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THE BEGINNINGS OF MATHEMATICAL INSTITUTIONS IN SERBIA

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Abstract. Institutional development of mathematics in Serbia rests on two national institutions: Belgrade Higher School established in 1863, from 1905 the University of Belgrade, and the Serbian Royal Academy founded in 1886, later the Serbian Academy of Sciences and today the Serbian Academy of Sciences and Arts. Dimitrije Nešić, professor of mathematics and rector of the Belgrade Higher School, founded the first mathematics library in Serbia in 1871. In time, as a result of the collaboration between the Academy and the University and overlapping activities, it had become the main place for mathematicians to gather and work and became known as the Mathematical Seminar of the University of Belgrade. The year 1896 is considered to be the year when the Seminar was officially founded and when it began its activities as an institution. Professors Mihailo Petrović and Bogdan Gavrilović, members of the Serbian Royal Academy, were the two people most responsible for its establishing. The period between the two world wars is the most significant period in the development and institutionalization of the activities of the Mathematical Seminar and Petrović's school of mathematics, which represent the root of the overall development of mathematics in Serbia. The Mathematical Institute was founded in 1946 under the authority of the Serbian Academy of Sciences. All Institute achievements and activities – publishing activities, organization of scientific seminars, introducing young and talented mathematicians to scientific work, improving the education process at the University of Belgrade – are pointed out. Today, after 70 years, the Mathematical Institute developed into the most significant Serbian institution of mathematics.

1. Introduction

The year 1873 marks the beginning of institutional development of mathematics in Serbia. At the Belgrade Higher School within the Faculty of Philosophy, two departments – the Natural Science Department which also included the Chair

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for Mathematics, and the History and Philology Department – were then established. Prior to this, higher mathematics classes had been held only for students of the Faculty of Engineering. Until 1887, mathematics had been taught both at the Faculty of Philosophy and the Faculty of Engineering exclusively by Professor Dimitrije Nešić (1836–1904), one of the key figures with regard to Serbian science at that time. Due to educational and scientific work in the field of mathematics and because of the fact that he was the first Serbian author of several mathematical papers published in the issues of the Serbian Learned Society and the Serbian Royal Academy, Nešić is justly considered the first Serbian mathematician. He succeeded in dividing the old inexplicit mathematics course, into lower and higher mathematics. Furthermore, due to the reforms he initiated, for the first time mathematicians taught only mathematics and not architecture, mechanics, geography and physics, while on the other hand mathematics was taught only by mathematicians. In 1871 he founded the first mathematics library in Serbia.

In 1885 the Chair of Mathematics of the Natural Science Department at the Faculty of Philosophy was divided into two areas of study: higher and lower level mathematics. Lower-level mathematics covered analytical geometry and trigonometry, while higher-level mathematics included classes on algebraic analysis, combinatorics and the basic elements of infinitesimal calculus. Two years later, due to the increase in mathematics courses, Bogdan Gavrilović (1864–1947), doctor of philosophy-mathematics from the University of Budapest, was appointed professor of lower-level mathematics at the Higher School[1]. His rival and colleague Dimitrije Danić (1862–1932), a Berlin student who earned his doctoral degree in 1885 in Jena[2], was unsuccessful in his attempt to do the same. But, in our national history of science he will be remembered as the first Serbian doctor of mathematics.

In the year 1894 when Professor Dimitrije Nešić retired, as many as three young doctors of sciences applied for a position of a mathematics professor at the Faculty of Philosophy of Belgrade Higher School and all three with degrees from respectable European schools: Đorđe Petković (1863–1913) from Vienna[3]; Petar Vukićević (1862–1941) from Berlin[4] and Mihailo Petrović (1868–1943) from École Normale Supérieure, Paris[5]. M. Petrović was elected for this position while the other two never realized their university careers.

[1]After defending his thesis "On the Construction of Single-Valued Analytic Functions" in 1887 (in Hungarian), Gavrilović became the second mathematician in Serbia with a doctorate in sciences. About Gavrilović see [**12, 25**].

[2]Demeter Danitsch, Conforme Abbildung des elliptischen Paraboloids auf die Ebene, Fakultät zu Jena, 1885, p.41.

[3]Abel's Theorem Proved With Algebra and Riemann's Function (Abels Theorem bewiesen algebraisch und mit der Hilfe von Riemanns Funktion), Vienna, 1893. Prosvetni glasnik for 1886, book XVII, Belgrade, pp. 582–588, 634–653. Petković was the third mathematician in Serbia with a doctorate in science, following Danić and Gavrilović.

[4]Die Invarianten der linearen homogenen Differential-Gleichungen II-ter Ordnung, Friedrich Wilhelms Universität zu Berlin, 1894, p.48. In this way he became the fifth mathematician in Serbia with a doctorate in science.

[5]Sur les zéros et les infinis des integrales des équations différentiel algébriques, Gauthier-Villars, Paris, 1894, p.109. Petrović returned from Paris as the fourth of the first five mathematicians in Serbia with a doctorate in science.

After Mihailo Petrović was appointed professor of mathematics at the Faculty of Philosophy of the Belgrade Higher School, Bogdan Gavrilović took over all the mathematics courses at the Faculty of Engineering. Their scientific, but also organizational work at the turn of the 19th century represented the great change in the Serbian scientific world. A huge shift was made away from basic mathematical subjects and problems, thus making a significant move towards global mathematics. This is especially true for Petrović. They remained the only representatives of mathematical sciences and math professors, both of theoretical and applied mathematics, continuing on to the University of Belgrade from 1905, through to the 1920s. Their interests in mathematics complemented each other. Petrović was mainly interested in mathematical analysis and differential equations. On the other hand, Gavrilović pursued algebra and geometry, especially combinatorics, the number theory, analytic geometry, determinants. While they often differed to a great extent, they opened all the doors to Serbian science and paved the way to the more advanced science of the Western Europe world. The defense of the first two doctoral theses in mathematical sciences at the University of Belgrade (Mladen Berić (1885–1935) in 1912 and Sima Marković (1888–1939) in 1913) took place in their time. The defense of these theses marks the beginning of Petrović's school of mathematics which was significant for the development of mathematics in Serbia, and also, due to the achieved mathematics results, recognized and esteemed abroad[6].

It was following the suggestion of Petrović and the wholehearted support by Gavrilović, as well as the consent of the Faculty of Philosophy, that in 1909 Milutin Milanković (1879–1958), another great name in the world of science, came to Belgrade from Vienna and accepted the position of professor of applied mathematics (rational mechanics, theoretical physics and celestial mechanics). His presence and activities at the University of Belgrade and the Mathematical Seminar left a significant mark on national science. He will become world famous and most cited Serbian scientist, and although the main results he achieved were in climatology and geology, it must be noted that mathematics takes an important place in all of his theories.

Results achieved by the Gavrilović–Petrović duo through their scientific and organizational activities are immeasurable for the cultural and intellectual history of Serbia. Gavrilović, as one of the most influential professors, is responsible for the transformation of the Belgrade Higher School into University (1905), and Petrović for the organization of the Mathematical Seminar at the University of Belgrade, the future center of mathematics in terms of scientific and mathematical education. It could be said that Petrović opened the door to the world science which his students entered in a big way and introduced Serbian mathematics into the world trends.

[6]Their careers did not last long. Berić, who was an associate professor, left the University in 1921 for personal reasons, while Marković turned to politics soon after defending his doctorate thesis. [**29**, pp. 241–247].

2. Mathematical Seminar

The Mathematical Seminar was founded and opened officially in 1896 when the Statute was passed at the Higher School which, among other things, provided for seminars in all departments of the Faculty of Philosophy. At that time, they were located in the Mansion of Captain Miša Anastasijević (Kapetan Mišino zdanje) and the Chair for Mathematics of the Natural Science Department had on the first floor only one auditorium with a large blackboard and one joint professor's room for discussions and research where the mathematical sciences library was located. These two rooms were named the Mathematical Seminar. At the time it was founded the Mathematical Seminar consisted of only two mathematicians from the University of Belgrade – Mihailo Petrović from the Faculty of Philosophy and Bogdan Gavrilović from the Faculty of Engineering. After having arrived in Belgrade, Milutin Milanković became the third member of the Seminar. Since Petrović and Gavrilović were members of the Serbian Royal Academy, the former since 1897 and the latter since 1905, the future activities of the Seminar were tightly linked to that of the Academy regardless of being officially an integral part of the University of Belgrade.

Immediately upon arriving at the Higher School, Petrović joined Gavrilović in the organization of Nešić's mathematics library. Petrović moved all the mathematical books he brought from France into the library of the Seminar. Based on the only remaining book of records of the first inventory of books at the Higher School Mathematical Seminar, dated 1902, we know that the library also included the following books: *Traite d'Analyse* by Paul Matthieu Hermann Laurent, *Geschichte der Mathematik* by Moritz Cantor, *Gesammelte Mathematische Werke* by Bernhard Riemann, *Differential und Integralrechnung* by Rudolf Lipschitz, *Determinanten* by Blaise Pascal, and *Lecons sur les séries divergentes* by Émile Borel; collections: Collection de mémoires des mathématiques and Collection de théses de doctorat à la Faculté des Sciences des Paris; and journals: Comptes Rendus De l'Academie des Sciences de Paris, Bulletin de la Société mathématique de France, Bulletin des Sciences Mathématiques, Mathematische Annalen, Revue semestrielle des publications mathématiques, Annales de la Faculté des Sciences de Toulouse, L'Enseignement Mathématiques, Zeitschrift für Mathematik und Physik, Acta Mathematica, and Crelle Journal für die reine und angewandte Mathematik. Over the years, the library collection of the Mathematical Seminar was expanded and carefully enriched with new books, and due to initial efforts of Petrović and Gavrilović and later the younger mathematicians, it became extremely well-stocked with the most current literature in mathematics. The most of them were destroyed and disappeared during the World War I. At the end of the War, Petrović requested and received a great number of major works in mathematics as part of war damage compensation.

The period between the two World Wars is the most significant period of the Mathematical Seminar with regard to the institutionalization of Petrović's school of mathematics, as the root of the overall development of mathematics in Serbia. During this period, the qualitative development of Serbian mathematics was greatly influenced by two mathematicians of Russian descent who came to Belgrade in the

1920's to escape from the Bolshevik Revolution in Russia, Anton Bilimovič (1879–1970) and Nikola Saltikov (1866–1961). They made a significant contribution to the reputation of the Serbian mathematics in the period between the two world wars. At this time, Radivoj Kašanin (1892–1989), one of rare Serbian mathematicians who were not students of the Belgrade University between two the World Wars, returned to Serbia after completing his studies in mathematics at the Sorbonne in Paris. In 1922, he accepted the position of assistant professor at the Faculty of Engineering, as soon as 1924, he successfully defended his doctorate thesis and, after B. Gavrilović retired in 1929, he took over all mathematics classes at the Faculty of Engineering. Kašanin made a significant mark in Serbian mathematics and the University program, but since he did not publish any of his works in foreign journals, he remained, undeservedly, anonymous outside Serbia.

With such individuals and scientists, the level of Petrović's Mathematical Seminar increased significantly. Demanding a high quality work at the University and within the Mathematical Seminar resulted in a pleiad of young and gifted mathematicians. They were created due to the efforts of, first of all, Mihailo Petrović. These are: Tadija Pejović, earned his PhD in 1923, Radivoje Kašanin (1924), Jovan Karamata (1926), Miloš Radojčić (1928), Dragoslav Mitrinović (1933), Danilo Mihnjević (1934), Konstantin Orlov (1934), Petar Muzen (1937), Dragoljub Marković (1938) and Vojislav Avakumović (1939). The new generation of Serbian mathematicians and Petrović's school of mathematics were in full plumage in the period between two World Wars. These new scientists began to express their own personal interest in various branches of mathematics, and through this interaction between new and old views, paths and methods the Serbian mathematics achieved great success. The important characteristic refers to the area of mathematics pursued by Belgrade mathematicians. They were all, more or less, Petrović's students and so their main interest was in problems in the area of mathematical analysis and differential equations. At the beginning of the 1920's, in Serbian mathematics there were no matrix theory, algebra and linear algebra; there was no mention of continuum problems; set theory, mathematical logic, axiomatization of algebra were a very far distance from Serbian mathematicians of those generations. Most of vector calculus and vector analysis was present only in the classes and textbooks of Milutin Milanković, in other words, in applied mathematics. Also, there was almost complete lack of geometry, not only in science but in education as well. Petrović's school of mathematics did not foster geometry or favor this very important area of mathematical science. The organization and planning of geometry classes did not begin begore 1930 when, upon the initiative of M. Petrović and N. Saltikov, Miloš Radojčić (1903–1975) was hired by the University for the main purpose of teaching courses in geometry, although during his career he taught various subjects and in his scientific work he mainly pursued the theory of analytic complex functions and the theory of relativity[7].

During the 1920's, the expansion of the University and introduction of new departments occurred, the number of teachers and Seminar members slowly increased

[7]About M. Radojčić see [**17, 30**].

up to 15 and so the Mathematical Seminar was given four rooms for the library and a place where the members could gather and carry out their regular activities. Their science papers covered equally theoretical and applied mathematics and were published regularly, not only in the Academy publications, but also in publications of European academies of sciences (Paris, Belgium, Poland, Czech) and well-known European science journals such as: Comptes Rendus (Paris), Bulletin des Sciences Mathématiques, L'Enseignement mathématique, Bulletin of the American Mathematical Society, Mathematica (Cluj), Mathematische Zeitschrift, Journal für die reine und angewandte Mathematik, Studia Mathematica (Lwów), Abhandlungen aus dem Mathematischen Seminar der Hansischen Universität, Proceedings of the London Mathematical Society, etc.

In 1932 two Belgrade University trusts "Luka Ćelović-Trebinjac" and "Pavle and Katarina Kurtović" helped the foundation of Publications mathématiques de l'Université de Belgrade – the first international mathematical journal in Serbia. His founder and editor was Anton Bilimović. Five volumes were published until 1941 and the World War II, while the sixth and seventh volumes were lost in the printing shop during the German bombing of Belgrade, that occurred on April 6, 1941[8]. Through these seven volumes with more than 100 papers published on over 1300 pages, the newly established journal gained the great importance among Serbian mathematicians, but it was highly esteemed abroad as well – Paul Montel, H. Wendelin, Élie Cartan, Henri Lebesgue, Waclaw Sierpiński, Wilhelm Blaschke, Georges Valiron were, beside Serbian mathematicians, among the authors of these papers [**14**].

During this period, the most significant results were published by Jovan Karamata, perhaps the best known and most esteemed name from that period of development of Serbian mathematics[9]. While Mihailo Petrović, his professor and mentor, was a versatile scientist, researcher and travel writer, Karamata was a true mathematician. In science, he pursued pure mathematics and still as a young scientist, he published two papers that made him renowned in the mathematics world. His simple and elegant proof of the Hardy-Littlewood theorem from 1930 is found in the well-known monographs of Titchmarsh, Knopp, Widder, Hardy and Favard, while his regularly varying and slowly varying functions can be found in many areas of contemporary mathematics, but most of all probability and theory of differential equations. It might be interesting to single out another mathematician from the same school, Vojislav G. Avakumović (1910–1990). By sheer coincidence or fate, he began his mathematics studies in 1932 and, while still in school, published outstanding results, but his working years fall into the post-war period of the Mathematics Institute. Today, his research results are perhaps even more valuable and quoted more often than when they were published[10].

[8]Based on pure chance saved copies, that sixth-seventh volume was published as a facsimile edition in 1963. This edition shows that "As a testimony to the gratitude and affection of members of the Mathematical Seminar of Belgrade University, Volume 37–38 (was) is dedicated to Professor Mihailo Petrović on the occasion of his retirement after 44 years of scientific and pedagogical work."

[9]For more on Karamata see [**6, 18, 19, 21, 28**].

[10]For more on V. G. Avakumović see [**10**].

In addition to the Seminar, the Mathematician's Club of the University of Belgrade was also founded in the 1920's upon the initiative of Anton Bilimovič, as a casual and informal organization which also included mathematicians who did not left the most significant mark in the history of mathematical institutions in Serbia, and even some secondary school teachers. This was a club without rules, board of directors, annual elections and membership cards. Club meetings were held once a month. Members of the Club would present their scientific papers and following an analysis and discussion of the work, a decision would be made as to where and in what form the paper should be published. The Seminar members and the eldest members of the Club, academicians Petrović, Gavrilović and Milanković, once again played the leading role at the Club meetings. These meetings would always end in a fish restaurant, where they stayed long into the night enjoying good food, drinks and music [**23**, pp. 53–57, 70], [**3**, p. 177].

When in 1938 Mihailo Petrović decided to retire, he wrote a text entitled The Mathematical Institute of the University of Belgrade — a bee-hive of science activity, which was published in Politika, a prominent Belgrade daily newspaper, and in which the Mathematical Seminar is officially referred to as the Mathematical Institute for the first time[11].

During World War II and the occupation, from April, 1941 to October, 1944, the University and Mathematical Seminar were officially closed. Unfortunately, the entire building of the Faculty of Philosophy, including the Library and the Mathematical Seminar, were set on fire and burned to the ground during German retreat at the end of the war, in October of 1944. The entire extensive collection was lost, with the exception of only a few books that were lent out for personal use. And so, in the whirlwind of the war everything, except the people, disappeared. The books, journals, rooms, the Seminar no more existed. A great chapter in the institutional development of the Serbian mathematics was ended. All that remained were memories, a few archival records and enthusiasm of the individuals who survived.

3. Mathematical Institute of SAS

Already in 1944, the work began on renewal of all Belgrade scientific institutions, in an effort to normalize their activities as soon as possible. By successfully completing the most essential restorations of the damaged buildings, laboratories, and the astronomical and meteorological observatory, classes were ready to start at the University as early as the 1945–46 school-year. During this time the Mathematical Seminar of the Faculty of Philosophy included two Chairs – the Chair of Theoretical Mathematics (with professors N. Saltikov, T. Pejović, J. Karamata

[11]Politika, May 8, 1938, p.9. The article was written on the occasion of the retirement of a group of university professors. It was not signed and the names of the members of the Mathematical Institute were not given. In those times, modesty among the most prominent figures was not rare! After researching the Legacy of Mihailo Petrović, it was established that the author of this article was M. Petrović (see [**26**, book 10, pp. 65–69], with comments by Dragan Trifunović).

and M. Radojčić) and the Chair of Applied Mathematics (with professors M. Milanković, A. Bilimovič and V. Mišković) – and Mathematics and Astronomy Study Groups. Mathematics courses (both theoretical and applied) were continued at the Faculty of Engineering as well (with professors R. Kašanin, M. Tomić and T. Anđelić).

When the Serbian Academy of Sciences resumed its activity after World War II, discussions were held regarding steps that should be taken in order to expand scientific work, not only within the Academy, but in the whole of Serbia, in a country horribly devastated by the war in which the number of reputable and promising mathematicians had declined leaving a small number of those who were able to pursue scientific work. Mathematics in Serbia found itself in an unfavorable position, especially after the priceless library of the Mathematical Seminar burned down. This is why, during one of the Academy's meetings in September of 1945, Academician Anton Bilimovič (1879–1970) introduced his idea suggesting that the Mathematical Institute should be established within the Serbian Academy of Sciences. This suggestion was supported by M. Milanković and Aleksandar Belić (1876–1960), who was the president of the Academy at that time[12]. Draft regulations of the Mathematical Institute were adopted at a conference of the Academy of Natural Sciences of the Serbian Academy of Sciences and the final decision regarding its formation was made at a meeting of all academicians, which took place on April 26, 1946. The seat of the Institute was situated in the building of the Serbian Academy of Sciences. This was how the Mathematical Institute became the first, today the oldest, scientific and research institute in Serbia. The three primary goals of the Institute were: to gather scientists in the field of mathematical sciences, provide them with the conditions to do the best possible research work and use the achieved results to further mathematical sciences and broaden mathematical knowledge; to choose among the young associates those who demonstrate the desire and ability to do scientific work and enable them to become independent scientists; to establish contact and collaborate with similar institutions in the country and abroad, and represent the country in world organizations committed to the advancement of mathematics. The institute consisted of full and part-time associates, external associates and administrative, technical and support staff.

The Science Council of the Mathematical Institute was established on May 23, 1946 and the appointment of academic Anton Bilimovič, as its first director, and the corresponding member of the Serbian Academy of Sciences, Radivoj Kašanin, as the secretary of the Institute, was confirmed. The first Science Council included academicians: M. Milanković, B. Gavrilović, A. Bilimovič, V. Mišković and N. Saltikov; and corresponding members: J. Karamata and R. Kašanin. Unfortunately, the name of Mihailo Petrović was not found among the associates and members of the pre-war Mathematical Seminar – the cradle of the Mathematical Institute. At the start of the war, he was taken to a prison camp in Germany and soon after his release and return to Belgrade, in 1943, he passed away. Still, his vision of the Mathematical Institute lived on, and in the second half of the 20th

[12]Almanac of the Serbian Academy of Sciences, 1946. Also see [**4**].

century, Petrović's successors, as well as their students, finalised the famous Belgrade School of Mathematics based on the groundwork and ardent efforts of Mihailo Petrović and Bogdan Gavrilović in the period between the two great wars[13].

New associates of the Institute were elected at subsequent conferences of the Serbian Academy of Sciences. In 1946, they were: Ivan Arnovljević, Jakov Hlitčijev, Tadija Pejović, Milan Vrečko, Miloš Radojčić, Vojislav Avakumović and Tatomir Anđelić, and in 1947: Dragoljub Marković, Konstantin Voronjec, Miodrag Tomić, Miodrag Milosavljević, Danilo Rašković and Manojlo Maravić. The newly elected associates were chosen from among university teachers, therefore they were not necessarily members of the Academy and they all constituted the Council of the Institute. It might be interesting to note that all scientists, who were associates of the Institute, received a small financial incentive for their work. Among the members and associates, there were those who chose mechanics as their field of study, in other words, applied mathematics. At the time the Institute was established, the opinion was that the two fields of science – theoretical and applied mathematics (primarily mechanics and theoretical physics) – should be developed within the same Mathematical Institute, in accordance with the tradition of the University of Belgrade. And they were, until 1961 when a separate department of mechanics was formed. In time, the Mathematical Institute, with its formally shaky but essentially firm structure, became a true pivot of mathematical life in Serbia.

3.1. Contributions and activities of the Mathematical Institute. A few great contributions of the Mathematical Institute were realized immediately upon its formation. The first significant achievement of the Institute was maintaining a high scientific level of mathematics in Belgrade and Serbia and introducing young, talented mathematicians to scientific work. The first to receive scholarships from the Mathematical Institute were Bogoljub Stanković (1924), Branislav Miljković, Mileva Prvanović (1929–2016), Stevan Grujić, Milenko Nikolić and Branislav Lapčević. The most prominent among them are B. Stanković and M. Prvanović, university professors and academicians. Together with Manojlo Maravić and Ranko Bojanić, they were appointed junior teaching assistants at the Mathematical Institute between 1949 and 1951. Soon afterwards the first doctoral dissertations were

[13]Similar term – the Yugoslav School of Mathematics – was first used by N. H. Bingham (in the preface of the monograph of N. H. Bingham, C. M. Goldie, J. L. Teugels, *Regular Variation*, Encyclopedia of Mathematics and its Applications, vol. 27, Cambridge University Press 1987,) and E. Seneta (in the preface of his monograph: E. Seneta, Regularly Varying Functions, Springer, Berlin 1976), and it was primarily used to refer to Karamata's students and associates: V. G. Avakumović, Miodrag Tomić, Ranko Bojanić (1924–2017), Slobodan Aljančić (1922–1993), Vladeta Vučković (1923–2012) and the somewhat younger Časlav Stanojević (1928–2008), Bogdan Bajšanski (1930–2008), Dušan Adamović (1928–2008), Vojislav Marić (1930) and Dragoljub Aranđelović (1942–2010). The youngest generation included Tatjana Ostrogorski (1950–2005), Slobodanka Janković (1951) and Slavko Simić (1950). Five names affiliated with this school became members of the Serbian Academy of Sciences and Arts, and four professors at prominent universities in the U.S. Perhaps a more precise name for this school would be Karamata's School of (classical) Mathematical Analysis which, together with Petrović's school, comprises the Belgrade School of Mathematics.

defended at the Institute: Tomić in 1950, Slobodan Aljančić (at that time an assistant at the Faculty of Natural Sciences) in 1953, Bojanić in 1953 and Stanković in 1954. The young mathematicians transferred to the universities of former Yugoslavia: Stanković and Prvanović moved to Novi Sad, Maravić to Sarajevo, Bojanić to Skopje, while Tomić stayed in Belgrade. Two mathematicians from Novi Sad who became esteemed mathematicians, as well as members of the Serbian Academy of Sciences and Arts, should also be mentioned: Mirko Stojaković (1915–1985) who pursued algebra and automata theory, and Vojislav Marić, whose focus is on classical mathematical analysis and in particular the qualitative analysis of solutions of ordinary and functional differential equations. They both took an active part in the work of the Institute after 1950, and Stojaković was later even appointed its director.

The next was the starting of issuing of today legendary journal in Serbian mathematics, Publications de l'Institut Mathématique, regarded as the successor of prewar Publications Mathématique de l'Université de Belgrade. The first issue was published in 1947, and is still being published today. Publishing a paper in this journal was the primary goal of every young mathematician entering the world of science. This was where the most of Serbian mathematicians, as well as a pleiad of scientists from abroad, published the results of their research. Here are only some of the more significant names: Waclaw Sierpinski, Wolfgang Jurkat, Alexander Peyerimhoff, Georges de Rahm, David Vernon Widder, Erich Kamke, Karl Knopp, Otto Szász, Hubert Delange, Paul Erdös, Tord Ganellius, Béla Szökefalvi-Nagy, Lothar Collatz, B. S. Yadav, and C. T. Rayagopal. The fact that the journal was sent regularly to science institutions around the world and that in exchange the Institute annually received over 200 world journals speaks for the reputation of the Publications de l'Institut Mathématique abroad. In order to intensify activities in publishing, especially to enable young mathematician to acquaint themselves with methods of scientific work and the problems of contemporary directions in mathematics, the first issue of the Zbornik radova – Recueil de Travaux, a new publication of the Mathematical Institute, came out in 1951. It was published until 1960 and it will be remembered for publications of doctoral dissertations of M. Tomić, S. Aljančić, V. Vučković, M. Maravić, R. Bojanić, V. Marić, B. Bajšanski, and B. Stanković (mathematical analysis) and M. Prvanović (geometry). In cooperation with the Serbian Society of Mathematicians, Physicists and Astronomers, in 1964 the Institute launched a new series of the journal Matematički vesnik (Bulletin de la Societé des mathematicians et physicians de Serbie). It was published for 13 years before being completely taken over by the Serbian Society of Mathematicians, Physicists and Astronomers. The journal included science articles, short notes, review articles, book reviews and various mathematical problems. Papers published in all these journals were regularly referred to in the well-known review journals: Mathematical Reviews (USA), Zentralblatt für Mathematik und ihre Grenzgebiete (Berlin) and Referativni Žurnal (Moscow). This speaks not only of the reputation of the Institute's journals, but also of the true value of the articles published in them (see [**2**]).

Shortly after the Institute was founded, three historical and major works in geometry were translated for the Classical Scientific Documents (Klasični naučni spisi) edition: 13 volumes of *Euclid's Elements* (1949–1957, translated by A. Bilimovič), *Foundations of Geometry* by David Hilbert (1954, translated by Ž. Garašanin) and *Geometrical Investigations on the Theory of Parallels* by Nicolai I. Lobachevsky (1951, translated by Branislav Petronijević) [14]. The following three monographs were printed by 1961 as part of the publication Special Editions (Posebna izdanja): *Teorija i praksa Stieltjesova integrala* (Theory and Practice of the Stieltjes Integral) (1949) by J. Karamata, *Dinamika čvrstog tela* (Dynamics of Solids) (1955) by A. Bilimovič and *Astronomska teorija klimatskih promena – njen postanak i odjek* (The Astronomical Theory of Climate Change – Origin and Effect) (1957) by M. Milanković[15]. We should mention that the Institute also published monographs regarding certain areas of mathematics and their application (mathematical logic, Boolean algebra, combinatorics, probability, numerical mathematics and computer programming), as well as special editions of the Astronomy and Numeric Group, Nautički godišnjak (Nautical Almanac) (6 volumes) and Godišnjak našeg neba (Almanac of our Sky – Annuaire de notre ciel) (7 volumes). In addition to its own publishing activities, from 1946 to the 1970's the Mathematical Institute collaborated and exchanged publications with almost 350 science academies, scientific institutions, institutes and libraries in 46 countries around the world.

Along with publishing activities the great effort has been done in opening and organizing of the Institute's new library. At the time the Institute was established, it did not have a single book because the entire collection of mathematics books had been destroyed during the previous war. By 1970, the library collection included approximately 8,700 books and 520 mathematics journals, about 300 of which were from other countries, mainly from the U.S. (51), Soviet Union (37), Japan (32), Italy (31) and Germany (28) [**2, 3**].

The important activity of the Mathematical Institute also was the organization of seminars and regular sessions. The first scientific exposition at the Mathematical Institute was presented during the II Session, in July of 1946, by Anton Bilimovič. From 1946 to 1961, 588 sessions were held at the Institute (440 in mathematics and 148 in mechanics), at first, once a month and later every week, with the exception of the summer vacation, and each time with at least one exposition. Up to 1961, all sessions were held within the Council of the Institute, but later expositions were held at the Mathematics Department and the Department of Mechanics. All

[14]Later, as a part of a new series, the following works were published: *A Dissertation on the Law of Continuity and its Consequences Pertaining to the First Elements of Matter and of its Powers* by Ruđer Bošković (1975), *Continuity and Irrational Numbers* and *What Are Numbers and What Should They Be?* by Richard Dedekind and *Über die Ausdehnung eines Sätzes aus der Theorie der trigonometrischen Reihen* (On the Generalization of a Theorem from the Theory of Trigonometric Series) by Richard Cantor (1976, translated by Zlatko Mamuzić), *Ten Apollonius Circle Problems* by Anton Bilimovič (1977).

[15]By 1981, another 14 monographs were published whose authors were associates of the Institute, Spomenica Mihailu Petroviću 1868–1968 (Memorial to Mihailo Petrović 1868–1968, Rečnik matematičkih termina (Dictionary of Mathematics Terminology) (1966).

through to the 1990's, information on the expositions was scattered in various, often illegible and incomplete minute-books and reports hand-written by the Institute administrators or leaders of the sessions and seminars, filed away in archives, and Serbian Science Institute reports. Some of the documents were even lost. Thanks to Milan Čavčić, the irreplaceable 'all-purpose man' at the Mathematical Institute at the time, the remaining preserved documents were all gathered in one book, Saopštenja naučnih rezultata u Matematičkom institutu: 1946–1961 (Expositions of Scientific Results of the Mathematical Institute: 1946–1961), which was published by the Mathematical Institute and the Serbian Academy of Sciences and Arts. This book shows that, in that period, the sessions included 133 lecturers, 87 of which were from Serbia and 46 from abroad. The greatest number of expositions was presented by Karamata (42), Avakumović (40), Tomić (36), Saltikov (31), and Bilimovič (30), [**3**]. Prominent world scientists were also invited to these sessions and this was an excellent way to ascertain the newest achievements in the world. They would often give series of lectures presenting an area of their scientific work. The following were only some of the foreign lecturers: Einar Hille, Ralph Palmer Agnew, Arnaud Denjoy, D. V. Widder, H. Delange, Lars Valerian Ahlfors, Jeorme Keisler, Leon Henkin, Alfred Tarski and Walter Rudin (USA), János Aczél (Hungary), C. T. Rajagopal (India), Maurice Fréchet and Jean Favard (France), A. Peyerimhoff (Germany), W. Sierpinsky and Kazimierz Kuratowski (Poland), Sergei Lvovich Sobolev and Pavel Sergeyevich Aleksandrov (USSR), Ian Sneddon (Scotland, Great Britain), Paul Erdős (Jerusalem), G. de Rahm (Switzerland), Enrico Bompiani (Italy), T. Ganelius (Sweden). The majority of these expositions were included in publications of the Institute and Academy (Glas de l'Académie Serbe des Sciences et des Arts, Bulletin de l'Académie Serbe des Sciences et des Arts), as well as many foreign journals. At that time, mathematicians from all parts of the former Yugoslavia frequently visited Belgrade and the Institute: Željko Marković, Đuro Kurepa, Danilo Blanuša, Vilko Niče, Stanko Bilinski (Zagreb); Ivan Vidav, France Križanić (Ljubljana); Veselin Perić, Šefkija Raljević, Vera Šnajder, Mahmut Bajraktarević (Sarajevo), Ǵorǵi Čupona (Skopje). Today, they are all included in their national histories of mathematics.

4. Epilogue

The year 1947 is institutionally significant because this was when the mathematical and natural science disciplines were separated from the Faculty of Philosophy of the University of Belgrade, and the Faculty of Natural Sciences, comprised of five departments, was founded. The Mathematics and Physics Department included Study Groups on mathematics, astronomy and physics. The Chair of Applied Mathematics was discontinued and theoretical physics was added to the Physics Group, while mechanics was included in the newly formed Chair of Celestial Mechanics and Astronomy (soon after renamed the Chair of Mechanics and Astronomy). A separate Mechanics Group was formed in 1951. This marks the beginning of the independent development of mechanics as a science, and higher education mechanics. The education of the first post-war generations of mathematics students at the University of Belgrade was still influenced by areas in mathematics pursued by M. Petrović and his successors – most of the courses dealt with mathematical analysis and other similar areas of mathematics. During regular meetings of the members of the Institute and seminars, many original scientific results were presented. They were discussed, and as a result new papers and doctorate dissertations were written both in the field of classical mathematics (analysis, differential equations, algebra) and in newer areas of mathematics, which had just begun to develop in Serbia (topology, functional analysis, control theory, number theory, differential and projective geometry, mathematical logic and automata theory). Seminars and special courses were as follows: The Notion of Regular Variation (J. Karamata, D. Marković and M. Tomić were the hosts and lecturers); General Astronomy (V. Mišković); Successive Approximations and Zero Integrals of Nonlinear Differential Equations of the Second Order, Differential Equations of Mathematical Physics and Eigenfunctions of Second-Order Limit Problems (V. G. Avakumović); Orthogonal Systems and the Fourier Series, Slowly Varying Functions and Their Application, Torsor Calculation and General Methods of the Summability of Fourier Series (J. Karamata). When Vladeta Vučković in 1959 published his first paper *Partially Ordered Recursive Arithmetic*[16] in the area of mathematical logic, it caused a great surprise among the Serbian mathematicians of that time. This paper marks the beginning of studies and the development of this area of mathematics in Serbia. In addition to all previously mentioned seminars that were organized at the Institute, the Seminar on mathematical logic, which was founded and led by Slaviša Prešić (1933–2008) and Aleksandar Kron (1937–2000), held during the 1970-ies and 1980-ies. Prešić and Kron could be considered as the founders of mathematical logic in Serbia, as well as their Seminar for dominant one in the life of the Mathematical institute in that time. As these circumstances had a great impact on many of our modern mathematicians and logicians, the arrival of Đuro Kurepa (1907–1993) in Belgrade in 1965 had the influence primarily the on development of set theory, topology, but also number theory, graph theory, combinatorics, foundations of mathematics, in the similar way. Through the terms of Kurepa tree, Kurepa family, Kurepa line, his name stays forever in the world of mathematics and he was undoubtedly one of the most famous and influential mathematicians of the former Yugoslavia[17]. It could be said that after Petrović's and Karamata's schools of mathematics, his students and collaborators belong to the third Serbian school of mathematics – Kurepa's school of topology and algebra.

During the fifties, officially due to economic reasons, J. Karamata went to Switzerland (Université de Genève) and in 1960, for similar reasons, V. G. Avakumović moved to Germany (Philipps University at Marburg an der Lahn) and M. Radojčić to France (Centre national des recherche scientifique, Paris). The first two men were scientifically the most important figures and the driving force at the Mathematical Institute during the first ten years of the post-war period. They gathered around them young generations of mathematicians with an interest

[16] Math. Scand. **7** (1959), 305–320.
[17] More on Kurepa see [**8, 12, 9**]

in scientific research and they worked with their students, not always in the classrooms of the Institute, but also in private homes or even bistros. And once again the academicians from Mathematical Institute, as M. Petrović poetically stated – the bee-hive of scientific work in Serbian mathematics – played a key role. Thanks to the enthusiasm of the new generations and a number of mathematicians and mechanics professors, all genuinely devoted to science, the Mathematical Institute survived many later reforms. This only confirms that the Institute was built on a stable foundation, both in 1896, as Petrović's Mathematical Seminar, and in 1946, as the Mathematical Institute of the Serbian Academy of Sciences. We should also mention that all technical and administrative tasks, pertaining to the organization of work at the Institute, operation of the library, all publishing activities and translations, were during the not so easy post war period performed usually by only two men: Vojislav Popović and Milan Čavčić.

Continuous discussions regarding the reorganization of the Academy's institutes, especially in the second half of the 1950's, were in fact directed towards the separation of all institutes, including the Mathematical Institute, from the Serbian Academy of Sciences and their ultimate independence. Neither of the first two directors of the Institute – A. Bilimovič (1947–1949) and J. Karamata (1949–1951)[18] – were adherent to the new rule. The subsequent directors of the Institute, R. Kašanin (1951–1958) and M. Tomić (1958–1961), made a great effort to preserve the mission and profile of the Institute. After 15 years of working within the Serbian Academy of Sciences, the Mathematical Institute, together with the rest of the institutes at the Academy, was separated from the Academy of Sciences in 1961 and became an independent science institution. The board members as well as the majority of members of the Mathematical Institute, especially its director Miodrag Tomić, were against separating the Institute from the Serbian Academy of Sciences and Arts. While other Institutes were separated by self-management agreements, the Mathematical Institute was "forcefully" separated by a special Decree regarding its new foundation[19]. The 438th and final Session of the Mathematical Institute Council, which was held within the Serbian Academy of Sciences, took place on May 17, 1961 (see [**4**, pp. 46–48]). Now, as an independent science institution, the Mathematical Institute took over the staff and resources and assumed the rights of the former Mathematical Institute. The first session of the Council of the independent Institute was held on June 13, 1961. Bogdan Vujošević, who had a degree in mechanics, was elected as the president of the Council of Mathematical Institute and professor Tadija Pejović, who was an esteemed mathematician and retired professor of Belgrade university[20], was appointed as the director of the Mathematics Institute by the Executive Council of the People's Republic of Serbia. This was a

[18]Although Karamata was officially appointed director of the Mathematical Institute, he never formally entered upon the position (see [**20**])

[19]We are grateful to dr Zoran Marković, the former director of Mathematical Institute in the period from 1985 till 2015, for this important detail.

[20]In the opinion of Miodrag Tomić [**27**, p. 25] Pejović's results are, after Petrović's papers, among the best contributions in the field of differential equations published in Serbia until World War II.

new era for the Serbian mathematics. Because of the changed working and living conditions, some of young mathematicians left the country and moved to the U.S. in the sixties[21] On the other side, S. Aljančić from the Faculty of Natural Sciences and M. Tomić from the Faculty of Mining and Geology, remained in Belgrade. But all those for whom the Institute had been a science haven, almost like a sanctuary, experienced this new situation with great sadness and found it difficult to endure.

In 1992 Mathematical Institute was returned to its position within the Serbian Academy of Sciences and Arts.

The subsequent development of the Institute and mathematics proceeded in accordance with contemporary world trends. Groups of scientists, which independently make their way through the world of science, are formed at all Serbian universities – Novi Sad (1960), Niš (1971), Kragujevac (1976) – but the Mathematical Institute of Serbian Academy of Sciences and Arts in Belgrade remains to the present days as the center of mathematics development in Serbia. Probably, there is not any prominent Serbian mathematician who has not given at least one lecture on the premises of the Mathematical Institute or has not attended at least one of its numerous seminars and science conferences.

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