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WORLD WAR I AND MATHEMATICS IN "THE RUSSIAN WORLD"

I WOJNA ŚWIATOWA I MATEMATYKA W IMPERIUM ROSYJSKIM

Abstract

The First World War marked a turning point in the Russian history. The country entered the war in August 1914 as an empire, and in 1918, when the war ended, its name was: the Russian Soviet Federative Socialist Republic. In 1917 it confronted two revolutions – the February and the October Revolutions. As a result of the October Revolution, the Bolsheviks ruled the country and began the construction of a new type of state. In 1918 a civil war broke out, which was largely over in 1920, but in some areas continued until 1922. In the end of 1922 the USSR was formed – the Union of the Soviet Socialist Republics. In this article we analyze the impact which these events had on academic and mathematical life. We discuss the mathematical schools of St. Petersburg and Moscow, mathematical centers in Kazan Kharkov, Kiev and Odessa, academic institutions relocated inland (University of Warsaw ,Riga Polytechnics) and others. We also mention mathematicians immigrants from Russia, who became a common phenomenon in mathematical communities of other countries.

Keywords: *history of mathematics in the Russian empire at the turn of 19th and 20th centuries, changes in mathematical centers in the Soviet Russia*

Streszczenie

Pierwsza wojna światowa wyznaczyła punkt zwrotny w historii Rosji. Kraj do początku wojny w sierpniu 1914 roku funkcjonował jako Imperium, a w czasie jej zakończenia w 1918 roku jego nazwa brzmiała: Rosyjska Federacyjna Socjalistyczna Republika Radziecka. W wyniku rewolucji październikowej bolszewicy rządzili krajem i rozpoczęli budowę nowego typu państwa. W 1918 roku wybuchła wojna domowa, która w wielu miejscach trwała do roku 1920, zaś w niektórych do roku 1922, z którego końcem powstał ZSRR – Związek Socjalistycznych Republik Radzieckich. W artykule analizujemy wpływ wspomnianych wydarzeń na matematyczne życie naukowe. Omówione zostaną szkoły matematyczne w Petersburgu i Moskwie, ośrodki matematyczne w Kazaniu Charkowie, Kijowie i Odessie, a także instytucje akademickie ewakuowane w głąb Rosji (np. Carski Uniwersytet Warszawski, Politechnika Ryska) i inne. Wspomnimy również matematyków imigrantów z Rosji, którzy zasłużyli się w ośrodkach matematycznych innych krajów.

Słowa kluczowe: *historia matematyki w imperium rosyjskiego na przełomie XIX i XX wieku, zmiany w ośrodkach matematycznych w Rosji Sowieckiej*

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1. Introduction

On July 19 (August 1) 1914 Germany declared war against Russia, and the conflict between Austria-Hungary and Serbia, of a seemingly local significance, turned into a major war, later called First World War . The official completion of that war was on June 28, 1919 – the date of the signing of the Treaty of Versailles, which summed up the war's preliminary results. One of the results was a collapse of four empires –the Russian, German, Ottoman and Austro-Hungarian empires. This collapse changed radically the political map of the world. The balance of forces in the world changed completely and, last but not least, the spirit of international relations changed. The methods of warfare marked the unprecedented importance of a technological factor, the equipment of troops based on advanced technologies, which was determined by scientific and technological level of adversaries. Science and technology, which at the turn of the century seemed the basis for the future progress of humanity, became a source of military power aimed at the destruction of the enemy and the victory that promised domination. Russia entered the First World War having the rank of an empire, and by the date of its formal completion was already a republic – the Russian Socialist Federative Soviet Republic. During the war, she experienced two revolutions – the February 1917 one and the October 1917 one, and the fratricidal civil war, which lasted until 1923. It was only the end of this war that became the actual completion of the First World War for Russia. The country has entered its next break between the First and the Second World Wars as the Union of Soviet Socialist Republics. This Union, founded December 29, 1922, was proclaimed as the state of a new type – a republic of workers and peasants, built on the ideological foundations of Marxism, in which the power was actually carried out by the Bolsheviks (VKP (b) – All-Union Communist Party of Bolsheviks) headed by V.I. Lenin.

The aim of our report is to try to trace the evolution of mathematics (i.e. of the mathematical community, of its institutions, of mathematical research and of mathematical education) during the war in the "Russian world", that is, in the Russian-speaking world of people who met the beginning of the First World War as citizens of the Russian Empire, but many of whom later found themselves far beyond its borders as a result of the dramatic historical events of those years. Let us try to answer the question of what role the war played in this development.

To understand and appreciate the scale of changes which occurred during the war, try to start to look at the Russian mathematics in early summer 1914, as it met the beginning of war. Let us go back to May – beginning of June of that year – to the end of the last semester of peace in the history of the higher education of the Russian Empire.

2. Mathematics of the Russian Empire by the summer of 1914

The main centers of mathematical life of the Empire were its capital – St. Petersburg and Moscow. In St. Petersburg the centers were the Imperial Academy of Sciences and the University. These institutions were connected with the activity of the school known in Russia and in Europe as the Petersburg mathematical school or school of P.L Chebyshev which grew

in the last third of the XIX century into one of the most important in Europe. Its main areas of studies became probability theory, constructive theory of functions, analytical mechanics, mathematical physics and number theory, which at the beginning of the twentieth century were represented by such names as A.A. Markov, A.M. Lyapunov and V.A. Steklov. The orientation of studies towards applications dominated in St. Petersburg circles (the exception was the theory of numbers – a traditional area for the northern capital since L. Euler), along with the desire for a rigorous and at the same time effective solution of problems, for the construction of algorithms which permitted one to complete the solution either with a numerical answer or with a suitable approximation, as well as the desire for simplicity and using elementary means. In St. Petersburg the general understanding of mathematics and of its place in the world was positivist. Characteristic for it was a negative attitude toward idealistic philosophy, toward religion, and of course toward the monarchy. The policy of the school was defined by the leader of the school – the academician A.A. Markov – an outstanding mathematician, famous for his results in the theory of probability, approximation theory and number theory. His convictions were shared by the academician A.M. Lyapunov, the author of classical results in the qualitative theory of differential equations, mathematical physics and probability theory. Among their supporters was a student of Lyapunov, the academician V.A. Steklov, who began to gain popularity in the world for its results in the field of mathematical physics. All three were wonderful teachers, who lectured at university and other educational institutions of St. Petersburg. If one counts in addition such known scientists and teachers as Yu.V. Sokhotskii, K.A. Posse, D.F. Selivanov, I.I. Ivanov, N.M. Gyunter and Ya.V. Uspenskii, it is not surprising that St. Petersburg of that time was positioned in the mathematical world as one of the most important scientific and educational centers. The leading role in the upbringing of the new generation of mathematicians belonged to Steklov, who created one of the most prominent schools in the first third of the twentieth century. The most known of its representatives are: V.I. Smirnov, Ya.D. Tamarkin, A.A. Fridman. All of them stayed at the university in the years 1910 – 12 “to prepare for a professorship” (which was equivalent to the position of the modern post-graduate). In the same years, a pupil of Markov, A.S. Bezikovich, also stayed at the university. The explosion of scientific activity of young people in St. Petersburg in those years was largely prepared by the work that St. Petersburg mathematicians (Markov et al.) carried out among the student youth. A mathematical seminar for high school students was working with great success.

In Moscow, the focus of the mathematical life were the university and the Moscow Mathematical Society, functioning by the university since 1864, whose activities in the last third of the XIX century took the nationwide (all-Russian) character. In 1866 the Society started to publish the journal “Matematicheskii Sbornik”(Mathematical Collection), which became a platform for the developing Russian mathematical community. In Moscow, mathematics developed in a paradigm different from that of St. Petersburg. And although the Muscovites, like St Petersburg mathematicians, had inherent interest in the applied subjects (this is how the drive for the development of intellectual and industrial forces of the Empire, common to all the Russians of that time, manifested itself), all their other mathematical tastes radically diverged: Muscovites had special interest in the geometric studies and the aptitude for the idealist and even religious philosophy. This tendency became a reason why the school, which developed in the last third of XIX – the beginning of XX century, was named

a philosophical and mathematical one. The Moscow mathematical community welcomed the Orthodox Christianity and even the monarchism.

By the beginning of the century studies on mechanics (especially on aerodynamics and fluid mechanics) and differential geometry (in the direction laid by the works of K.M. Peterson) flourished in Moscow. The most important achievements of Muscovites of that time are associated with the names of N.E. Zhukovskii and D.F. Egorov. The difference in worldviews which characterized the mathematical communities of two capitals created a confrontational relationship between these communities. Petersburgers looked down at their Moscow colleagues and did not miss the opportunity to put "illiterate Muscovites" in place. Muscovites who were offended by this attitude of the academic Petersburg were looking for topics (if possible, far away from the interests of St. Petersburg) which would allow them to take a position defining the face of the modern mathematics (differential geometry and the mechanics of continuum did not count as fashionable at that time). At the beginning of the century they found such a theme – it was the theory of functions of a real variable, a new section of mathematics initiated by the French – E. Borel , H. Lebesgue and R. Baire. In 1911 in *Comptes Rendus* of the French Academy of Sciences, the article of Egorov "On a sequence of measurable functions" was published, which contained the well-known theorem that bears his name, and in 1912 in the same journal the article of his pupil N.N. Luzin on C-property of measurable functions appeared. These works began the history of one of the most influential mathematical schools of the twentieth century – of the Moscow school of function theory. So in the spring of 1914 the face of mathematics in Moscow was determined as follows: in applied mathematics, by Zhukovskii and his pupils, in differential geometry, by Egorov and B.K. Mlodzeevskii. S.S. Byushgens and S.P. Finikov started to work on their master's theses (magister thesis) on the theory of surfaces, while V.V. Golubev, V.V. Stepanov and I.I. Privalov worked on various questions of the theory of functions. But the main event of the summer of 1914 was the return from a long trip to Göttingen and Paris of the rising star of the Moscow school, Luzin. In the fall semester he announced at the University a course on the theory of functions of a real variable and a seminar on the same topic. From this seminar, in the first years of its existence, grew the first generation of the famous Luzitania – D.E. Men'shov, M.Ya. Suslin, A.Ya. Khinchin, P.S. Aleksandrov.

These successes did not change the overall negative attitude of St. Petersburg to the Muscovites, especially since the set-theoretic works of Cantor and research on the theory of functions of a real variable based on these works (in the words of Uspenskii "Cantor's and Lebesgue's trash") were met by them with a point-blank hostility. The confrontation between Muscovites and Petersburgers created the tension throughout the Russian mathematics community: we must not forget that the majority of teaching staff in Russian universities were graduates of the metropolitan universities.

And in the Russian province in the late XIX – the early XX century there was a sharp rise in mathematical activity. Although traditionally the whole social and cultural life of the Russian Empire was rigidly centralized, and the top-down power pervaded all fields of activity, at the distance from the capitals the impact of the managing hand became nevertheless noticeably weaker.

In particular, in the province it was possible to develop freely the ideas coming from the West which did not find support among the capital's mathematicians. So, in Kazan

University, besides the traditional (since N.I. Lobachevsky) geometrical topics studied by A.V. Vasil'ev, A.P. Kotel'nikov et al., there was the avant-garde research in mathematical logic of P.S. Poretskii and N.A. Vasil'ev.

The mathematical logic became a topic of research in a young Novorossiisk University in Odessa, with I.V. Sleshinskii and S.I. Shatunovskii. There V.F. Kagan began his geometrical research with the questions in non-Euclidean geometry and the foundations of geometry.

In general, at the turn of the centuries the mathematical life in the south of the Russian Empire considerably quickened. At Kharkov University, one of the oldest in the country, the high level of teaching was established by the efforts of Lyapunov and Steklov. In the prewar years such mathematicians as D.M. Sintsov, N.N. Saltykov, A.B. Psheborskii, and finally one of the greatest mathematicians of the twentieth century S.N. Bernshtein, worked there. Kiev University had very moderate mathematical achievements in the XIX century, but thanks to the endeavors of a remarkable representative of the St. Petersburg school D.A. Grave, who moved there in 1901, it sharply raised its mathematical level. By Grave's efforts a school was created in 1908–1914, which had mainly algebraic character. Such famous mathematicians as B.N. Delone, O.Yu. Shmidt, N.G. Chebotarev, who laid the foundation of the Soviet school of algebra, and also M.F. Kravchuk and A.M. Ostrovskii.came out from this school in those years. Among the mathematicians of the Warsaw University (where such well-known scientists as N.Ya. Sonin, V.A. Anisimov and G.F. Voronoi worked before) we can name two pupils of the St. Petersburg school – D.D. Mordukhai-Boltovskoi and V.I. Romanovskii. Although Yuryev (formerly Dorpat) University was at that period going through not the best of times, however, among its professors in 1914 we can see such known scientists as the alumni of Moscow University V.G. Alekseev and L.S. Leibenzon. Of the outstanding mathematicians working in those years in other educational institutions of the Russian Empire, we can name the outstanding algebraist professor of the Tomsk Institute of Technology F.E. Molin and one of the pioneers in the development of qualitative methods of the theory of differential equations, a professor of the Riga Polytechnic Institute P.G. Bohl. The listed names of the first-class mathematicians, the wide range of their research, the importance of the mentioned schools in the science of the twentieth century show that mathematics on the eve of the events of the World War I in the Russian Empire experienced a period of rapid growth. The Russian mathematical community also developed at extreme speed. Mathematical societies worked actively: besides the oldest Moscow mathematical society the Mathematical branch of Novorossiysk society of scientists in Odessa (founded in 1876), the Kharkov mathematical society (founded in 1879), the Kazan physical and mathematical society (from 1880 it existed as physical and mathematical section of the Kazan society of scientists, and from 1890 as independent society), the Kiev physical and mathematical society (founded in 1889).

A large number of participants gathered at the mathematical section of the All-Russian congresses of scientists and physicians, the first of which took place in January 1868 in St. Petersburg, and the last one on the 13th of June, 1913, in Tiflis. While at the First congress there were only 6 mathematical reports, at the 13th their number increased to 31. While at the first congresses the number of participants of mathematical sections was somewhere about 50, it rose by the last congresses to 500. At these congresses problems of school mathematical education were put forward and actively discussed. The leading Russian

scientists took part in these discussions together with teachers of high schools, who made the majority at the congresses. The importance of these problems became the reason for the organization of special All-Russian congresses of teachers of mathematics. The first such congress was carried out in St. Petersburg in January of 1912, the second in Moscow in January of 1915. The central theme of these congresses was the teaching reform; the movement towards reform, headed by F. Klein, was supported passionately by the Russian mathematical community. The training of school students in the functional thinking, and also the introduction to the school program of elements of "higher mathematics" became a goal of this reform. Russia took active part in the work of the International commission on teaching mathematics created in 1908. N.Ya. Sonin became the chairman of its Russian section (subcommittee).

In general the Russian mathematicians appeared as active participants in the all large international undertakings of the end of XIX century and the beginnings of the XX century. They were active participants of the international congresses of mathematicians, starting from the first in 1897 in Zurich, then in Paris (1900), Heidelberg (1904), Rome (1908), finally, in the last pre-war congress of 1912 in Cambridge. They apprehended with enthusiasm the beginning of the large project carried out by the Berlin mathematician C. Ohrtmann – "Books of achievements of mathematics in a year" (Jahrbuch über die Fortschritte der Mathematik), whose first volume was issued in 1871 – and took an active part in it. A.N. Korkin, E.I. Zolotarev, K.A. Posse, D. M. Sintsov cooperated with this year--book. As A.V. Vasil'ev wrote: "It is very difficult, I think, to estimate that enormous benefit which it brought; in particular, of course, the Russian science is especially obliged to it. With amazing ignorance of our language by foreigners … only thanks to this Jahrbuch the Russian mathematical literature could become known to the mathematicians of other countries" [1, p. 323]. The Russian mathematicians took part in implementation of the international project "Enzyklopädie der mathematischen Wissenschaften" organized in Germany – .D.F. Selivanov wrote the section on the calculus of finite differences (1901), A.N. Krylov in cooperation with C. Müller wrote the section on the theory of the ship (1906–1907), T.A. Afanas'eva-Ehrenfest in a co-authorship with her husband P. Ehrenfest wrote on statistical mechanics (1909–1911).

The Russian mathematicians became frequent visitors in Paris and Göttingen and actively published in the French, German and Italian mathematical journals. Long scientific trips of the persons "prepared for a professorial rank" in the leading European mathematical centers became a usual practice of the Russian system of mathematical education. Already mentioned Luzin, still being a student, at the end of 1905 was sent to Germany and France, from where he returned only in the summer of the next year. And while working on his master thesis he stayed in these countries since the end 1910 until the beginning of summer of 1914.

Many leading Russian professors spent a considerable time in the West. Some of them met the beginning of the World War I in such study tours.

One can say that the Russian mathematics met the World War I as an integral part of the European mathematical world. And though the Russians were not among its leaders – those were still the French and Germans, with Italians snapping at their heels – nevertheless the Russian mathematical community was one of its most successful and dynamically developing groups.

3. Mathematics and mathematicians in the first years of the war (before the February revolution of 1917)

When during the military operations there was a real danger of the entry of the German troops on the territory of the Russian Empire, the Russian government made the decision on the evacuation of higher educational institutions from the western territories far inland. So in 1915 the Kiev university was evacuated to Saratov, the Warsaw university to Rostov-on-Don.

Only in 1918 did the Warsaw polytechnical institute find a haven in Nizhny Novgorod, the Yuryev university in Voronezh, the Riga polytechnical institute in Ivanovo-Voznesensk.

The Kiev university returned home in the fall of 1916.Later the Warsaw and Riga polytechnical institutes, and also the Yuryev university (which became Tartu university) returned to the already independent states. The last three institutions returned respectively to Warsaw, Riga and Tartu already not in full strength: the Russian professors, with few exceptions, preferred to remain in Russia. So professors of the Warsaw polytechnical institute joined the structure of the Nizhny Novgorod university, and professors from Riga and Yuryev laid the foundation of the Ivanovo Voznesensk polytechnic institute and the Voronezh university, respectively. The former Warsaw university remained in Rostov-on-Don ever since.

Perhaps only at these schools, which were settling down at the western boundaries of the Empire, the war seriously broke the normal course of pedagogical process and scientific researches.

At all other universities – in Petrograd, Moscow, Kazan and even in Kharkov – the tide of life proceeded in a habitual rhythm. Lectures were given, scientific seminars were conducted (research seminars already were coming into fashion: for example in Moscow such seminars were conducted by Egorov and Luzin), the theses were prepared and defended.

It was very important that, by then-effective legislation of the Russian Empire, the youth studying at the higher schools, the persons staying at universities "for preparation for a professorial rank", the privat-dozents and the professors were not subject to a draft for an active military duty. This created necessary conditions for preservation of the scientific capacity of the country.

In Moscow Zhukovskii worked successfully with his pupils (S.A. Chaplygin, etc.). Their works on aerodynamics acquired special value because of the prospects of use of aeronautic equipment which were opened by the war. Mlodzeevskii and especially Egorov with his pupils continued to develop successfully the traditional (for Moscow) directions in differential geometry and in the geometric theory of partial differential equations. In the spring semester of 1914 Egorov announced a seminar on the theory of functions. Then, as Men'shov remembered later [2, p. 188], "just appeared … Lebesgue's integral and the so-called metric theory of functions". In the summer of that year Luzin returned to Moscow from Paris and announced his course on the theory of functions of a real variable. "Precisely this special course given from year to year and the seminar accompanying it … were the center from which the Moscow school of the theory of functions – a remarkable monument to scientific activity of N.N. Luzin – grew", – Men'shov said [3, p. 475]. Luzin then was preparing for the defense of his thesis, which was titled "Integral and trigonometric series";

it was published in 1915 and defended in May 1916. The work was so successful that the Academic board decided, as an exception, to grant immediately to the author of the thesis the degree of the doctor of pure mathematics, bypassing the master's degree. The thesis included also a result of his pupil A.Ya. Khinchin, who introduced a notion of asymptotic derivative. In the same year remarkable results of another of his pupils, Men'shov, appeared, and in 1915 yet another of his pupils, P.S. Alexandrov, proved a continuum hypothesis for the Borel sets (B-sets) – the sets which, according to a belief of that time, exhausted all stock of sets really used in mathematics. The belief, as it soon became clear, was incorrect: in 1916 the student of Luzin M.Ya. Suslin introduced a new type of the sets which were not B-sets: A-sets.

This class of sets, also called Suslin sets or analytical sets, turned into the main object of research in descriptive theory of sets for many years, becoming the trademark of Luzin school. Results of Luzin's pupils were immediately printed in the Parisian Comptes Rendus (we should not forget that Russia and France were allies in that war) and became known in Europe. Moscow was becoming one of the leading centers of mathematical research in Europe.

Petrograd (the name that St. Petersburg received after the beginning of the war with Germany) kept its position as a recognized European mathematical center. The academicians Markov, Lyapunov, Steklov kept working, N.M. Gyunter's and Ya.V. Uspenskii's research talents ripened, Yu.V. Sokhotskii, K.A. Posse, I.L. Ptashitskii, Selivanov, I.I. Ivanov continued their scientific and pedagogical activity, finally, the whole cohort of remarkable pupils grew – Smirnov, Tamarkin, Fridman prepared their master theses. A.S. Bezikovich and I.M. Vinogradov obtained their first-class results. The war affected the activity of the Petersburg school almost only in some delays in publishing and in postponing the dates of defending of theses. Only Friedman, who left for the front as a volunteer and in 1914–1916 served in air units, was involved directly in military operations.

Normal activity proceeded in other Russian educational institutions located in the territories which were not affected by military operations.

4. Mathematics and mathematicians in the era of the collapse of the Russian Empire

The situation started to change sharply in the era of the revolutionary events of 1917, especially after the October revolution, which led to the cardinal change of the system of the civic life, to the demolition of the old state machinery, to the establishment of the new orders unknown hitherto and to a fratricidal civil war. All territory of the former Empire flared. Of course, such events extremely negatively affected the life of the scientific and the educational institutions.

The termination of the normal functioning of the institutions of power and the disastrous situation with food and fuel put the university professoriate on the edge of survival. Old and sick persons quickly descended to a grave. In 1918 Lyapunov committed suicide, in 1921 Zhukovskii, died and in 1922 did Markov. For the younger and vigorous there came time of search for daily bread. Especially grave situation developed in both capitals. Luzin with his pupils (Men'shov, Suslin, Khinchin) went over to Ivanovo-Voznesensk where in 1918,

as we already mentioned, the Polytechnical institute was organized. The mathematicians of Petrograd (Tamarkin, Fridman, Bezikovich, Vinogradov) safeguarded themselves in Perm, where in 1916 a branch of Petrograd university was opened (in 1917 this branch became an independent university).

The events in the south of the European part of the Empire were developing in an unpredictable way and with an extraordinary speed – the detachments of white and red armies, parts of the regular German army, the soldiers of unexpectedly appearing and also quickly disappearing "states", finally, numerous gangs (the most known of which was headed by the legendary Father Makhno) operated there. Despite all lawlessness created there in those years D.A. Grave, who settled in Kiev already in 1899, could create the well-known school (O.Yu. Schmidt, N.G. Chebotarev, B.N. Delone), connected primarily with the beginning of national research on modern algebra.

Such famous mathematicians as A.M. Ostrovskii, later M.F. Kravchuk, N.I. Akhiezer and M.G. Krein also were his pupils. In Kharkov the activity of the higher school and the mathematical society also continued. Its high scientific level was kept and supported by such mathematicians as D.M. Sintsov, N.N. Saltykov, S.N. Bernstein. Despite grave situation in Odessa mathematicians tried to arrange the educational and the scientific life there as much as it was possible.

The severe conditions of life in the country caused by the events of revolution and civil war were aggravated by the uncertainty of the relation of the new authorities to establishments of science and education. The unwillingness to reconcile with such situation and to live in the world operated by the new Soviet power pushed many persons, including mathematicians, to the emigration. So from Petrograd in 1922 Ya.A. Shokhat[1] went to Poland, and then in a year to the USA, in the same year Selivanov[2] was deported on well--known "philosophical steamship", in 1924 Bezikovich[3] and Tamarkin[4] escaped (having crossed the border with one of the Baltic countries), and in 1929 the academician Uspenskii[5], who was on a study tour, decided not to return home. A number of mathematicians from the universities of the South of the Empire emigrated.

So in 1919, from Kharkov, N. N. Saltykov left at first to Tiflis and later, when in 1921 Bolsheviks came to the power there, to Belgrade[6]; in the same year the young statistician Yu.Ch. Neyman left Kharkov and moved to Poland[7]. In 1922 A.P. Przeborski left

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[1] J.A. Shohat (1866–1944). For many years he was a professor of the University of Pennsylvania.

[2] D.F. Selivanoff (1855–1932). He lived and worked in Prague.

[3] A.S. Besicovitch (1891–1970 Initially he worked with H. Bohr in Copenhagen, later he was a professor in Cambridge. Member of the London Royal Society.

[4] J.D. Tamarkin (1888–1945). He settled in the USA. Since 1929 professor of Brown University. In 1942–1943 the vice-president of the American mathematical society.

[5] J.V. Uspensky (1883–1947). Since 1929 until his death he worked at Stanford University.

[6] N.N. Saltykov (1872–1961). He at the Belgrade university. The full member of the Serbian Academy of Sciences.

[7] Jerzy Neyman (1894–1981). In 1938 he was invited in the Californian university in Berkeley with which all his further activity was connected. Member of the National Academy of Sciences of USA.

Kharkov and moved to Poland[8]. In 1920 from Odessa A.D. Bilimovich[9] moved to Belgrade, and in 1922, also from Odessa, E.L. Bunitskii moved at first to Belgrade and then to Prague[10].

The events of the revolution and of the civil war which followed became the time of a radical break-up of the old institutions and of the old mentality. The public life changed rapidly. What took years in the usual course of life, could be accomplished almost instantly in such a period. The Tomsk university, founded in 1878, for a long time comprised only one faculty – the medical faculty. The long-term persistent efforts towards organization of other faculties did not yield any results and only in 1917 the physical and mathematical faculty opened. The Saratov university, founded in 1909, acquired, at last, physical and mathematical faculty only in 1917. In 1918 universities opened in Simferopol (Tavrian university), Tiflis and Tashkent (Turkestan university), in 1919 in Baku and Erevan, in 1920 in Yekaterinburg and in Vladivostok (Dalnevostochnyi university), in 1921 in Minsk. In those years the history of many higher educational institutions, including teacher training colleges and institutes of technical profile, began. New forms of scientific activity started to appear. So in 1918 in Kiev the All-Ukrainian Academy of Sciences was created. V.I. Vernadskii was elected its first president. In February 1922 at the initiative of Steklov the Physical and mathematical institute of the Russian Academy of Sciences was organized, which received his name in 1926 (from this institute in 1934 the V.A. Steklov Mathematical institute emerged). In the same 1922 a number of research institutes started their activities at Moscow university. Among them there was the Research institute of mathematics and mechanics, whose first director was Mlodzeevskii, replaced by Egorov the next year.

The first post-revolutionary decade became the time of migration of the pedagogical and scientific personnel on an unprecedented scale. Moscow, which in 1918 got the status of the capital of the state, became the main point of attraction. There V.F. Kagan moved from Odessa in 1923, Schmidt did from Kiev in 1920, A.P. Kotelnikov in 1924, and E.E. Slutskii in 1926. Some mathematicians moved to Petrograd: at the very beginning of the war G.M. Fikhtengolts, from Odessa and in 1922 Delone from Kiev moved there. The university centers (first of all Moscow and Petrograd) attracted the studying youth, whose social and ethnic composition radically changed: people of worker and peasant origin, and also numerous Jewish youth, for whom receiving the higher education in imperial Russia was extremely complicated, came to the higher schools.

In the first post-war years the Russian Academy of Sciences endured the most dramatic period in its almost bicentennial history. Its mathematical class in 1923 consisted of three full members: Steklov, Krylov and Uspenskii. In 1926 Steklov died, and soon Uspenskii left the country forever and the mathematical class shriveled to one full member – Krylov.

The national commissariat of education, under whose authority the Academy fell, at first did not count it among the priorities at all. Moreover, many of the Bolshevik leaders

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[8] A.B. Przeborski (1871–1941). He worked a few months at the Vilno university, afterwards he moved to Warsaw.

[9] A.D. Bilimovich (1879–1970). He worked in the Belgrade university. A full member of the Serbian Academy of Sciences and in 1936–1940 the secretary of the Department of natural and mathematical sciences of this Academy.

[10] E.L. Bunitzky (1874–1952). He worked in the Charles University.

considered Academy the obsolete heritage of an old regime. In their opinion the new Socialist Academy created in 1918 in Moscow (later renamed the Communist Academy) should take the place of the old Academy "forgotten" in the old capital. The return of Academy of Sciences to the number of the state-forming institutions of the country was to a considerable extent a merit of Steklov, who was elected its vice-president in 1919. A person of the leftist view who accepted Bolshevist revolution and established good relations with the people's commissar of education A.V. Lunacharskii as well as with V.I. Lenin himself, Steklov acccomplished that the Academy of Sciences gained the status of the head scientific institution of the USSR. But this status went into effect only in the later 1920s.. In 1923 the country only started recovering after the end of a long civil strife. The era of the Soviet state construction (including construction of the system of national education, at the school and higher level) began. The dreams about the world revolution of the Bolshevist ideologists who brought about the revolution were consigned to the past[11]; it became obvious that the country was destined to build a new society while living in a hostile environment. The collectivization and the industrialization of the country was coming. It was necessary to have educated personnel and consequently, efficient schools – the primary, the secondary and the highest. The educational system and, first of all, the school system existing in the Empire, collapsed in the first years of the Soviet rule. And for the accomplishment of the tasks facing the USSR it was necessary to solve an ambitious problem – to build the mass schooling, which did not exist in imperial Russia, to create a branched system of polytechnic education, the construction of which merely began before the revolution. It was necessary to carry out all this in a mobilization order: as we know, there were less than two decades remaining before a new war and the most shrewd politicians already felt its breath. The construction of a scientific and technical and educational complex which was necessary for the country required, in particular, great mathematics: a highly professional mathematical community and a well-built system of mathematical education. Was it possible to solve such problems in a foreseeable future? To answer this question we will consider the situation which developed in the Soviet mathematical community in 1923–1927.

5. Mathematics in the USSR during 10 years

As we already said, by the time of the revolutionary events of 1917 mathematical research in the country was on the rise. The level of this research was such, that even the difficulties of the five-year period which saw the trials of the devastating wars (one of which was the civil war) and the bloody revolution did not stop its progress. As Khinchin wrote in an article devoted to development of mathematics in the country during ten years of the Soviet

[11] In 1918 V.I. Lenin wrote: "…The international revolution was coming nearer … at such a distance that it should be reckoned with as an event of the next few days" [4, p. 185]. In the Constitution of the USSR of 1924 we still read: "the new union state … will serve as a right stronghold against the world of capitalism and a new decisive step on the way of association of workers towards the World Socialist Soviet republic". But already the Stalin Constitution of 1936 does not even mention this republic.

power, [5, p. 41]: «Perhaps in those first difficult years of the revolution, mathematics, for purely external reasons, was put under rather special conditions, which allowed it to develop more intensively than other exact sciences did: a mathematician does not need laboratories or reactants; paper, a pencil and creative power are the prerequisites for his scientific work; and if to this one adds an opportunity to use a more or less solid library and a certain share of scientific enthusiasm (which almost every mathematician has), no devastation can stop his creative work. The lack of the modern literature was to a certain extent compensated by continued scientific communication which was organized and supported during these years». Mathematical Moscow, which loudly publicized itself in 1911–1916, generally managed to cross safely the rough waters of history: the death in 1919 of typhus of ingenious Suslin became the sole terrible loss. In 1922 Luzin returned to Moscow from his trip to Western Europe and the regular meetings of his seminar resumed. In this seminar students – N.K. Bari, V.I. Glivenko, L.G. Shnirelman, later A.N. Kolmogorov, and still later M.A. Lavrent'ev, L.V. Keldysh, E.A. Leontovich, P.S. Novikov and G.A. Seliverstov participated with their teachers (Stepanov, Alexandrov and Urysohn. The "old men" – Privalov, Men'shov and Hinchin – returned to Moscow and got into gear [6]. The studies on the set theory and the theory of functions proceeded successfully, wherein attention was concentrated on the problems of the theory of analytical sets. However, already at that time in Egorov--Luzin school the tendency to expanding the scope of research distinctly showed itself.

As Stepanov wrote later: "Every scientific school with the specialized subject is, in the course of its development, in danger of epigonism … when the main problems are resolved and settled by the works of a number of talented scientists, the same scientists and their pupils gather remaining bits. The Moscow school in general overcame this danger by expansion of its area of research and by application of methods of the theory of functions and theories of sets to other branches of mathematics" [7, p. 51]. The school's own achievements in the metric theory of functions became a starting point for work in new directions. The metric theory of function in many respects also defined the methods used in new areas.

Even in the years of revolution Luzin and his pupils (Privalov, Golubev, Men'shov, Khinchin) started to investigate problems of the theory of functions of a complex variable.

In 1925 M. A. Lavrent'ev joined them. Later he brought up a remarkable pupil – M.V. Keldysh.

Alexandrov's and Urysohn's achievements of 1921–1924 marked the first steps of the Soviet topological school. In 1925 under the leadership of Alexandrov the seminar on topology started to work. In this seminar such outstanding mathematicians as A.N. Tikhonov and L.S. Pontryagin grew up.

In 1923 the first important results of Khinchin on probability theory appeared, and at the end of the years 20th one of the greatest mathematicians of the XX century – Kolmogorov – started his studies on this discipline.

In 1922–23 Khinchin also started the studies on number theory. In 1925/26 academic year he organized a special seminar on this subject, in which A.O. Gelfond and Shnirelman participated.

Research in the directions traditional for Moscow proceeded: in differential geometry (Egorov, S.P. Finikov), in the theory of partial differential equations (Egorov), in applied mathematics (S.A. Chaplygin). If one adds the works on tensor differential geometry by

Kagan and his pupils, on the theory of integral equations by Egorov and V.A. Kostitsyn, on the theory of almost periodic functions by Stepanov, on probability theory and statistics by E.E. Slutskii, and, finally, on the theory of groups by O.Yu. Shmidt and his pupils, one can say that by the mid-1920s Moscow became an important and quickly developing center of mathematical research. This center was formed around the Research institute for mathematics and mechanics of Moscow university and the Moscow mathematical society. Egorov, who tried to do everything for revival of the normal life of the Russian mathematical community, was at the head of both institutes. The publication of "Matematicheskii Sbornik" (Mathematical collection) resumed, now as an all-union and even an international mathematical journal – the journal started to publish articles not only in Russian, but also in the German, French and Italian languages[12].

Muscovites got to work on the edition of Complete works of N.I. Lobachevskii. At last, they prepared the All-Russian mathematical congress and conducted it from April 27 to May 4, 1927. This meeting revived regular activity of mathematical community in the country, now the USSR. At this congress the decision was made to organize the First All-Union congress of mathematicians in 1930 at Kharkov.

Thus Moscow became the center of the life of the national mathematical community de facto and de jure. But in Petrograd, renamed Leningrad in 1924, there remained the Russian Academy of Sciences, which since 1925 was called the Academy of Sciences of the USSR. As we said before, the Academy needed considerable efforts to keep its place among the national state institutions. Steklov played a major role in this. It was under his leadership that the text of the new statute of the Academy, adopted in 1927, was drafted, according to which the Academy assumed the place of the main scientific institution of the Soviet Union. But this happened already after his death, which took place in 1926.

The mathematical community of the old capital took the period from 1917 to mid--1920s very hard. We already said that the academicians Lyapunov and Markov died, and a number of young talented mathematicians – Uspenskii, Tamarkin, Shokhat, Bezikovich – emigrated to the west. Tragicaly, the brilliant Fridman died (from a typhus). A situation began to improve only in mid-1920s. The mentioned academic Physical and mathematical institute started to play an essential role. Mathematical physics (Steklov, Gyunter, Smirnov), the theory of differential equations – ordinary (Krylov, Smirnov, I.A. Lappo-Danilevskii) and partial (Steklov, Gyunter), number theory (I.I. Ivanov, B.N. Delone, I.M. Vinogradov, R.O. Kuzmin, B.A. Venkov) became the most important directions of research of Leningrad mathematicians. We would like to remark that the young Petrograd mathematicians also dealt with the questions of the theory of a real variable (Bezikovich, G.M. Fikhtengolts) – a subject absolutely forbidden by leaders of he old Petersburg school. At the end of the 1920s also S.L. Sobolev's and L.V. Kantorovich's first studies appeared. So by the mid-1920s mathematical Leningrad possessed a serious creative potential.

Among other points of creative growth it is necessary to mention, first of all, the cities of Ukraine: Kiev, Kharkov and Odessa. Bernshtein continued to publish excellent results

[12] As a result, foreign authors, including E. Cartan, M. Frechet, B. Gambier, J. Hadamard, H. Hopf, S. Lefschetz, R. Mises, E. Noether, W. Sierpinski, L. Tonelli, started actively to publish their articles in the journal [8].

on the theory of differential equations, constructive theory of functions and probability theory.

Grave's pupils (Kravchuk, N.I. Akhiyezer, M.G. Krein) worked successfully. The activity of a school for nonlinear oscillation of N.M. Krylov – N.N. Bogolyubov developed. D.M. Sintsov continued his geometrical research.

An important center of mathematical researches was, as before, Kazan, where since the times of Lobachevskii work in the field of geometry was successfully conducted and where in 1928 the famous algebraist Chebotarev moved from Odessa. Tiflis became a new point on the mathematical map of the country (G.N. Nikoladze, A.M. Razmadze, N.I. Muskhelishvili), where in January of 1918 the university was opened. Important results in the fields of probability theory and mathematical statistics were obtained by a professor of the Warsaw – Rostov-on-Don university who got stuck in Tashkent and became one of founders of Turkestani university, V.I. Romanovskii.

Summing up the achievements of mathematics in the USSR by the end of the first decade of the Soviet power, Egorov wrote [9, p. 231-232]: "the works of mathematicians of the USSR take a worthy place among works of the European scientists and contribute their share to development and improvement of various mathematical disciplines".

As a result, the mathematics of our country left the war decade on the rise. Having suffered some losses – some mathematicians who could not stand the hardship of the wartime died early, a number of scientists emigrated from the country, many projects were frozen for a long time or even completely stopped, some institutes and universities found themselves outside of the country – in general the Soviet mathematics by the mid-1920s became a phenomenon extremely noticeable in the world and, as the subsequent events testify, was preparing for a powerful leap forward. Its implementation was initiated by "the travel from Leningrad to Moscow" of the presidium of Academy of Sciences and of the V.A. Steklov mathematical institute, which took place in 1934. This move put an end to the conflict of mathematicians of two capitals, which kept the national mathematical community in tension, and marked the start of the process of formation of the Soviet mathematical school. But this is already a subject for another report.

6. Conclusions

Certainly, any war causes a significant damage to the society, especially, if it is a world war – millions of the dead and crippled, sufferings of civilians, etc. It also brings great losses to the development of science, to the scientific community and to the system of national education. Not being able to stand the severe conditions of life developing in the conditions of the war, the old and the sick die prematurely, and some gifted young people who could grow into serious researchers perish on fronts (Fortunately, by the Russian legislation with which the country entered the war, the pupils of higher educational institutions, persons staying "for preparation for a professorial rank", and also privat-dozents and professors of the higher schools were not subject to conscription). The higher educational institutions located in the west of the Empire were evacuated to the east and their normal activity was broken. As a result of reduction of financing many projects were slowed down or even stopped

completely. But the mankind did not yet learn to solve many problems facing the society without resorting to such a surgical tool as a war. As hard as it is, a war helps with the solution of some public problems[13]. So World War I helped with the solution of some problems facing the Russian scientific community. So to say, those problems could be solved also under peace and certainly they would have been solved without any war, but their solution would require a considerably longer time under peace. The World War I, more distinctly than ever, uncovered opportunities which the war industry relying on advanced technologies (which, in turn, were based on the last scientific achievements) could provide for its success.

So the utilization of the aeronautic equipment in military operations showed importance of the aerodynamic research which was successfully conducted in Moscow by the group of Zhukovskii. In 1901 in his manor Kuchino near Moscow the millionaire D.P. Ryabushinskii created an Aerodynamic laboratory, which was directed by Zhukovskii. However only the war prompted the state (already the Soviet state!) to organize a big state institute: On December 1, 1918 in Moscowthe Central aero hydrodynamic institute (TsAGI) , under the leadership of Zhukovskii, was opened. The importance of problems of mechanics became undisputable. Hence the appearance at the Moscow university in 1922 of the Research institute of mathematics and mechanics[14]. The creation of such establishments of absolutely new type in the usual routine of public affairs turns into an extremely slow process of any kind of coordination of numerous departments, the search for free resources, etc. The wartime situation changes everything. What in a time of peace can take many years becomes sometimes a matter of days in war conditions. So, the organization of new universities and of new faculties at already existing universities which went on for years and years, was carried out extremely quickly during the war. Even the compelled evacuation of higher education institutions helped with this process (This evacuation also promoted geographical expansion of the scientific and educational institutions of the country).

For the solution of problems of the rising industrial society professionals were necessary. It was necessary to change the whole education system, which had to become a mass one. It was necessary to build a new mass (not elite, as earlier) high school, it was necessary to create and expand the system of educational institutions training specialists for the developing industry. It was necessary to open the doors of the educational institutions to the broad masses, and not just to representatives of the highest strata of society. All this happened in the USSR in the late 1920s–1930s. As a result the youth of working and peasant background and the numerous youth from small Jewish towns came to universities[15].

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[13] The regaining of independence by Poland as a result of the war led to the birth of one of the most brilliant mathematical schools of the XX-th century. Of course, at any development of events Poland would gain independence sooner or later. However, the World War I accelerated this event and so helped in the successful development of the Polish mathematical school [10, 11].

[14] Along the same line also lies the creation in 1933 of the Faculty of Mathematics and Mechanics at the Moscow university, which in the post-war Soviet Union became one of the central institutes of the country and of the world in the development of mechanics of flight and of theoretical astronautics.

[15] One must not forget the restrictions of the rights to the higher education introduced by the Soviet power for “descendants of exploiting classes” of the Russian Empire. However, in real life there were ways allowing one to bypass these restrictions. So among the graduates of Moscow university there were a descendant of a noble family A.N. Kolmogorov or a son of a merchant I.G. Petrovskii.

Considering the high starting level at which mathematics in the Empire was at the beginning of World War I,,all this created prerequisites for a real explosion of scientific activity in the field of mathematics which happened in the 30th–40th years in the USSR.

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