petrović's unusual versatility of character, emphasizing “the three lives led by Mihailo Petrović, of which the first was his life as a

*The Scientific Feuilleton:*  
*History of Mathematics*  
*in Serbia*, RTS 1989.  
Episode: *Maturity*, according  
to the idea of  
Prof. Dr. Dragan Trifunović  
(Source: Program Archives  
of Television Belgrade)





A shot from cultural-educational programming *History of Science – TV Lexicon*, RDU – RTS, 2010. Episode: *History of Science: Mihailo Petrović Alas* (Source: Programming Archive of Television Belgrade)

scientist. The second was his life on the river, fishing and befriending fishermen and skippers. The third life, and perhaps his greatest love, was his violin; and music, singing and merry-making.” The show featured professor Dr. Dragan Trifunović, a mathematician, historian of mathematics and biographer of Mihailo Petrović, and Petrović’s friends Višeslava Đuričić and writer Mladen St. Đuričić.

The editorial board of the Science and Education Programming of Radio Television Serbia prepared in 2010 a series entitled *History of Science: TV Lexicon*. Selecting fifteen scientists, among them Mihailo Petrović Alas, the series employs the short documentary form, and brings informative shows on important personages and achievements of our scientists who have left a major trace in science in Serbia and beyond.

Audio-visual records manifest as media which possess the power not only to reflect but also to project living memory, the place which preserves and encourages the unforgettable. They can be called a tool –a media between subjective and collective memory. Video media, with pictures, bring us into modernity and acquaint us with different reading of the meaning and purpose of objects and phenomena and create a new visual world. These media may separately provide an exhibition of a time, of people’s lives, presenting and materializing their thoughts, musings and imaginings.

The inquisitive spirit of Petrović's inspirations for science permeates some of these shows and films. Emphasizing his love of nature, especially rivers, for example in the short documentary film *Mika Alas* from 1968, based on the script by professor Dr. Dragan Trifunović and Miodrag Mija Jakšić, the narrator makes a statement, but also poses a question: "From his very childhood, Mihailo was fascinated with rivers and people on their shores, old wise fishermen, their craft and their exciting stories. The river flowed incessantly. The clock was ticking inexorably. Will that have any meaning? Significance?"

This section of the film's narrative is suggestive of Petrović's close relationship with nature and science, or, more accurately, it suggests that Petrović will draw inspiration from nature; that in nature he will find poetry, and in poetry mathematics. As he himself has stressed: "Not only do true poetry and true science have common points, but they also display deep common properties. One such property, so much so that it is sometimes difficult to tell where science stops and where poetry begins, consists in revealing and utilizing similarities among disparate elements and facts." Such examples could be used to make an analogy and emphasize proximity with the views of French painter Eugène Delacroix (Delacroix Ferdinand Victor Eugène, 1798–1863), a realist painter who in his *Journal* (Thursday, May 6, 1852) wrote the following about the significance and the bond which binds nature and science, defining it in the following way: "Scientists ought to live only in villages, close to nature: they like to talk in the green pastures of academies and institutes, about things which the world knows equally well as them: in forests, on the mountains, you observe natural laws, you cannot make one step without seeing an object you can admire. An animal-beast, a plant, an insect, earth and water, are food for a spirit which examines and wants to record various laws of all these creatures-beings. However, these gentlemen do not find in it a simple observation worthy of their genius: they want to break through and force systems from the depths of their offices which they take as their laboratory. And in addition, one should visit salons, have *crosses* and *salaries*: science which takes that road is not worth anything." Petrović's science did not take that road. It reaches its pinnacle both in his works and invention and in works which were and are being created about him.

# ARCHIVAL MATERIALS ON MIHAILO PETROVIĆ

THE NEED TO TREAT SEPARATELY THE matter of archival materials on Mihailo Petrović is informed by the fact the existing materials are scattered and that much of it has never been published. A good starting point for initial acquaintance with extant materials is a collection of manuscripts and books published as a part of the Digital Legacy of Mihailo Petrović Alas, which provides the researcher, casual or academic, with access to scans of the originals, as well as their meta-data. Furthermore, a useful sources of information are catalogues of previous exhibitions on Mihailo Petrović, such as the catalogue of the exhibition organized in the Archive of Serbia in 1968, or the catalogue of the exhibition held at the University Library "Svetozar Marković" in 2003. The best information, however, is provided by Dragan Trifunović, who has dedicated over thirty years to studying the life and work of this Serbian mathematician and whose books and publications are available at the eLibrary of the Faculty of Mathematics.

The guidelines or instructions for archival research attempt to give users an overview of archival, library or museum holdings and collections in certain historiographical contexts, as well as to make research more efficient. These instructions are mostly composed by collection holders, for example, archives, libraries or museums. The following describes the research of archival materials on



The cover page of the catalog for the exhibition organized in the Archive of Serbia, in 1968.



The cover page of the catalog for the exhibition organized in the University Library "Svetozar Marković," in 2003.



The slip to Petrović's name, for having a suit made at the tailors' in Paris, around 1890–1894. (Adligat Society)

Petrović from the point of view of one researcher. The focus is on materials held in small, and to the broader academic community unknown, "archives," such as the archive of the Association Adligat, Foundation "Mihailo Petrović Alas" and the archive of the SASA Mathematical Institute. A review of the materials held by the two state archives: the Archive of the Serbian Academy of Sciences and Arts (SASA) and the Archive of Serbia, is also provided.

The Association Adligat is a Belgrade-based non-profit NGO which holds several personal and family foundations and collections. This association also holds a part of the legacy of Mihailo Petrović entrusted for safekeeping by a donor whose wish was to remain anonymous to the general public. The materials are held in two cardboard boxes, one large and one smaller, which have not been formally archived, and with currently no records being made of it. However, one should duly note the effort of the archivist of the Association to identify and categorize portions of the material. Upon reviewing this legacy, one can single out the following: letters, personal documents, manuscripts, photographs, maps, fliers, brochures and journalistic puns which concern mostly the period of Petrović's schooling in France, from 1889, and to the outbreak of World War II in Yugoslavia in 1941. Thematically, it spans Petrović's schooling, academic career, scientific work, travels and fishing. Since the materials are mostly in Serbian and French, study is impossible without fluency in these two languages. The material in French from the time of his advanced studies in Paris, is particularly rich, and features, in addition to enrollment documents, lecture notes and degrees, also atypical materials such as city maps, public transport tickets, hotel or tailor bills, library receipts etc. The problem encountered by studying these materials is that they are in a very bad condition. Parts of the material had been exposed to humidity and mold, and it is not possible to review it. Therefore it is recommended that this body of material be classified and recorded in the near future, as soon as possible, to ensure conditions for its keeping and recovery, and to subsequently digitalize it and make it accessible to researchers.

A part of the legacy of Mihailo Petrović is preserved in Elementary School "Mihailo Petrović Alas" in Belgrade, as a gift by Jovan Hans-Ivanović, the grandson of Petrović's sister Mara, who now lives in Switzerland. This material is partially showcased in two

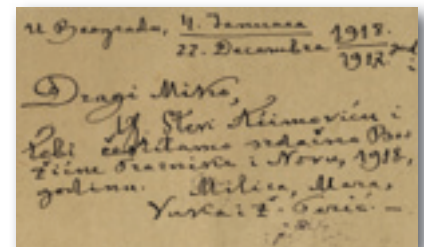


cabinets in the school's entrance hall and a part is situated in Petrović's suitcase in the office of the school principal. In 2010, a school librarian and an editor of the Foundation "Mihailo Petrović Alas", Mr. Miroslav Lukić, composed a book of inventories where he made entries for over 400 items. They can be grouped as follows: personal objects, such as clothing, writing utensils or a violin; personal documents, including a passport or a military ID card; letters, photographs or journalistic puns. The bulk of the legacy consists of letters, postcards or telegrams by Prince Đorđe Karađorđević, Mihailo Petrović's pupil and friend, written circa 1914–1918. The letters of Petrović's assistant, Mladen Berić, composed in the summer of 1918, have also been preserved, as well as the letters by Petrović's family: sister Mara, her husband Živojin Perić and daughter Vuka. The materials are mostly in Serbian or French and are well preserved. Even though one part of it has been presented on the official web-site of the Foundation, it is recommended that conditions be ensured for its further keeping as well as to fully digitalize it and make it accessible for future research.

Original manuscript notebooks from Mihailo Petrović's lectures were accidentally found in 2012 in the Mathematical Institute of SASA in Kneza Mihaila Street no. 36. The details of their discovery were described by Professor Žarko Mijajlović in one article, which reveals that they have been composed by a student of Petrović, Borivoj J. Pujić, in the period between 1910 and 1914. It is assumed that Pujić had personally bequeathed the notes to the Institute and that they were recorded in a library catalogue in the 1960s and are not available as a part of the Digital Legacy of Mihailo Petrović. It should be taken into account that the Institute also holds other archival materials that may be useful for studying the influence of Mihailo Petrović on the development of mathematics in Serbia. Thus, for example, the Book of Minutes from the meetings of the Council of the Mathematical Institute of the Serbian Academy of Sciences in 1950, contains notes about the translation of the doctoral dissertation of Mihailo Petrović, as well as about the preparation of his selected works. The problem is that this archival material is not recorded or classified and that at this moment it is not known what it encompasses precisely. It would be recommended to classify the existing materials, as well as to create a register so that the broader scientific community could familiarize itself with its contents.



A Paris-Rouen ticket, with Petrović's name, 1892. (Adligat Society)



A New Year's greeting card sent to Mihailo Petrović from his sister Mara and her family, 1918. (Foundation "Mihailo Petrović")



The front cover page of the book of notes taken from Professor Petrović's lectures on the ordinary differential equations, around 1910–1914. (Library of MISASA, 3262)

The SASA Archive holds over 120 Petrović's photographs. Even though they were classified into two separate halves, no individual entries were made and there is no accompanying description of persons or events, or time and place of origin, apart from some anonymous notes. The assessment of the author of this article is that they cover the period from 1885 to 1941 and thematically encompass family and school photographs, military photographs from the time of Balkan wars and the First World War, group photographs with fellow university professors and scientists, as well as photographs taken when fishing, travel photographs and those with the musical band "SUZ." A part of these photographs was scanned in 2003 and preserved on a CD, which is accessible to users of the Archive. In addition to photographs, Petrović's legacy also encompasses several letters and manuscripts. Special materials are minutes from the meetings of the Academy of Natural Sciences and the Presidency of the Serbian Royal Academy, which testify about the election of Petrović for an academician and his work as the representative of the Academy. These minutes were published in Serbian Royal Academy Yearbooks for the period after 1896.

The materials on Mihailo Petrović in the Archive of Serbia do not represent a single holding, but have been placed in several administrative funds, so their study requires dedication and time. They encompass primarily the fund of the Royal-Serbian Ministry of Education and Church Affairs, which is preserved in the Archive building in Karnegijeva street no. 2. It contains some thirty letters, applications and approvals in the period from 1890 to 1894, in connection with issues of Petrović's scholarship for studying abroad. A part of that fund is a hard-cover manuscript book with a decree on the appointment of Mihailo Petrović as full professor of the newly established University of Belgrade in 1905. The fund of the Ministry of National Economy, the Department for Trade, Handicraft and Traffic contains a group of documents related to Petrović's participation at the World Exhibition in Paris in 1900. The funds record of the Faculty of Philosophy in Belgrade and the University of Belgrade, kept in the Archive building in Železnik, contain over 150 units testifying about the work of Mihailo Petrović as a university professor in the period from 1897 to 1941. They include Petrović's reports on the work of the mathematical cabinet and seminar, his proposals for appointments and promotions, funding applications etc. One should bear in mind that



Petrović's vineyard at Topčidersko Brdo. All the way to the right: Mihailo Petrović, with his dog Beka. (SASA Archive, 14188/26)

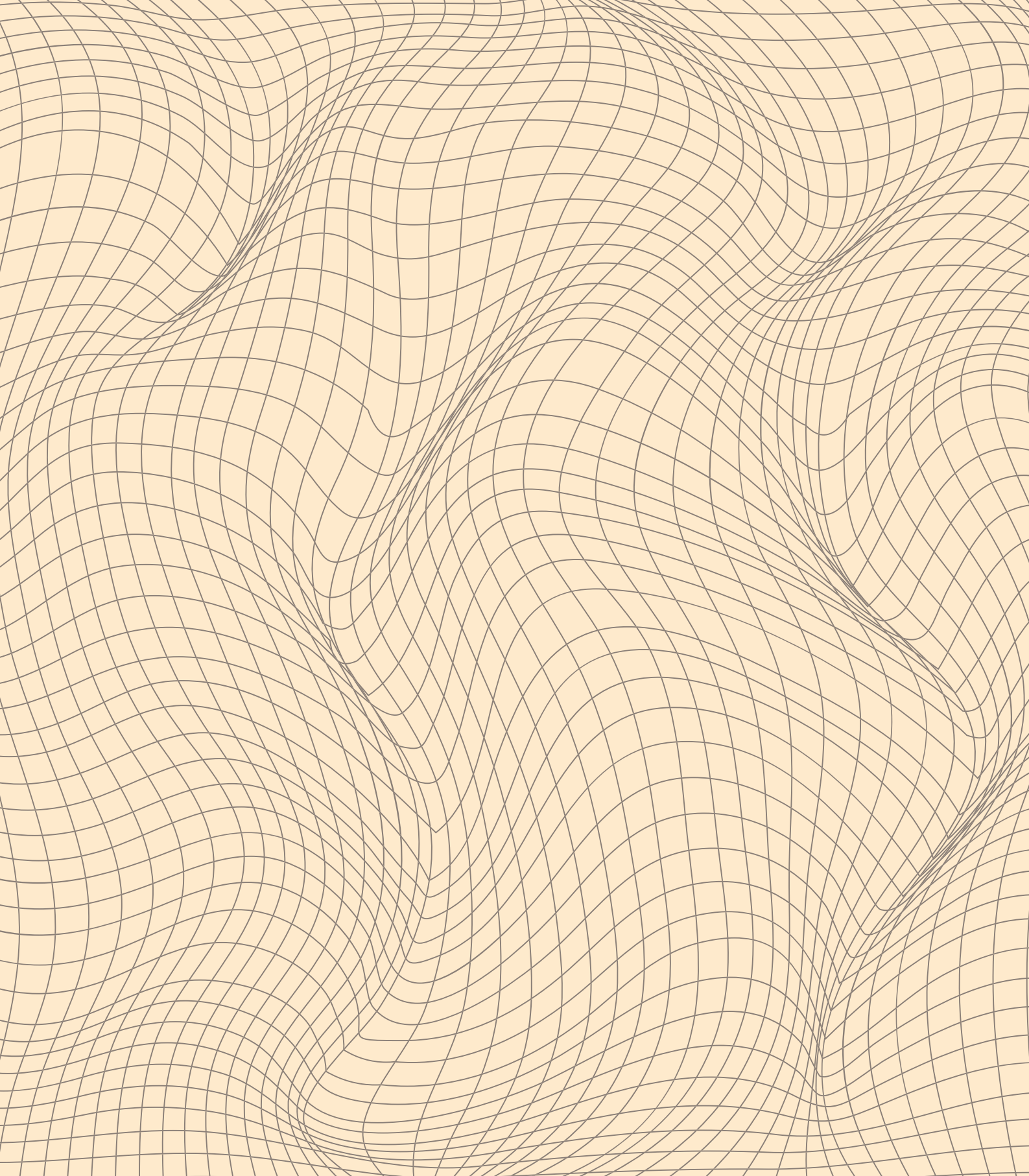
the materials on Petrović can also be found in other funds, such as the fund dedicated to the Grand School, so consequently the creation of a digital themed collection, which would encompass at one place the appropriate materials from various administrative funds, would facilitate and render further research more efficient.

The archival materials on Mihailo Petrović, in addition to the aforementioned, are also kept in the Archive of Yugoslavia, Museum of the City of Belgrade, Museum of Science and Technics, Museum of Natural History and University Library "Svetozar Marković." Therefore it would be recommended to create an instruction manual for archival research on the life and work of Mihailo Petrović that would identify research questions and contain a review of the existing archival materials. It would be recommended that such a manual be visible and accessible on the global network in order to facilitate the research process, link with a broader context and create conditions for future networking and cooperation.

*Marija ŠEGAN RADONJIĆ*



The petition written by Mihailo Petrović and Milutin Milanković on behalf of the Mathematics Seminar of the Faculty of Philosophy, to the Provost of the Belgrade University, on December 3, 1919 (Archive of Serbia, Faculty of Philosophy, G-208, III, 1919)



# A CHRONOLOGY OF IMPORTANT EVENTS 1868–1943

## Birth and education

- 1868.** Born on May 6 (April 24 in the Julian calendar) in Belgrade to a renowned Belgrade family of mother Milica and father Nikodim.
- 1878–85.** Enrolls in and finishes the First Belgrade Gymnasium in the same generation with Milorad Mitrović, Jovan Cvijić, Pavle Popović and other prominent personages of Serbian science and culture. A TV film *Professor Vujić's Hat* was made on this topic.
- 1885.** Enrolls in the Department of Mathematics and Natural Sciences at the Faculty of Philosophy in Belgrade.
- 1889.** Completed studies in Belgrade and went to Paris for further education, and preparation for the entrance exam for enrollment to the famous university École Normale Supérieure.
- 1890.** Passed the entrance exam for enrollment to École Normale Supérieure.
- 1891.** Awarded the state scholarship of Serbia.
- 1892.** Graduated from the Sorbonne in mathematical sciences with highest marks.

- 1893.** Graduated in physical sciences from the same university. As the best student of his generation, attended the annual reception given by the President of the French Republic in 1893 and 1894.
- 1894.** Defended the doctoral dissertation *Sur les zéros et les infinis des intégrales des équations différentielles algébriques* before a commission composed of the most distinguished French mathematicians: Charles Hermite, Émile Picard and Pol Painlevé.

## Academic career

- 1894.** Elected a full-time professor at the Grand School in Belgrade for the mathematical group of subjects.
- 1896.** Became a member of the Society of Italian Mathematicians in Palermo.
- 1897.** Elected a correspondent member of the Serbian Royal Academy. Became a correspondent member of the Yugoslav Academy of Sciences and Arts in Zagreb.
- 1899.** Elected a regular member of the Serbian Royal Academy. He was only 31 years old at the time.
- 1905.** When University of Belgrade was founded, he was one of the first eight professors who subsequently elected other professors of the University.
- 1908–09.** Performed duty of Dean of Faculty of Philosophy in Belgrade.
- 1922.** Becomes a corresponding member of the Czech Academy of Sciences in Prague.
- 1927.** Nominated for the president of the Serbian Royal Academy. The nomination rejected by the higher authorities due to his friendship with Prince Đorđe who had fallen into disfavor with the king.
- 1929.** Elected a member of academies in Warsaw and Bucharest.

- 1931. Nominated again for the president of the Serbian Royal Academy, but the nomination was again rejected.
- 1937. Became a correspondent member of the Polish Academy of Sciences in Krakow.
- 1939. Was awarded the honorary doctorate from the University of Belgrade and the Decoration of St. Sava of the first degree.

## Scientific work

- 1886. As a freshman, wrote his first academic paper *On one Modification of Graeffe's Method for Solving Higher Numerical Equations*. In his lifetime, he published over 300 academic papers in mathematics, the greatest number of which were published in world's leading academic journals.
- 1900. Constructed a hydro-integrator. For this invention he was awarded a bronze medal at the World Exhibition in Paris. Participated at the Congress of Mathematicians in Paris at which David Hilbert presented his famous list of 23 problems, which were very influential on 20<sup>th</sup> century mathematics.
- 1908. Presented academic work at the Fourth International Congress of Mathematicians in Rome.
- 1909. At the proposal of Mihailo Petrović, Jovan Cvijić and Bogdan Gavrilović, University of Belgrade invited Milutin Milanković to become a professor of applied mathematics. Milanković accepted the invitation and came to Belgrade the same year.
- 1911. Published a monograph *Elements of Mathematical Phenomenology*, an edition of the Serbian Royal Academy.
- 1912. The first doctoral dissertation in mathematics was defended at the University of Belgrade. The dissertation was defended by Mladen Berić, under the supervision of Mihailo Petrović. Presented academic work at the Fifth International Congress of Mathematicians in Cambridge.
- 1919. Published a monograph *Les spectres numeriaues*, Paris, 1919.

- 1924. Presents academic work at the International Congress of Mathematicians in Toronto. He was the vice president of the Congress and the president of the Section for Theoretical Mathematics.
- 1928. Published a monograph (his lectures at the Sorbonne) *Lecons sur les spectres mathematiques*, Paris.
- 1930. Established the Mathematical Club of the University of Belgrade.
- 1932. Together with Anton Bilimirović established the first Serbian mathematical journal *Publications de l'Institut Mathématique Université de Belgrade*.
- 1933. Published a monograph *Phenomenological Copying*, Serbian Royal Academy.
- 1934. Participated in the work of the Second Congress of Mathematicians of Slavic Countries.
- 1936. Published a monograph *One Differential Algorithm and Its Applications*, Serbian Royal Academy.
- 1937. Published a monograph *Elliptic Functions*, edition of the Endowment of Luka Trebinjac.
- 1967. His monograph *Metaphors and Allegories* was published by Srpska književna zadruga.

## Major overseas travels

- 1931. Expedition to Northern Seas, from France to Hammerfest, Greenland and Island.
- 1932. Expedition to the Caribbean, visit to the Bermuda Triangle and Sargasso Sea.
- 1933. The third major journey, from Labrador to Newfoundland.
- 1934. Expedition to the Canary and Cape Verde islands, the Island of St. Helena and the south of the Atlantic Ocean and the visit to the rims of the Antarctica.
- 1935. Expedition to the Indian Ocean, journey through the Suez Canal, the Red Sea and a visit to Madagascar.



## Fishing

- 1882.** Became a fisherman apprentice.
- 1897.** Published his first paper in fishery "*Do Fish Sleep*" in the magazine *The Hunter*. He published over twenty papers on the subject of fishery.
- 1888.** Became a fishing prospect.
- 1895.** Passed an exam for a fishing master.
- 1898.** Participated in the preparation of the first laws on fishing in the lakes and rivers of Serbia.
- 1900.** A member of a delegation for an agreement on a fishing convention with Austria-Hungary.
- 1902.** A member of a similar delegation for an agreement with Romania.
- 1907.** In London, as a part of the Balkan Exhibition, organized an exhibition of Serbian fisheries.
- 1911.** At an international exhibition in Turin, received a gold medal for exhibited fishing specimens.
- 1912.** Caught a catfish weighing 120 kilos.
- 1919.** One of the founders of the Institute of Oceanography in Split.
- 1920.** Bought a 13-meter steamer he named "Karaš."

## Other activities

- 1896.** Established the famous tavern music band "Suz."
- 1898.** Passed the exam for a reserve second lieutenant. At the same time worked on state security ciphering tasks. Will remain the chief coder of the Serbian and the Yugoslav Army until the outbreak of World War II.
- 1910.** At the French Patent Institute registered a patent for a depth measurer. He will register a total of five patents. In the course of his entire career, Petrović was deeply engaged in the development of the teaching of mathematics in high schools.

- 1912–13.** Participated in both Balkan wars, as a reserve engineering lieutenant and then second lieutenant.
- 1914.** Participated in World War I. Was adjutant officer of Prince Đorđe. A part of the war spent in France and Switzerland working on cryptography tasks on behalf of the Serbian army. Introduced ciphering system “The Three Cardboards.”
- 1925.** Became a reserve engineering lieutenant colonel.

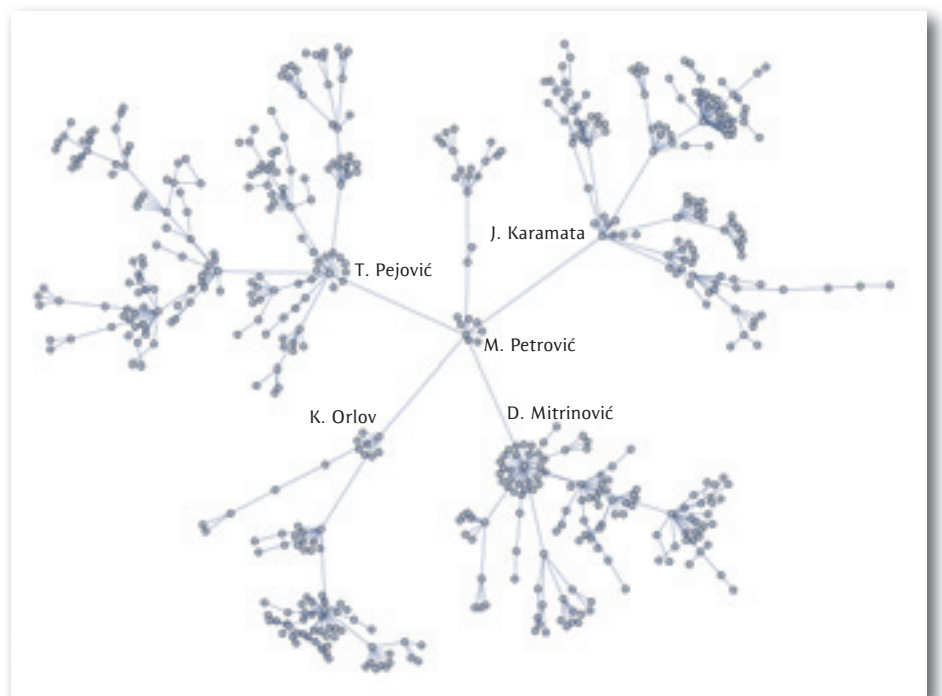
## Last years

- 1938.** Retired.
- 1939.** Received an honorary doctorate of the Belgrade University and the Decoration of St. Sava of the first degree. Professors of the Faculty of Philosophy of the University of Belgrade put forward a proposal to establish “Mathematical Institute Mihailo Petrović.”
- 1941.** At the age of 74, as a reserve officer, called again to war. The Germans captured him, but due to illness and old age he was released from captivity.
- 1943.** Died on June 8 at his home in Kosančićev venac in Belgrade.

Edited by Ž. MIJAJLOVIĆ

# MATHEMATICAL GENEALOGICAL TREE OF MIHAILO PETROVIĆ

DOCTORS OF MATHEMATICAL sciences are linked through a supervisory relationship to Mihailo Petrović. This lineage is graphically represented as a genealogical tree structure. The nodes in the tree represent mathematicians, while the links between them indicate the mentoring relationship between a doctoral candidate and their mentor. The name of a node includes the names of mathematicians, the university and year of defending their doctorate theses.



## Mihailo Petrović, U. Paris, 1894.

Mladen Berić, UB, 1912.

Sima Marković, UB, 1913.

Tadija Pejović, UB, 1923.

Vojin Dajović, UB, 1956.

Mioljub Nikić, UB, 1972.

Žarko Pavićević, UB, 1983.

Vladimir Mičić, UB, 1973.

Milutin Obradović, UB, 1984.

Nikola Tuneski, UB, 1999.

Miodrag Perović, UB, 1978.

Dušan Georgijević, UB, 1979.

Miroljub Jeftić, UB, 1979.

Jovo Šarović, UB, 1988.

Ivan Jovanović, UB, 1992.

Miodrag Mateljević, UB, 1979.

Vladimir Marković, UB, 1998.

Alastair Fletcher, U. Warwick, 2006.

Anestis Fletcher, U. Warwick, 2006.

David Kaljaj, UB, 2002.

Marijan Marković, UB, 2013.

Đorđije Vujadinović, UB, 2014.

Vesna Manojlović, UB, 2008.

Marijan Marković, UB, 2013.

Miljan Knežević, UB, 2014.

Enes Udovičić, UB, 1980.

Stojan Duborija, UB, 1981.

Miloje Rajović, UB, 1985.

Dobrivoje Mihajlović, UB, 1956.

Rastko Stojanović, UB, 1956.

Dragovan Blagojević, UB, 1969.

Ernest Stipanić, UB, 1957.

Zagorka Sakl-Šnajder, UB, 1960.

Dragoljub Cvetković, UB, 1985

Milorad Bertolino, UB, 1961.

Julka Knežević-Miljanović, UB, 1979.

Jelena Manojlović, UB, 2000.

Pavle Pejović, UB, 1971.

Blažo Okiljević, UB, 1962.

Nedeljko Parezanović, UB, 1962.

Vojislav Stojković, UB, 1981.

Ivan Obradović, UB, 1991.

Milan Tuba, UB, 1993.

Raka Jovanović, UB, 2012.

Nebojša Bačanin, UB, 2015.

Adis Alihodžić, UB, 2016.

Duško Vitas, UB, 1993.

Sanja Petrović, UB, 1997.

Davor Radenović, UB, 1998.

Slaviša Prešić, UB, 1963.

Koriolan Gilezan, UB, 1971.

Janez Ušan, UB, 1971.

Svetozar Milić, UB, 1972.

Zoran Stojaković, UB, 1974.

Stojan Bogdanović, U Novi Sad, 1980.

Veljko Vuković, U Priština, 1985.

Todor Malinović, U Novi Sad, 1986.

Petar Protić, U Novi Sad, 1986.

Milan Božinović, U Niš, 1997.

Nebojša Stevanović, U Niš, 2006.

Miroslav Ćirić, UB, 1991.

Tatjana Petković, U Niš, 1998.

Žarko Popović, U Niš, 2001.

Jelena Ignjatović, U Niš, 2007.

Ivana Micić, U Niš, 2014.

Zorana Jančić, U Niš, 2014.

Ivona Brajović, U Niš, 2015.

Aleksandar Stamenković, U Niš, 2010.

Milan Bašić, U Niš, 2011.

Nada Damljanović, U Niš, 2012.

Velimir Ilić, U Niš, 2012.

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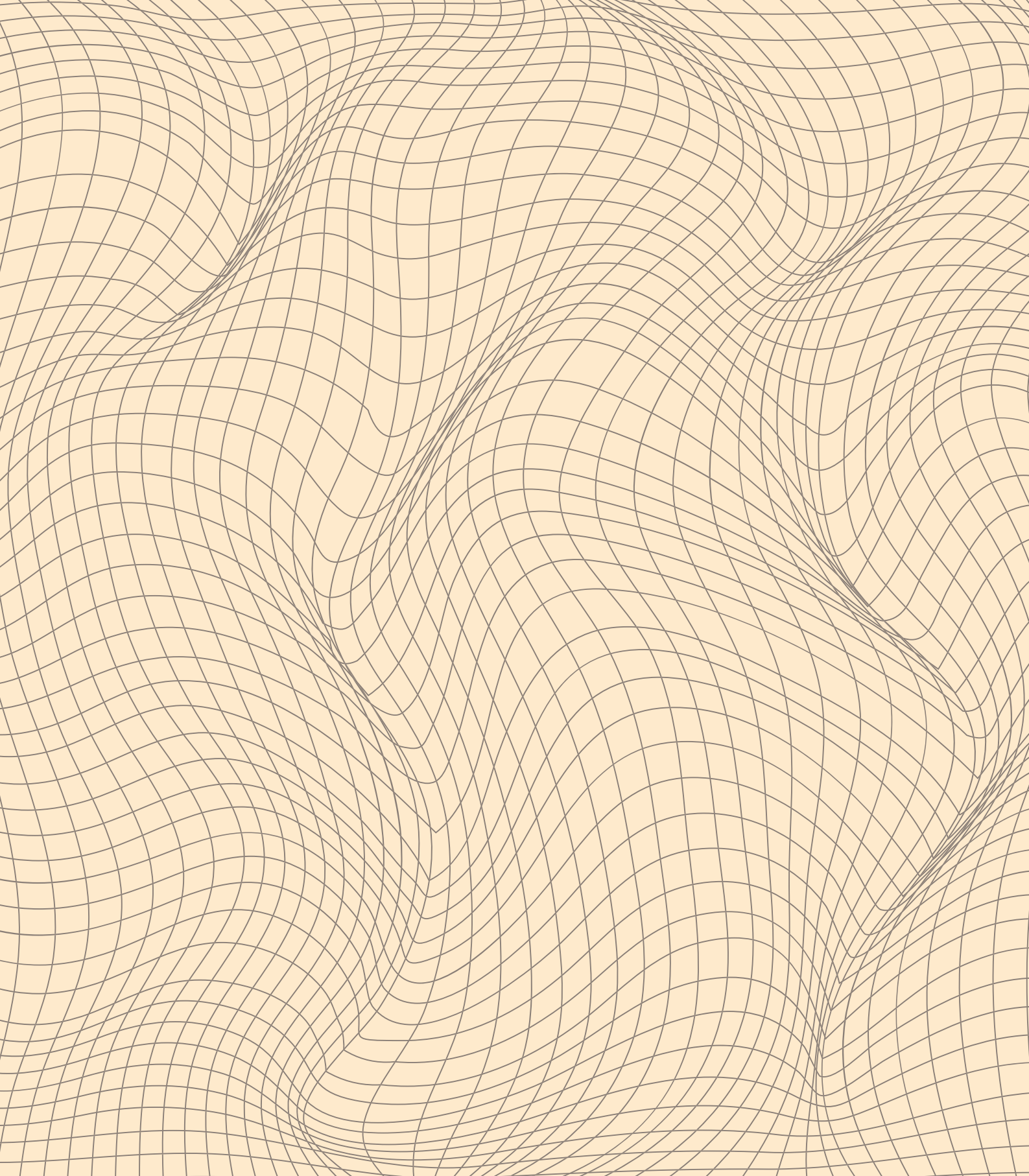
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Compiled by: Ž. MIJALLOVIĆ

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 Software by: S. Simić, R. Popović



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<http://elibrary.matf.bg.ac.rs>

Hyperlink to the article about Mihailo Petrović's patents, published in *The Planet* magazine:

[http://www.planeta.org.rs/56/05\\_Tema1.htm#.Wpa1JKjwaUI](http://www.planeta.org.rs/56/05_Tema1.htm#.Wpa1JKjwaUI)

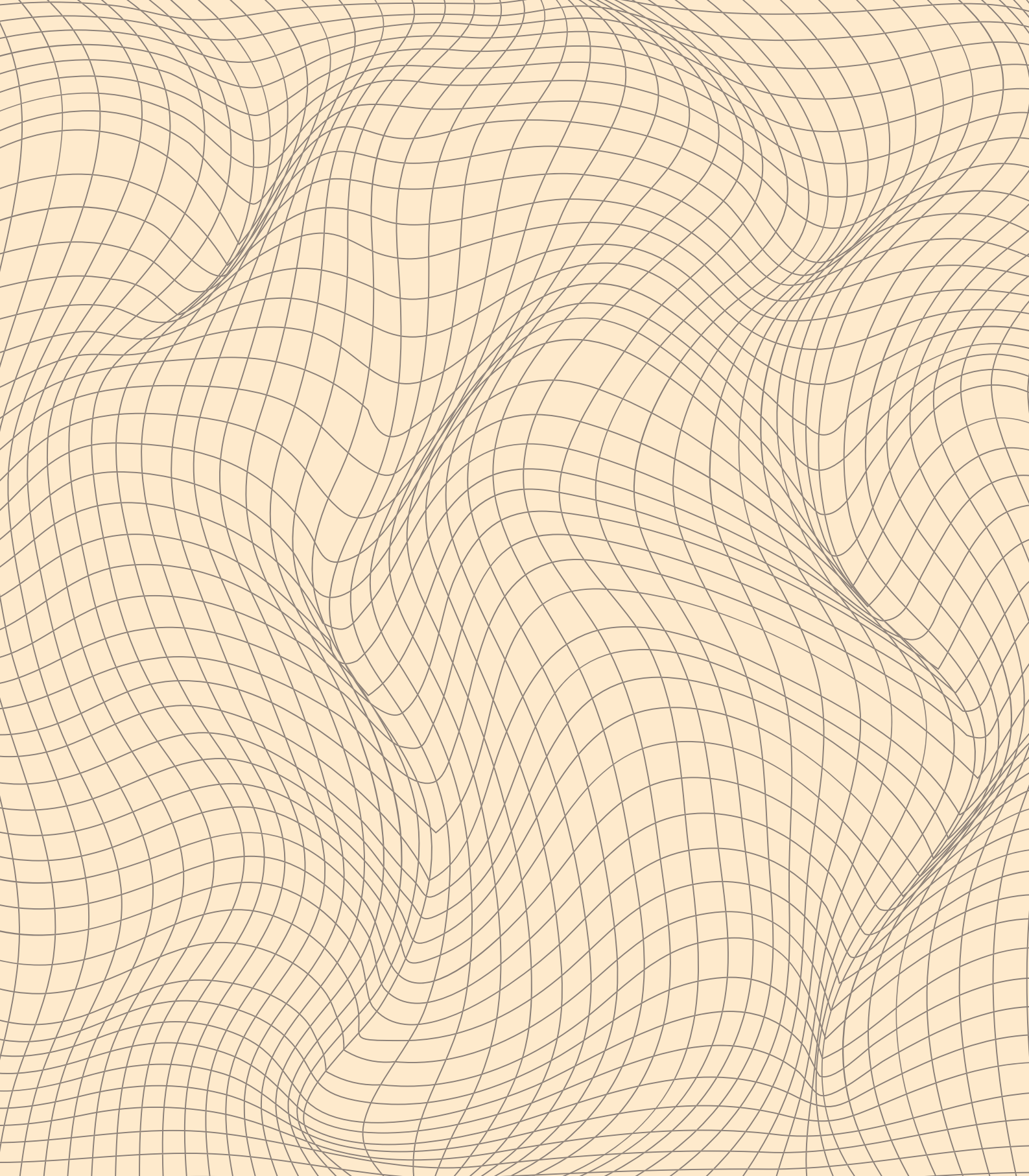
Special Issue of International Journal Non-Linear Mechanics, Vol. 73, Pages 1–128, July 2015

Dedicated to Petrović's theory: ***Elements of mathematical phenomenology and Phenomenological Mappings.***

Edited by Katica R. (Stevanovic) Hedrih, Ivan Kosenko, Pavel Krasilnikov and Pol D. Spanos

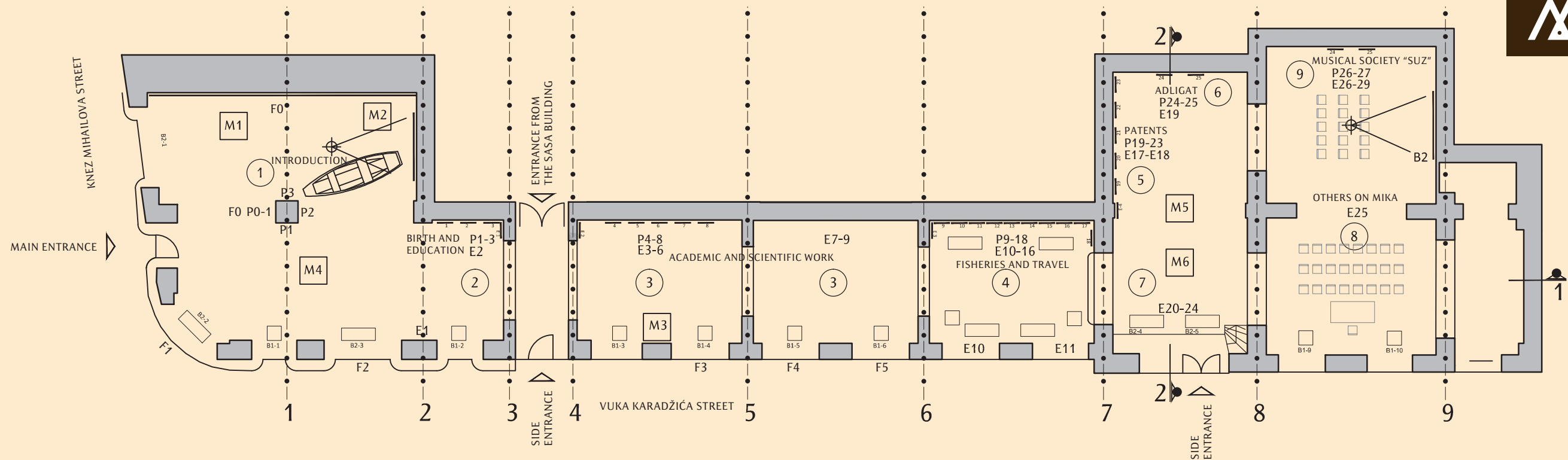
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Compiled by Ž. MIJAJLOVIĆ



# MIHAILO PETROVIĆ ALAS

THE FOUNDING FATHER OF THE SERBIAN SCHOOL OF MATHEMATICS



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|--|---|---|--|--|
| <p><b>LEGEND</b></p> <p>M - MEDIA</p> <p>B1- PROJECTION</p> <p>F - FOIL</p> <p>P - POSTER</p> <p>E - EXHIBIT</p> | <p><b>1. INTRODUCTION</b></p> <p>P0/F0 Introductory note</p> <p>P1-P3 Chronology, genealogy</p> <p>M1 Genealogy of Serbian mathematics</p> <p>M2 Projection - about mathematics</p> <p>M4 Dissertation - original in a magic box</p> <p>E0 Mika's catch</p> <p>E1 Portrait of Mihailo Petrović Alas by Uroš Predić</p> <p>F1-2 Portrait of Mihailo Petrović Alas, manuscript</p> <p><b>2. BIRTH AND EDUCATION P1-P2</b></p> <p>P1-P3</p> <p>Introductory note</p> <p>E2 Photos, letters</p> | <p><b>3. ACADEMIC AND SCIENTIFIC WORK</b></p> <p>P4-P8</p> <p>E2 Photos (generation meeting, 4 professors from L'Ecole Normale Supérieure)</p> <p>E4 Globe, rulers, notebook, writing accessories</p> <p>E5 Letters to grandfather from L'Ecole Normale Supérieure</p> <p>E6 Documents (The certificate on the maturity exam, etc.)</p> <p>M3 Film and book "Professor Kosta Vujić's Hat"</p> <p>F5 Formulas, signature, information about the exhibition</p> <p>E7 Faculty of Philosophy / University / SASA documents + photographs</p> <p>E8 Paris world fair 1900, document + photographs</p> <p>E9 Books and works by Mihailo Petrović</p> | <p><b>4. FISHERIES AND TRAVEL</b></p> <p>P9-P18</p> <p>E10 Photos on fishing net</p> <p>E11 Mihailo Petrović's personal belongings from travels</p> <p>E12 World map with a marked travel path</p> <p>E13 Mihailo Petrović's books on travel and fisheries</p> <p>E14 Fishery diploma</p> <p>E15 Foil and window</p> <p>E16 Fish collection</p> <p><b>5. PATENTS</b></p> <p>P19-P23</p> <p>M5 projekcioni sistem, 3D patent</p> <p>E17 The depth measurer of the land artillery, hydro integrator, 3D model</p> <p>E18 Mihailo Petrović's documents and manuscripts</p> <p><b>6. ADLIGAT</b></p> <p>P24-P25</p> <p>E19 Documents, manuscripts, cryptography, photographs</p> | <p><b>7. MIKA'S ACQUAINTANCES</b></p> <p>M6 Multimedia roll up</p> <p>E20 Portraits (oil on canvas)</p> <p>E21 Sculptures</p> <p>E22 Furniture, cabinet</p> <p>E23 Photographs, documents, correspondence</p> <p>E24 Books</p> <p><b>8. OTHERS ON MIKA</b></p> <p>E25 Books</p> <p><b>9. MUSICAL SOCIETY "SUZ"</b></p> <p>P26-P27</p> <p>E26 Violin</p> <p>E27 Sculptures</p> <p>E28 Furniture</p> <p>E29 Photographs, documents, correspondence</p> |
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# LIST OF EXHIBITS AND LABELS

Institutions and organizations	The title of the exhibit and its label	Holding/registry number	Dimensions	Thematic unit
ARCHIVE OF SERBIA	The certificate on the maturity exam, July 15, 1885	MPS, F25, r207/894		Birth and education
	A confirmation by the Embassy's secretary, Mr. Ristić, that Mihailo Petrović had been admitted as a student to Ecole Normale Superieure in Paris, October 15, 1890	MPS, F25, r207/894		Birth and education
	Mihailo Petrović's application for the award of state scholarship, reviewing his achievements and stating the reason for applying for one, December 7, 1890	MPS, F25, r207/894		Birth and education
	The rules of the Ministry applying to state cadets being schooled abroad and the statement by Mihailo Petrović that he would adhere to them, November 14, 1891	MPS, F25, r207/894		Birth and education
	The statement on passing of the comprehensive exam, May 11, 1893	MPS, F25, r207/894		Birth and education
	The application for printing of the doctoral dissertation, May 10, 1894	MPS, F25, r207/894		Birth and education
	The decree on appointment of Mihailo Petrović for full professor of the University, February 27, 1905	MPS, F25, r207/894		Academic and scientific work
	The documents of the Ministry of National Economy on participation of Mihailo Petrović and his graphic-calculating machine "Integraf" at the World Exhibition in Paris in 1900	MNP-T, 1900, F VII-2		Academic and scientific work Patents
	Mihailo Petrović reports to the dean of the Faculty of Philosophy on the work of the Mathematical Cabinet in the 1904/1905 academic year, May 5, 1905	FACULTY OF PHILOSOPHY, G-208, F2 1905 22		Academic and scientific work
	The proposal of Jovan Cvijić and Mihailo Petrović to confer the honorary doctorate by the Faculty of Philosophy onto Sima Lozanić, around 1911. Lozanić was awarded the honorary doctorate ten years later, on November 14, 1922	FACULTY OF PHILOSOPHY, G-208, F3 1911		Mika and others
	A set of documents concerning application of Sima Marković for the post of the lecturer of Theoretical Mathematics, March 1920	FACULTY OF PHILOSOPHY, G-208, F3 1920		Mika and others
	The proposal of Milutin Milanković and Mihailo Petrović to the Council of the Faculty of Philosophy to appoint a professor of University of Kiev, Anton Dimitrović Bilimović, for full professor under the contract for Applied Mathematics at the Faculty of Philosophy, March 5, 1920	FACULTY OF PHILOSOPHY, G-208, F3 1920 1007		Mika and others
	The application submitted by Mihailo Petrović to the Council of the Faculty of Philosophy to introduce didactics of mathematics as a university course, November 23, 1920	FACULTY OF PHILOSOPHY G-208, F3 1920 2290		Academic and scientific work

	Mihailo Petrović's application for a leave enabling him to participate in a scientific expedition to the South Pole region and for covering the expenses of the journey from Madagascar, March 23, 1935	FACULTY OF PHILOSOPHY, G-208, F6 1934–1937 3687	Fisheries and travel
	Mihailo Petrović' application to the Steering Board of Luka Čelović Foundation regarding a visit to France, where 300th anniversary of Decartes' ideas were being celebrated and where published and unpublished material would be placed at the disposal of experts to study the role of Marin Getaldić, a precursor of Decartes, in the creation of analytic geometry, March 30, 1937	FACULTY OF PHILOSOPHY, G-208, F6 1937 4267 3661	Academic and scientific work
	The dean of the Faculty of Philosophy informs Mihailo Petrović that the printing of the mathematics textbook "Integration of Differential Equations By Use of Series" has been approved, April 27, 1938	FACULTY OF PHILOSOPHY, G-208, F8 1938/2 3927	Academic and scientific work
	The proposal that the Mathematics Seminar be divided into two autonomous institutes, "The Institute for Theoretical Mathematics Dr. Mihailo Petrović" and "The Institute for Applied Mathematics"	FACULTY OF PHILOSOPHY, G-208, F8 1938 4203 2	Academic and scientific work
	Conferral of an honorary doctorate in philosophy by the University onto Dr Mihailo Petrović, a retired University professor, 1939	FACULTY OF PHILOSOPHY, G-208, 1938 4237	Academic and scientific work
	The application of Mihailo Petrović to take part at the Congress of Mathematicians in Toronto, where he would give a lecture on his "spectral calculating method," April 8, 1924	FACULTY OF PHILOSOPHY, G-200, F3, r182 1924 1	Academic and scientific work
	The Council of the Philosophical Faculty informs the Chancellor of the University that it had accepted the invitation that Mihailo Petrović should hold lectures at the Sorbonne in Paris on "The Theory of Mathematical Specters," November 26, 1927	FACULTY OF PHILOSOPHY, G-200, F3, r37 1927 4	Academic and scientific work
SASA ARCHIVE	The house where Mihailo Petrović was born in Kosančićev venac number 22	14188/1	Birth and education
		14188/2	Birth and education
	The celebration of the patron saint of SUZ	14188/3	SUZ
	The members of the music band SUZ celebrate St. Apostle Philemon patron saint day, December 5, 1913.	14188/6	SUZ
	The fortieth anniversary of his Gymnasium graduation. With mathematics professor Sreten Stojaković and teachers of pre-military training, June 8, 1925	14188/9	Birth and education
	Mihailo Petrović Alas's memento	14188/10	Fisheries and travel
	A set of photographs from Mihailo Petrović's journey from France to the North Pole, 1931	14188/13	Fisheries and travel
	Mihailo Petrović as a graduate student of the First Belgrade Gymnasium, 1885	14188/14	Birth and education
	Mihailo Petrović conducts the music band SUZ during a celebration	14188/16	SUZ
	Mihailo Petrović with his niece Vuka Perić, a daughter of Mira and Živojin Perić	14188/17	Birth and education
	A portrait of Mara Perić, a sister of Mihailo Petrović. Photographer: Milan Jovanović	14188/18	Birth and education
	Mihailo Petrović in his study, at his home in Kosančićev venac, around 1936	14188/21	Academic and scientific work

Mihailo Petrović with his mother Milica before her operation in Bern, 1918	14188/23	Birth and education
Mihailo Petrović Alas' fishing memento	14188/24	Fisheries and travel
Mihailo Petrović with captured catfish weighing 124 kilograms, December 5, 1913	14188/28	Fisheries and travel
Music band SUZ	14188/30	SUZ
The certificate on membership in the Czech Mathematical Society, January 20, 1923	14188/31	Academic and scientific work
The certificate on membership in Lviv mathematical society, March 28, 1925	14188/33	Academic and scientific work
Belgrade fishing association awards diploma to its founder Mihailo Petrović, July 12, 1942	14188/33	Fisheries and travel
A set of photographs from Mihailo Petrović's journey from France to the North Pole, 1931	14197/3	Fisheries and travel
Restranging of a fishing net in a boat	14197/6	Fisheries and travel
Mihailo Petrović on the Danube river bank with a foreign delegation, Belgrade, 1898	14197/8	Fisheries and travel
A memento from the International Congress of Mathematicians, Paris, 1900	14197/13	Academic and scientific work
Gymnasium graduation, The First Belgrade Gymnasium, June 1885	14197/15	Birth and education
Belgrade Mathematical School, 1926. Photographer: Standing from left to right: Miloš Radojčić, Tadija Pejović, Vjačeslav Žardecki, Anton Bilimović, Petar Zajankovski, (Jelenko Mihailović, seismologist), Radivoj Kašanin, Jovan Karamata. Sitting from left to right: Nikola Saltikov, Mihailo Petrović, (Pavle Popović, the university chancellor), Bogdan Gavrilović, (K. Petković, the dean of the Faculty of Philosophy), Milutin Milanković	14197/16	Academic and scientific work
The first eight professors of the Belgrade University, 1905. Sitting from left to right: Jovan Žujović, Sima Lozanić, Jovan Cvijić and Mihailo Petrović. Standing from left to right: Andra Stevanović, Dragoljub Pavlović, Milić Radovanović and Ljubomir Jovanović	14197/18	Academic and scientific work
Mihailo Petrović Alas's fishing memento	14197/23	Fisheries and travel
Trawl netters are dragging up the trawl net	14197/30	Fisheries and travel
15 <sup>th</sup> anniversary of the Gymnasium graduation, June 8, 1910	14197/32	Birth and education
The proposal to elect Mihailo Petrović a correspondent member of the Academy of Natural Sciences, January 20, 1897. Attached to the proposal are a letter by Sime Lozanić to Jovan Žujović and a list of papers by Mihailo Petrović	The Academy's administrative archive: proposals for election of Academy members in 1897.	Academic and scientific work
The proposal by Ljubomir Klerić, Dimitrije Nešić, Jovan Žujović and Sima Lozanić to elect Mihailo Petrović for the first member of the Academy of Natural Sciences, January 25, 1899	The Academy's administrative archive: proposals for election of Academy members in 1899, no. 26.	

SASA ART COLLECTION	A portrait of Mihailo Petrović. The work by Uroš Predić, 1943			Introduction
	A portrait of Milutin Milanković. The work by Paja Jovanović, 1943–1944			Mika and others
	Bogdan Gavrilović. The work by Đorđe Jovanović, 1935, the bust was cast in 2003			Mika and others
	A portrait of Jovan Žujović. The work by Uroš Predić, 1921			Mika and others
	Sima Lozanić, a bust. The work by Đorđe Jovanović			Mika and others
	Milutin Milanković, a bust. The work by Sreten Stojanović, 1944			Mika and others
SASA LIBRARY 1	The cabinet of Milutin Milanković: engravings (3 items), a writing desk, a chair, a lamp, a pen, a vase, a pipe, diploma, a book shelf, two books signed by Mihailo Petrović			Mika and others
SASA LIBRARY 2	LA PECHE EN SERBIE par Michel Petrovic. Exposition Internationale de Turin, 1911. – Belgrade, Imprimerie d'Etat du Royaume de Serbie, 1911; p. 7	18351	80	Fisheries and travel
	Mihailo M. Petrović: BELGRADE, ERSTWHILE CENTER OF MAJOR FISHING – Articles printed in "Belgrade Municipal Journal," No. 1 – X, 1940; p. 90	1268/40	40	Fisheries and travel
	DJERDAP FISHERIES IN PAST AND PRESENT. By Mihailo Petrović. – Belgrade, Serbian Royal Academy, 1941; p. VIII + 120; Serbian Ethnographic Edited Volume, Book LVII. Section II. The lives and customs of the population, book 25	A4/57	80	Fisheries and travel
	Mihailo Petrović: FISHERIES IN TIMOČKA KRAJINA. – Belgrade, "Mlada Srbija," / b. g./ pages 15; Reprint from Timočka krajina memorials	14041	80	Fisheries and travel
	Mihailo Petrović: THROUGH THE POLAR AREA. – Belgrade, Srpska književna zadruga, 1932; p. 248. Srpska književna zadruga, book 237	C6/120/237	19.8cm	Fisheries and travel
	Mihailo Petrović: IN THE PIRATE'S EMPIRE. – Belgrade, Srpska književna zadruga, 1933; p. 269; Poučnik Srpske književne zadruge, VII	C7/120/7	18.7cm	Fisheries and travel
	ONE GREAT MUSLIM PIRATE. An old fisherman. – Belgrade, the publication of the Čupić Endowment, 1934; p. 80–127; from "The Nikola Čupić Yearbook," book VLIII	14133		Fisheries and travel
	Mihailo Petrović: WITH OCEAN'S FISHERMEN. – Belgrade, Srpska književna zadruga, 1935; p. 245/+1/+109 pictures, Savremenik Srpske književne zadruge, book 19	C7/120/19	19.2cm	Fisheries and travel
	Mihailo Petrović: ON FARAWAY ISLANDS. – Belgrade, Srpska književna zadruga, 1936; pages 294; Poučnik Srpske književne zadruge, book 9	C7/120/9	19,2cm	Fisheries and travel
	FARAWAY LANDS AND SEAS: travelogues / Mihailo Petrović. Belgrade: Prosveta, 1948. – 265 pages – (Youth Library)	39804	20cm	Fisheries and travel

Mihailo Petrović Alas: GRAND JOURNEY. Edited by Dragan Trifunović. – Belgrade, Vuk Karadžić, 1982; p. 162+/6/; with bibliography/ Zlatna grlica	35394	80	Fisheries and travel
Mihailo Petrović: THE EEL NOVEL. – Belgrade, Srpska književna zadruga, 1940; p. 187; Poučnik Srpske književne zadruge, book XI	C7/120/11	19.1cm	Fisheries and travel
Academic paper: EQUATIONS ALGEBRIQUES INDETERMINEES A DEUX INCONNUES. Par Michel Petrovitch. – /s.l.n.t./; pp. 183–187	17970	80	Academic and scientific work
Academic paper: ON ASYMPOTOTE VALUES OF INTEGRALS OF THE FIRST-ORDER DIFFERENTIAL EQUATION. By Mihailo Petrovića. – Belgrade. Serbian Royal Academy, 1895, p. 43; Serbian Royal Academy Gazette, book L. The Department of Natural and Mathematical Sciences, book 17	A3/50	80	Academic and scientific work
Academic paper: Michel Petrovitch: LE NOYAU D'ANALOGIE. Paris, Librairie Felix Alcan, 1919; p. 14; Extr.: Revue du Mois, n. 119; 1919	17972	80	Academic and scientific work
Academic paper: M. Petrovitch: SUR UN NOMBRE ABSOLURATTACHE AUX GEODESIQUES DES SURFACES.-Bologna, Nicola Zanichelli, 1931; pp. 347–352; Estr.: Atti del Congresso Internazionale dei Matematici, VI, 1928	17973	80	Academic and scientific work
Academic paper: Michel Petrovitch: PROPOSITION SUR LES FONCTIONS ENTIERES.-Warszawa, J. Dziejwski, 1934; pp. 45–50; /Bilingual title and excerpt in Polish/ /Extr.:/ Comptes Rendus des seances de la Societe des Sciences et des lettres de Varsovie XXVII, 1934. Classe III	17976	80	Academic and scientific work
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Academic paper: QUELQUES CONTRIBUTIONS ELEMENTAIRES RECENTES AU PROBLEME DES TROIS CORPS. Par Michel Petrovitch. – Extr.: Memoires de l' Universite de Belgrade, III, 1936;p. 10	17969	80	Academic and scientific work
Academic paper: REMARQUE SUR LES ZEROS DES INTEGRALES DE LAPLACE-ABEL. Par M. Petrovitch.- Cracovie, Imprimerie de l'Universite, 1937;pp. 523–527; /Parallel title in Polish/ Extr.:Bulletin de l'Academie Polonaise des Sciences et des Lettres. Classe de Sciences Mathematiques et Naturelles. Serie A: Sciences Mathematiques, 1936	17968	80	Academic and scientific work
Academic paper: Mihailo Petrović: TYPICAL CONSTANT OF NUMBER SERIES. – Belgrade, Bogomir Jovanović for the printworks "Zora," 1937; p. 12, Reprinted by: The Gazette of the Yugoslav Professors' Society, book XVII, 1936	17971	80	Academic and scientific work
Academic paper: SUR UNE CLASSE DE DETERMINANTS. Par Michel Petrovitch. – /s.n.t/, p. 3	17975	80	Academic and scientific work

	Academic paper: ADDITION AU MEMOIRE SUR LES EQUATIONS DIFFERENTIELLES ALGEBRIQUES. Michel Petrovich.-/s.n.t./; p. 4. /with bibliography/	34723	80	Academic and scientific work	
	Book: Elliptic Functions/ Mihailo Petrović. Belgrade: Luka Đelović – Trebinjac Endowment, 1937; p. 128; – (Lectures at the University of Belgrade)	46314	23cm	Academic and scientific work	
	Book: LECONS SUR LES SPECTRES MATHEMATIQUES/ Michel Petrovitch.– Paris: Gauthier –Villars et cie, 1928. 90 p	46316	25 cm	Academic and scientific work	
	Book: MECANISMES COMMUNS AUX PHENOMENES DISPARATES. Par Michel Petrovitch.–Paris, Librairie Felix Alcan, 1921.; pag. 279	687/120	120	Academic and scientific work	
	Book: Mihailo Petrović:METAPHORS AND ALLEGORIES. Edited by Dragan Trifunović. – Belgrade, 1967, p. 196 + / 3 /;/ with bibliography/ Srpska književna zadruza, Series LX, Book. 405	C6/120/405	120	Academic and scientific work	
	Book: Mihailo Petrović:COMPUTING WITH NUMBER INTERVALS. Edited by Petar M. Vasić and Milorad Bertolino. 2nd edition. – University of Belgrade, 1969: pages. / 12/+169+pictures./1/; 8	u13588		Academic and scientific work	
	NOTICE SUR LES TRAVAUX SCIENTIFIQUES DE M. MISHEL PETROVITCH (1894–1921). M. Milankovitch: preface. – /Belgrade/, Paris, Academie Royale de Serbie, 1922; pag. IX 152; Special editions. Serbian Academy of Sciences, / book XLIII/. The Department of Natural-Mathematical Sciences/ book 10/ with bibliography of works by M. Petrovic/ 512:517	A10/43	80	Others on Mika	
	Mihailo Petrović (1868–1943). Belgrade: The Committee for Commemorating the Centennial of Mihailo Petrović's birth, 1968	15890		Others on Mika	
	TRIFUNOVIĆ, Dragan: The Biography of Life and Works by Mihailo Petrović, Belgrade: Serbian Academy of Sciences and Arts, 1969	A40/120		Others on Mika	
	TRIFUNOVIĆ, Dragan: Mihailo Petrović Alas. His Life and Work, Gornji Milanovac: Dečije novine, 1982	9140/120		Others on Mika	
	THE MEMORIAL OF THE CEREMONIAL GATHERING ON OCCASION OF THE CELEBRATION OF CENTENNIAL OF MIHAILO PETROVIĆ'S BIRTH 1868–1968. Belgrade: Serbian Academy of Sciences and Arts, 1968	A10/426		Others on Mika	
SASA MATHEMATICAL INSTITUTE	Lecture notes from lectures of Mihailo Petrović compiled by Borivoje J. Pujić, Lecture scripts: The Theory of Algebraic Equations, around 1910–1914			Academic and scientific work	
	Lecture notes from lectures of Mihailo Petrović compiled by Borivoj J. Pujić, Lecture scripts: Ordinary Differential Equations, circa 1910 – 1914			Academic and scientific work	
	Lecture notes from lectures of Mihailo Petrović compiled by Borivoj J. Pujić, Lecture scripts: The Analytic Geometry in Space, circa 1910–1914			Academic and scientific work	
	Article by Mihailo Petrović that appeared in daily newspaper Politika: "Mathematical Institute at the University of Belgrade – The Hub of Academic Work," 1938	Framed article			Academic and scientific work
	Smart board				Introduction
	A Portrait of Bogdan Gavrilović. The work by Kosta Hakman, 1939				Mika and others

“MIHAILO  
PETROVIĆ ALAS”  
FOUNDATION  
/ PRIMARY  
SCHOOL “MIHAILO  
PETROVIĆ ALAS”  
(A GIFT by Jovan  
Hans Ivanović)

Travel suitcase with the initials of Mihailo Petrović	1	72 × 41 × 20cm	Fisheries and travel
A pair of leather shoes of Mihailo Petrović, no. 26	2		Introduction
A grey cardboard box with ties of Mihailo Petrović, Au Bon Marche, Paris	4	1 box + 3 ties	Introduction
Mihailo Petrović's passport, without photographs, no. 143, August 1915	5		Fisheries and travel
A pair of black, suade leather shoes of Mihailo Petrović	6		Introduction
Mihailo Petrović's shaver with a metal case and two sets of razors, USA, 1905	7		Introduction/ Fisheries and travel
Mihailo Petrović's Photo Camera, Hutig A:G Dresden, 1908	8		Fisheries and travel
The induction battery-operated lamp of Mihailo Petrović of the Luzy brand	9		Fisheries and travel
A wooden box with writing utensils	10		Birth and education
A wooden ruler	12		Birth and education
A wooden triangle	13		Birth and education
The passport of Mihailo Petrović, No. 784, October 1915	15		Fisheries and travel
Mihailo Petrović with Prince Đorđe Karađorđević, no year	17		Mika and others
Tie bars from personal belongings of Mihailo Petrović	19	2 items	Introduction
A notebook. W. H. Smith & Son, Paris	33	26 × 21cm	Birth and education
A metal glass in a leather case with initials of Mihailo Petrović	36		Fisheries and travel
Petrović's leather case for keeping collars and 12 collars	38	46 × 10 × 6cm	Introduction
A metal tobacco box of Mihailo Petrović, Tanagra	40	10 × 7 × 3cm	Fisheries and travel
3 seals: the first contains concentric circles, the second 7 Arabic numerals and the third 12 Roman numerals	42, 43 и 44	3 items, 8 × 8cm	Fisheries and travel/ Patents
1917 Calendar, in French, property of Mihailo Petrović, 1917	60		Introduction/ Fisheries and travel
A travel document, Legation de Suisse en Italie Rome, le 7. jania 1915	64		Fisheries and travel
A letter of Prince Đorđe Karađorđević to his professor and friend Mihailo Petrović, Monte Carlo, March 8, 1915	84	4 pages	Mika and others
A letter of Mladen Berić to his professor and friend Mihailo Petrović, Grenoble, 1918	308	2 pages	Mika and others
A violin and a violin bow of Mihaila Petrovića			SUZ
Mihaila Petrović as a Grand School professor		A framed photograph in the school's hall	Academic and scientific work

ASSOCIATION ADLIGAT	A map of Paris with streets	0002_1	Birth and education
	A map of Paris with public transport lines	0002_2	Birth and education
	Among Mihailo Petrović's personal belongings, which are kept by the Adigat Association, a photograph has been found which is assumed to portray Mihailo Petrović as a child, however further research is necessary in order to confirm this	0003	Birth and education
	A shorthand notebook with notes by Mihailo Petrović	0004	Birth and education
	The enrolment into the second and the third year of studies in Paris, 1892	0005_1	Birth and education
	A copy of a birth certificate of Mihailo Petrović required for enrolment to Ecole Normale Supérieure, 1890	0005_3	Birth and education
	A letter by Josif Pančić concerning plans for a fishpond in Dobričevo, June 20, 1914	0006	Mika and others/ Fisheries and travel
	A business card of Mihailo Petrović as a military school cadet, circa 1890–1894	0007	Birth and education
	Petrović's diagrams for the depth measurer	0008	Patents
	Graduation paper in mathematics and physics	0009	Birth and education
	A letter of Mihailo Petrović to his grandfather Novica, Paris, June 24, 1892	0010	Birth and education
	A letter of Mihailo Petrović to his grandfather Novica, Paris, July 8, 1892	0010	Birth and education
	A letter of Mihailo Petrović to his grandfather Novica, Paris, February 1, 1893	0010	Birth and education
	A draft doctoral dissertation of Mladen Berić, who was the first to be awarded PhD in mathematical sciences by the University of Belgrade	0011	Mika and others/ Academic and scientific work
	At a tailor's in Paris, circa 1890–1894	0015	Birth and education
	Explanations of cryptography and ciphering in a document of the Chief of Staff of the Kingdom of Yugoslavia from the 1930s	0024/ Cryptography/ General terms	Academic and scientific work
	The appearance of Petrović's ciphering and deciphering cards	0024/ Military codes in the Kingdom of Serbs, Croats and Slovenes/ System 13	Academic and scientific work
	Mihailo Petrović's manuscript about ciphering	0024/ Ciphering-manuscript - 1	Academic and scientific work
	The first page of the notebook entitled "The (coding) System" from the 1930s	0024/ Military codes in the Kingdom of Serbs, Croats and Slovenes/ System 1°	Academic and scientific work



MUSEUM OF  
SCIENCE AND  
TECHNOLOGY

The depth measurer for ground artillery was constructed by Mihailo Petrović Alas, together with Milorad Terzić and was commissioned by the Military-Technical Institute of Kragujevac. The device was patented in France in 1910, under the title „Télémetre à sextant“ and under the registry number 413.730. The Russian army bought the patent

T:3.83

Four parts plus a box: two brass parts  $6 \times 5 \times 5$  cm, lens 5 cm  $\times$  diameter 6.5 cm, box  $7 \times 12 \times 6.5$  cm

Patents

For the construction of the hydraulic integrator, an analog computing machine operating on the circulation of fluids, performing a graphic integration of first-order differential equations, Mihailo Petrović Alas won a bronze medal at the 15th World Fair in Paris, 1900. Author of the model: Nemanja Đorđević; Produced by: The Science Festival Belgrade, 2007

study collection

$46 \times 36 \times 91$  cm

Patents

A part of the coding system, entitled “The Three Cardboards” which Mihailo Petrović Alas constructed in Geneva in 1917, commissioned by the Serbian Army. It was used by the Serbian army and diplomacy up until the Second World War

T:3.84

$10 \times 6.5 \times 2$  cm

Patents

A wooden barge for keeping the river fish alive; on the sides are circular holes which ensure unhindered flow of water, keeping the fish alive

T:18.64

$418 \times 76 \times 46$  cm

A wooden barge for keeping little white fish – baitfish and “a bug” – larvae of the water flower

T:18.83

$59 \times 16 \times 13$  cm

Kazuk, a wooden chained pole used for tying floating objects to undeveloped shores

T:18.12

height 107 cm  
width 14 cm

Kazuk

T:18.13

height 117 cm  
width 13 cm

Kazuk

T:18.25

height 107 cm  
width 16 cm

Kazuk

T:18.28

height 114 cm  
width 14 cm

UNIVERSITY  
LIBRARY  
“SVETOZAR  
MARKOVIĆ”

The magic box

Introduction

The doctoral dissertation of Mihailo Petrović, „Sur les zéros et les infinis des intégrales des équations différentielles algébriques: thèses présentées à la Faculté de Sciences de Paris pour obtenir le grade de docteur ès sciences mathématiques“, Paris, 1894

T R1 1231

Academic and scientific work

ARHIMEDIA  
GROUP,  
ELECTRICAL  
ENGINEERING  
FACULTY, NIŠ

An inclined projection surface displaying the 3D model of the Hydraulic Integrator – the first analog calculating machine for solving differential equations employing the principle of circulation of fluids

A projection film

Electronic exhibition guide enabled by a QR code

NATURAL HISTORY MUSEUM	Beluga, <i>Huso huso</i> (Linnaeus, 1758) (Đerdap, 1978. Taxider. R. Knežević)			Fisheries and travel
	Wels catfish, <i>Silurus glanis</i> (Linnaeus, 1758) (Srebrno jezero, 28.08.1997)			Fisheries and travel
	Sterlet, <i>Acipenser ruthenus</i> (Linnaeus, 1758) (Apatin, 1976)			Fisheries and travel
	Eel, <i>Anguilla anguilla</i> (Linnaeus, 1758) (Lake Ohrid, 19.02.1979)			Fisheries and travel
	Northern pike, <i>Esox lucius</i> (Linnaeus, 1758)			Fisheries and travel
	Sterlet, <i>Acipenser ruthenus</i> (Linnaeus, 1758) (Danube, 1978)			Fisheries and travel
	Silver carp, <i>Hypophthalmichthys molitrix</i> (Valencienns, 1844), (Umka, Sava, 15.1.1979. Taxider. R. Knežević)			Fisheries and travel
	Grass carp, <i>Ctenopharyngodon idella</i> (Valencienns, 1844), (Danube, Apatin 1978)			Fisheries and travel
	Tench, <i>Tinca tinca</i> (Linnaeus, 1758) (Danube, 1975)			Fisheries and travel
	Danubian salmon, <i>Hucho hucho</i> (Linnaeus, 1758)			Fisheries and travel
	Stellate sturgeon, <i>Acipenser stellatus</i> (Pallas, 1771) (Danube, 1976)			Fisheries and travel
Sterlet, <i>Acipenser ruthenus</i> (Linnaeus, 1758) (Apatin, 1976)			Fisheries and travel	
ETHNOGRAPHIC MUSEUM	Barge (for safekeeping of fish)	Hunting and Fishing Collection, registry number. 19953	P 58 cm; S 13 cm; H 5.7 cm	Fisheries and travel
	Dibber (for catfish)	Hunting and Fishing Collection, registry number. 34642	P 37 cm; S 3 cm	Fisheries and travel
	Fishing net	Hunting and Fishing Collection, registry number. 11479		Fisheries and travel
	Beluga hook	Hunting and Fishing Collection, registry number. 19953	P 17.8 cm	Fisheries and travel
A LIST OF FILMS AND SHOWS:				
MUSEUM OF SCIENCE AND TECHNOLOGY	<b>MIKA ALAS</b>			
	Script: Miodrag Mija Jakšić, Dragan Trifunović Director: Miodrag Mija Jakšić Genre: short documentary Publishing house: Center for Scientific Research Film TV Belgrade 1968. Duration: 14:36 minutes			
Programming Archive of the Television Belgrade	<b>PROFESSOR KOSTA VUJIĆ'S HAT</b>			
	Editor: Vasilije Popović Script: Milovan Vitezović Director: Vladimir Andrić Genre: TV drama TV Belgrade 1971. Duration: 60 minutes			

Programming  
Archive of the  
Television Belgrade

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**THEN AND NOW: THE THREE LIVES OF MIHAILO  
PETROVIĆ ALAS**

Script: Branko Milovanović  
Director: Nikola Stanković  
With participation of: Prof. Dr Dragan Trifunović  
TV Belgrade 1984.  
Duration: 30:16 minutes

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Programming  
Archive of the  
Television Belgrade

**THE SCIENTIFIC FEUILLETON: HISTORY  
OF MATHEMATICS IN SERBIA**

Series: (the fifth episode: MATURITY according to  
the idea of Prof. Dr. Dragan Trifunović)  
Text author: Prof. Dr Dragan Trifunović  
Editor: Ilja Slani  
Director: Pavle Grujičić  
Prepared and presented by: Prof. Dr Milan Božić  
TV Belgrade 1989.  
Duration: 22:23 minutes

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Programming  
Archive of the  
Television Belgrade

**HISTORY OF SCIENCE – TV LEXICON  
HISTORY OF SCIENCE: MIHAILO PETROVIĆ ALAS**

CULTURAL-EDUCATION PROGRAM  
Editor in chief: Miodrag Zupanc  
Editor and script writer of the series: Borislava  
Nikolić  
Expert consultant: Prof. Dr Aleksandar Petrović  
Director: Ivan Milanović  
Editor in chief of the Editorial Office for science and  
education: Stevica Smederevac  
Editor of the Science Section: Ilija Cerović  
Production: RDU – RTS 2010.  
Duration: 10:17 minutes

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Programming  
Archive of the  
Television Belgrade

**HISTORY OF SCIENCE – TV LEXICON  
HISTORY OF SCIENCE: MILUTIN MILANKOVIĆ**

CULTURAL-EDUCATION PROGRAM  
Editor in chief: Miodrag Zupanc  
Editor and script writer of the series: Borislava  
Nikolić  
Expert consultant: Prof. Dr Aleksandar Petrović  
Editor in chief of the Editorial Office for Science and  
Education: Stevica Smederevac  
Editor of the Science Section: Ilija Cerović  
Director: Ivan Milanović  
Production: RDU – RTS 2010.  
Duration: 09:06 minutes

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Archive of  
the Yugoslav  
Cinematheque

**CORONATION OF KING PETER I**

Year: 1904  
Organizer of the filming: Honorary Consul of Serbia  
in Sheffield Arnold Muir Wilson  
Cameraman: Frank S. Mottershaw.

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CIP – Каталогизација у публикацији  
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51:929 Петровић М.

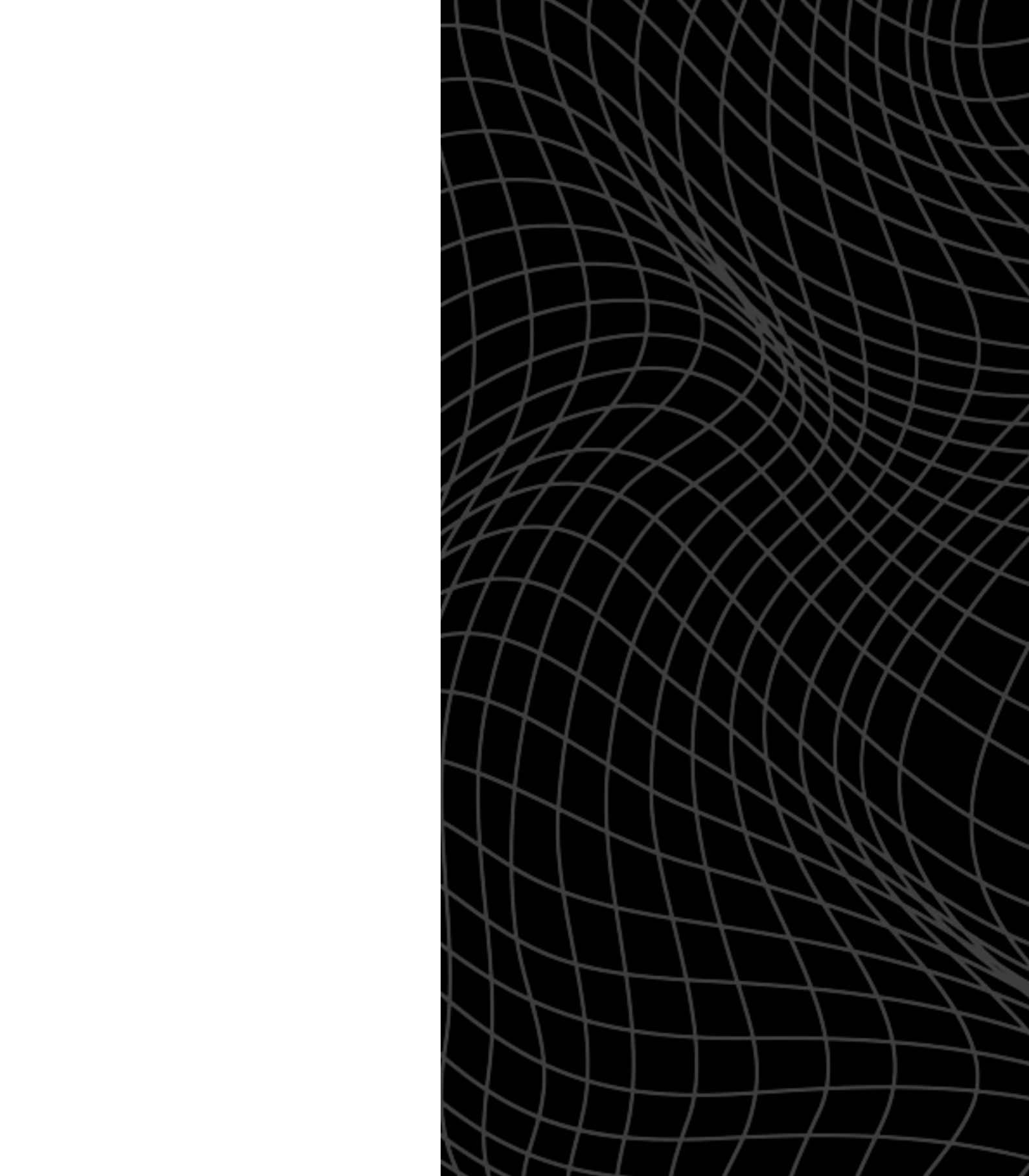
MIHAILO Petrović Alas : The Founding Father of the Serbian School of Mathematics / [editor Žarko Mijajlović ; English translation Vanja Savić, Daniela Nikolić]. - Belgrade : SASA, 2018 (Belgrade : Službeni glasnik). – 159 str. : ilustr. ; 24 cm

Prevod dela: Михаило Петровић Алас. – “In 2018, The Serbian Academy of Sciences and Arts (SASA) and mathematicians in Serbia celebrate the 150th anniversary of the birth of academician Mihailo Petrović Alas...” --> str. 7. – Tiraž 250.

ISBN 978-86-7025-769-6

а) Петровић, Михаило (1868–1943)

COBISS.SR-ID 263335948





# Mihailo Petrović ALAS

If I had not obtained that one additional vote for my application for a Grand School professor, I would have never pursued mathematics as my profession. I would have lived on Serbian rivers, not on a boat, but on a dinghy.

