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# Polish mathematicians and mathematics in World War I. Part I: Galicia (Austro-Hungarian Empire)

## Abstract

In this article we present diverse experiences of Polish mathematicians (in a broad sense) who during World War I fought for freedom of their homeland or conducted their research and teaching in difficult wartime circumstances. We discuss not only individual fates, but also organizational efforts of many kinds (teaching at the academic level outside traditional institutions, Polish scientific societies, publishing activities) in order to illustrate the formation of modern Polish mathematical community.

PUBLICATION INFO		e-ISSN 2543-702X ISSN 2451-3202		 DIAMOND OPEN ACCESS
<b>CITATION</b>				
Domoradzki, Stanisław; Stawiska, Małgorzata 2018: Polish mathematicians and mathematics in World War I. Part I: Galicia (Austro-Hungarian Empire). <i>Studia Historiae Scientiarum</i> 17, pp. 23–49. Available online: <a href="https://doi.org/10.4467/2543702XSHS.18.003.9323">https://doi.org/10.4467/2543702XSHS.18.003.9323</a> .				
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In Part I we focus on mathematicians affiliated with the existing Polish institutions of higher education: Universities in Lwów in Kraków and the Polytechnical School in Lwów, within the Austro-Hungarian empire.

**Keywords:** Polish mathematical community, World War I, Austro-Hungarian Empire, Mathematics Subject Classification: 01A60, 01A70, 01A73, 01A74

## Polscy matematycy i polska matematyka w czasach I wojny światowej. Część I: Galicja (monarchia austro-węgierska)

### Abstrakt

W niniejszym artykule przedstawiamy różnorodne doświadczenia matematyków polskich (w szerokim sensie), którzy podczas I wojny światowej walczyli o wolność swej ojczyzny lub w trudnych warunkach wojennych zajmowali się badaniami naukowymi i nauczaniem. Omawiamy nie tylko indywidualne koleje losów, lecz także różnego rodzaju przedsięwzięcia organizacyjne (nauczanie akademickie poza tradycyjnymi instytucjami, polskie towarzystwa naukowe, działalność wydawnicza), aby ukazać kształtowanie się nowoczesnego polskiego środowiska matematycznego.

W części I skupiamy się na matematykach związanych z już istniejącymi polskimi uczelniami wyższymi: z uniwersytetami w Krakowie i we Lwowie oraz Szkołą Politechniczną we Lwowie, w granicach monarchii austro-węgierskiej.

**Słowa kluczowe:** *polskie środowisko matematyczne, I wojna światowa, monarchia austro-węgierska*, Mathematics Subject Classification: 01A60, 01A70, 01A73, 01A74

### 1. Introduction

When thinking about Polish mathematicians during World War I one needs to keep in mind that from 1795 until 1918 there was no Poland on the political map of Europe. So whom do we consider a “Polish”

mathematician? As others pointed out before (Tatarkiewicz 1998; Duda 2012), there is no good answer to this question in general. Recall that the territory of the former Crown of the Kingdom of Poland and the Grand Duchy of Lithuania (also known as the Commonwealth of Poland) was divided among three neighboring powers: Austria (later Austro-Hungary), Prussia (later part of the unified Germany) and Russia. The Russian partition (the Polish Kingdom and Annexed Territories) saw periods of struggle for national independence (November Uprising 1830-1831 and January Uprising 1863–1864) followed by severe repressions. All public high schools conducted instruction in Russian and the Main School in Warsaw gave way to the Russian-language Imperial University and Polytechnic. Poles often had to look for educational and career opportunities elsewhere (Bartnicka 2014). In the Prussian partition Poles were subject to national and religious discrimination; the Germanization efforts intensified after the unification of Germany in 1871. There were no academic institutions there.<sup>1</sup> In the Austro-Hungarian partition (known as the Kingdom of Galicia and Lodomeria, usually referred to as Galicia) the policies were initially also repressive. But in 1866 Galicia was granted autonomy and Polish became the official language. Since then, Polish education, science and culture could develop much more freely. Polish-language academic centers (the only ones in the world) were located in Kraków (Jagiellonian University) and Lwów (University and Polytechnic).

This article and its sequel (Domoradzki, Stawiska 2019) concerns mostly men and women born in the Polish Kingdom or Galicia and educated there (at least up to the high-school level), speaking Polish as one of their primary languages, including a few who were ethnically Jewish and one of German descent. We do not apply any clear-cut criteria here, either for “Polish mathematicians” or “Polish mathematics”. We organized both articles around places where these people found themselves during the war and we discuss each person in connection with the place of his or her main wartime activity. We occasionally extend the discussion beyond November 11, 1918, the date of armistice and proclamation of independent Poland. The borders of the reborn state

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<sup>1</sup> Wrocław (Breslau) had an university, but the city was not within Polish borders in the 18th century. The Polytechnic in Gdańsk was established only in 1904, under the name of *Königliche Technische Hochschule zu Danzig*.

were not guaranteed, so Poland had to defend itself against the competing interests of its neighbors: Germany, Russia, Lithuania, Czechoslovakia, Soviet republics and multiple short-lived Ukrainian states. The fighting continued until 1921 (the Peace of Riga with Soviet Russia and Soviet Ukraine as well as the Third Silesian Uprising against Germany).<sup>2</sup>

When the World War I broke out on July 28, 1914, it pitched Germany and Austro-Hungary against Russia (backed by France and Great Britain). Poles could either remain passive or take sides in the conflict. Many were drafted into respective armies.<sup>3</sup> Some did not believe in fighting a war serving the interests of the occupying powers; a war viewed as fratricidal, given the Polish presence in the enemy states. On the other hand, many saw an opportunity to fight for the independent Polish state aligning themselves with the side of either Central Powers or of Triple Entente. This was particularly true in Galicia, where young men massively volunteered into Polish Legions.<sup>4</sup> Mathematicians (either from Galicia or from other partitions) were among those who were drafted or volunteered into military, who served in the trenches or in non-combat units, experiencing wounds, gas poisoning, prisoners' camps or internment. They were also affected by compulsory evacuations<sup>5</sup>, travel restrictions, food and raw materials shortages. None lost their life as a result of war operations, but two outstanding scholars (Marian Smoluchowski and Zygmunt Janiszewski) died of war-related epidemics. Although the fates we describe were typical in many ways, presenting the realities of war from personal perspectives is not

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<sup>2</sup> Mathematicians were involved in these struggles: Stanisław Saks fought in Silesian Uprisings; Antoni Łomnicki and Kazimierz Bartel fought in the Defense of Lwów; Stanisław Leśniewski, Stefan Mazurkiewicz and Waclaw Sierpiński worked in a cryptography group during the Polish-Soviet war (Zygmund 1982/1987; Kalbarczyk 2015; Nowik 2010; McFarland, McFarland, Smith 2014).

<sup>3</sup> The total number of men mobilized by Germany during WWI was 13.2 million, or 41.4% of the male population. In Russia, the number was 13 million men, or 7.4% of the male population, plus 5,000 – 6,000 women (Beckett 2001).

<sup>4</sup> Only those not subject to draft into the regular Austro-Hungarian army were allowed to enlist in the Legions. Some Poles from the Russian partition studying in Galicia did so (Kutrzeba 1988).

<sup>5</sup> The Russians evacuated about 130 industrial enterprises and 200 educational institutions – their personnel, equipment etc. – from the Polish Kingdom and part of Eastern Galicia, over 600 thousand people in total.

the only goal of our article. Rather, we want to focus on the impact of war on activities considered normal for mathematicians and other scientists: studying, research, teaching, academic administration, publishing and professional organizations. We note that some mathematicians extended their wartime activity to teaching at a high-school or elementary level when and where the need arose. A few also engaged themselves outside of mathematics and education: in political activities (Wiktor Staniewicz), artistic expression (Leon Chwistek) or writing on cultural and religious Jewish themes (Chaim Müntz). We found it convenient to adopt a somewhat broad definition of a “mathematician”. Besides scholars known for their outstanding results in mathematics (prior to the war or afterwards), such as Banach and Sierpiński, we introduce many individuals who made lesser contributions to mathematical knowledge, in particular those (e.g. Izabela Abramowicz, Zygmunt Chwiałkowski, Adam Patryn) who did not continue their research after the war. Finally, we talk about some physicists, astronomers, engineers and philosophers who in the circumstances of the war engaged in teaching mathematics at the academic level or in the activities of learned societies alongside their mathematical colleagues. Of course we cannot mention everyone, especially if the information concerning their war years is scarce. We omitted even some well-known mathematicians (Franciszek Mertens, Stefan Bergman and others) for whom the war happened during their adult or senior years.

All in all, academic courses went on (with inevitable interruptions) even though many students and faculty served in the army, buildings were requisitioned for military purposes and resources (libraries, scientific equipment etc.) were evacuated. Doctorates were awarded (Franciszek Leja, Witold Wilkosz, Antoni Plamitzer, Adam Patryn) or recognized (Zygmunt Janiszewski); habilitations were granted (Hugo Steinhaus, Stanisław Ruziewicz, Antoni Łomnicki, Eustachy Żyliński, Tadeusz Banachiewicz, Stanisław Leśniewski) or denied (Lucjan Emil Böttcher). Many new talented people were attracted to mathematics. A remarkable case is that of Stefan Banach. His mathematical career was spurred by his serendipitous meeting with Hugo Steinhaus in 1916, which probably would not happen if Steinhaus did not take an administrative job in Kraków after his release from the army. Below and in the sequel (Domoradzki, Stawiska 2019) we discuss several other cases. Soon the Polish Mathematical School emerged and gained worldwide

recognition. But how many perished before their talents were showing? How many could not pursue a scholarly career after the war because of impairment or material difficulties? This will never be known.

## 2. Mathematics in Galicia

### 2.1. Kraków

Kraków, an ancient Polish capital under Austro-Hungarian occupation, was the seat of the oldest Polish university (established in 1364). In the academic year 1913/14, 3736 students were attending Jagiellonian University. Classes in mathematics were taught by professors **Kazimierz Żorawski (1866–1953)**<sup>6</sup> and **Stanisław Zaremba (1863–1942)**<sup>7</sup> and docents **Antoni Hoborski (1879–1940)**<sup>8</sup>, **Alfred Rosenblatt (1880–1947)**<sup>9</sup> and **Jan Sleszyński (1854–1931)**<sup>10</sup> A course of mathematics for naturalists was taught by **Włodzimierz Stożek (1883–1941)**, who also taught in a gymnasium.<sup>11</sup>

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<sup>6</sup> Żorawski, born in the Polish Kingdom, got his doctorate in Leipzig under Sophus Lie. He took a chair of mathematics at the Jagiellonian University in 1893. His research was mainly in differential geometry, mechanics and iteration theory (Ślebodziński 1956).

<sup>7</sup> Zaremba, born in the Russian Empire, got his doctorate in Paris. He was appointed a professor of mathematics at the Jagiellonian University in 1900. His research was mainly in differential equations, potential theory and mathematical physics (Domoradzki 2012).

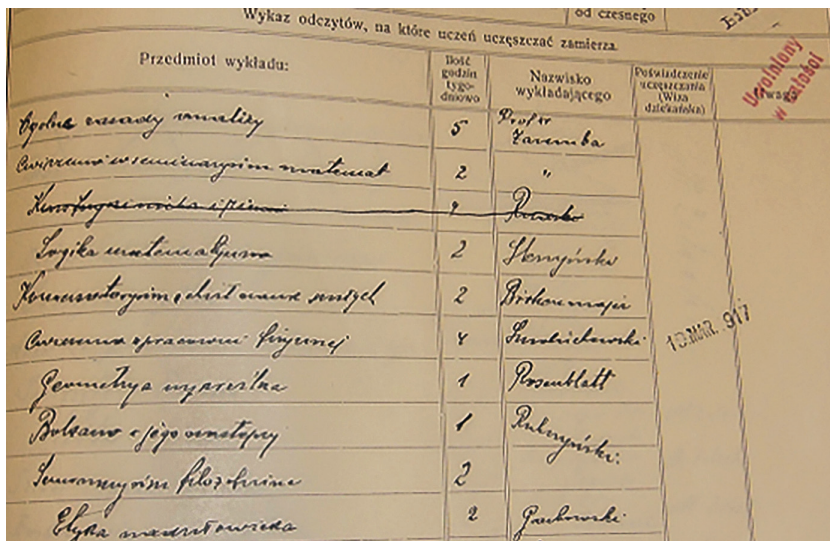
<sup>8</sup> In 1911 Hoborski got habilitation at the Jagiellonian University. Before the war he lectured on descriptive geometry and theoretical arithmetic while also teaching in a gymnasium. After the war he was appointed an ordinary professor of mathematics at the newly opened Academy of Mining in Kraków. His main achievements were in differential geometry (Gołąb 1969).

<sup>9</sup> Rosenblatt obtained *veniam legendi* in 1913. He was unsuccessful in getting a university chair in Poland, so in 1936 he emigrated to Lima, Peru. He worked in the fields of algebraic geometry, analytic functions, mathematical physics and many others (Ciesielska, Maligranda 2014).

<sup>10</sup> Sleszyński retired from his chair in Odessa in 1909 and moved to Kraków, where he lectured since 1911. He worked on number theory, probability and logic (proof theory). He used the title of professor, although formally he was appointed to professorship only in 1919. His teaching in the period 1911–1919, along with some other classes in mathematics and history of sciences, was financed by the fund of Władysław Kretkowski (Ciesielska 2016). His chair was the first chair of mathematical logic in Poland, and possibly in the world (Woleński 1995).

<sup>11</sup> Stożek's doctorate proceedings, started in 1917, were finalized in 1922.

The first year of the Great War proved very difficult for Kraków, which was a major fortress. The commander Karl Kuk ordered closing the gates on October 17, 1914. The Austrians evacuated over 63 000 people from Kraków. The Russian army advanced fast to the west, coming near Kraków and surrounding it. The first and second battle of Kraków took place respectively in the periods of November 18–22 and December 6–12, 1914, with 40 divisions fighting on both sides. Ultimately the Russians were stopped near Łapanów on December 12, 1914, and forced to retreat after heavy losses (Chwalba 2014).



Przedmiot wykładu:	Godziny tygodniowo	Nazwisko wykładowcy	Podpisane i potwierdzone (Własny datostan)
<i>Wykład z teorii matematyki</i>	5	<i>Zaremba</i>	
<i>Ćwiczenia z teorii matematyki</i>	2	"	
<i>Historia matematyki</i>	1	<i>Zaremba</i>	
<i>Logika matematyczna</i>	2	<i>Sleszyński</i>	
<i>Ćwiczenia z teorii matematyki</i>	2	<i>Rosenblatt</i>	
<i>Ćwiczenia z teorii matematyki</i>	4	<i>Sleszyński</i>	
<i>Geometria wykreślowa</i>	1	<i>Rosenblatt</i>	
<i>Polecamy i jego następny</i>	1	<i>Sleszyński</i>	
<i>Ćwiczenia z teorii matematyki</i>	2		
<i>Ćwiczenia z teorii matematyki</i>	2	<i>Zaremba</i>	

Stamp: *Uroczony # 917*

Fig. 1. Coursework record with signatures of Zaremba, Sleszyński, Rosenblatt and others (Jagiellonian University Archive, photograph by the first named author)

The Jagiellonian University was closed for the winter semester in the academic year 1914/15. Many of the university buildings were requisitioned for military purposes. The Academy of Sciences and Arts, which managed to avoid requisitions, came to help the University. On May 1, 1915, the University restarted teaching activities after a few month break. It was a success: the classes were held during the shortened summer semester, among them two lectures in mathematics by Sleszyński.

Regular academic activities continued after 1915, even though some faculty and students were enlisted in the military. **Marian Smoluchowski**

(1872–1917)<sup>12</sup>, who was appointed to the chair of experimental physics at the Jagiellonian University in 1913, was drafted in 1914 as an Austrian reserve officer. He commanded an artillery detachment, but soon he was released and allowed to come to the University of Vienna, and then back to Kraków. The building of chairs of physics was occupied by the military, so he conducted his work in the former private apartment of his colleague Karol Olszewski (1846–1915).<sup>13</sup> In 1916 Smoluchowski was invited to Göttingen to deliver Wolfskehl lectures in June 20–22. His topic was “Drei Vorträge über Diffusion, Brownsche Molekularbewegung und Koagulation von Kolloidteilchen” (Three lectures on diffusion, Brownian motion and coagulation of colloidal particles). In 1917 he was elected the rector, but he died of dysentery before the new academic year began. His duties were taken over by Żorawski (Fuliński 1998; Gudowska-Nowak, Lindberg, Metzler 2017; Polak 2017).

Before the war there were a few Polish paramilitary organizations in Galicia: the Riflemen Union, the “Rifleman” Society, the Bartosz Troops (Związek Strzelecki, Towarzystwo “Strzelec”, Drużyny Bartoszowe). The Austro-Hungarian authorities tolerated them, hoping to use them in a possible conflict with Russia.<sup>14</sup> Soon they were integrated with the Union for Active Struggle Związek Walki Czynnej, started by the immigrants from the Polish Kingdom, Józef Piłsudski (1867–1935) and Kazimierz Sosnkowski (1885–1969), who fought the imperial Russia in 1905 and intended to continue the fight. With the outbreak of war, these organizations gave rise to the Polish Legions (Legiony Polskie), a separate formation within the Austro-Hungarian army. In 1917 they were supposed to become a part of Polnische Wehrmacht (Polska Siła Zbrojna) organized by the German and Austrian authorities occupying the Polish Kingdom. However, most soldiers and officers refused to swear an oath of loyalty to the German emperor. This situation was referred to as the Oath Crisis. As a result, the former Russian subjects

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<sup>12</sup> Smoluchowski, an outstanding physicist, made some lasting contributions to mathematics. The most important ones are the theory of Brownian motions and the Smoluchowski equation, which is a limit case of the Fokker-Planck equation.

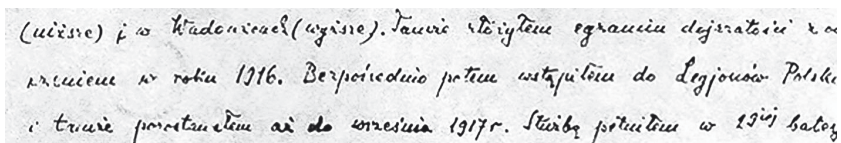
<sup>13</sup> Olszewski was the first, jointly with Zygmunt Wróblewski (1845–1888), to liquefy oxygen and nitrogen.

<sup>14</sup> The possibility of such a conflict arose already in 1910, after Austro-Hungarian annexation of Bosnia and Herzegovina.



were interned in the camps in Beniaminów and Szczypiorna, and the Austro-Hungarian subjects were enlisted in the Austro-Hungarian army. The Second Brigade of Legions swore the oath and continue fighting under Austrian command as the Polish Auxiliary Corps (Polski Korpus Posiłkowy) until the Treaty of Brest-Litovsk in 1918. In protest against territorial concessions to Ukraine, the corps, commanded by General Józef Haller (1873–1960), crossed the front lines to the Russian side. Those unsuccessful in crossing were interned in Marmaros-Sziget and Huszt (Kutrzeba 1988).

**Władysław Nikliborc (1889–1948)** passed the wartime maturity exam in Wadowice on December 14, 1916. In the first semester of the academic year 1916/17 he studied law at the Jagiellonian University, but soon (in December 1916) he joined the Polish Legions. He served in the 19th battery of the combat artillery. After the Oath Crisis (see above) he transferred along with the whole regiment to the Austrian army, in which he served until the emergence of the Polish state (he served in France, then in Czech territories in Olomouc). After 2 years he was released from the military and continued his studies, which he interrupted again twice to take part in the wars with Ukraine and Soviet Russia (1918 and 1920). In 1922 he completed his studies at Jagiellonian University and started working as an assistant to Antoni Łomnicki at the Lwów Polytechnics (Ślebodziński 1948)<sup>15</sup>.



*(uważne) p. w. Wadowicach (wziasne). Za dnia służyłem w szeregach dojrzałej 2. a. kolumny w roku 1916. Bezpośrednio potem wstąpiłem do Legionów Polskich i trawię porządkowo aż do września 1917 r. Służyłem w 19. b. artyl.*

Fig. 2. A mention of military service in W. Nikliborc's curriculum vitae (Lviv District Archive, personal file 26.5.1355; copy made for the first named author for non-commercial use)

**Stefan Kaczmarz (1895–1939)** started studies in mathematics, physics and chemistry at the Jagiellonian University in 1913. On September 1, 1914 he enlisted in the Polish Legions. He served in the 16th company

<sup>15</sup> The Lwów Polytechnics was the post-war name of the former Lwów Polytechnical School.

of the 2<sup>nd</sup> infantry regiment. From March 1915 to March 1917 he took part in the Carpathian campaign. In July 1917 he was promoted to the rank of *plutonowy* (platoon sergeant). In 1917 he was transferred to artillery. After the Oath Crisis and dissolution of the Polish Legions he was interned in Huszt and Bustyahaza (Hungary). He escaped, but was caught in Galicia and placed in the internment camp in Witkowiec (now part of Kraków). In January 1918 he was assigned to the School of Artillery Ensigns of the Polish Auxiliary Corps (Polski Korpus Posiłkowy) in Walawa (Przemyśl region). Released from the army in March 1918, he resumed his studies in Kraków. From November 1918 to February 1919 he served in the Academic Battalion in Kraków as a private. In July 1920 he voluntarily enlisted in the Polish army. He managed to finish his studies in 1922 (Maligranda 2007).

The events of war brought to Kraków many people trained in mathematics. **Edward Stamm (1886–1940)**<sup>16</sup>, a logician, philosopher and historian of science, a graduate of the University of Vienna, taught mathematics in a private gymnasium in Surochów near Jarosław since 1911. By 1914 he published 23 works on logic and philosophy of mathematics. As the front lines came close, he went first to Nowy Sącz, then to Vienna. Many refugees from Eastern Galicia were there, among them Kazimierz Twardowski (1866–1938)<sup>17</sup> and other Lwów scholars<sup>18</sup>. Stamm came into contact with Twardowski. Then in 1915 he was drafted into Austrian army and served in a radiotelegraphy station in Kraków, translating cablegrams from French, English and Italian. In 1917 he started officer's training in telegraphy in St. Pölten and after completing it, he commanded a telegraph station in Cheb (Bohemia). He returned to Kraków in 1918 and served as the Polish commander of the telegraph station until his discharge in 1921, promoted to the rank of a captain (Pabich 2002; Wachulka 1980; Jewsiewicki 1974).

**Leon Chwistek (1884–1944)**, a mathematician, philosopher and painter, interrupted his studies of drawing in Paris when the war broke out and joined the First Brigade of Legions. He suffered a wound to his leg, which caused a lasting impairment. After the Oath Crisis Chwistek

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<sup>16</sup> Stamm was a descendant of German Josephine colonists in Galicia.

<sup>17</sup> Twardowski was the founder of the Lwów-Warsaw philosophical school.

<sup>18</sup> On behalf of the rector Twardowski, Tadeusz Czeżowski was responsible for accommodation of the refugees who wanted to continue their studies (Łukasiewicz 2018).

returned to Kraków, where he devoted himself to his art and art theory. In 1917 he co-founded the group of “Formists” (initially called the “Polish expressionists”), whose goal was creation of a modern national style, merging the achievements of the Western avant-garde (expressionism, cubism, futurism) with native traditions (medieval arts and crafts, primitive reverse glass painting from Podhale)<sup>19</sup> (Baranowicz 1975; Dawidowiczowa 1989; Rzewuski 2014).

**Franciszek Leja (1885–1979)**, after completing his studies in Lwów and obtaining teacher’s licence in mathematics and physics, worked as a teacher in high schools in Kraków and Bochnia. The scholarship from the Academy of Letters enabled him to continue his studies in Paris and London in 1912–1913. As a member of Bartosz Troops (Drużyny Bartoszone)<sup>20</sup>, he was enlisted in the Eastern Legion and fought in 1914–1915. When the Legion was dissolved, Leja returned to teaching in the Gymnasium V in Kraków and worked half-time as an assistant in the Chair of Mathematics at the Jagiellonian University at the recommendation of Kazimierz Żorawski. Under Żorawski’s supervision he defended his doctorate in 1916. The title of his thesis was “Własność niezmiennicza równań różniczkowych zwyczajnych ze względu na przekształcenia styczeńnościowe [Invariant property of ordinary differential equations with respect to contiguous transformations]” (Kleiner 1985; Siciak 1982).<sup>21</sup>

**Witold Wilkosz (1891–1941)**– Stefan Banach’s classmate in the Gymnasium IV in Kraków, showed early interests in mathematics and Oriental languages. A paper on semitology brought him a scholarship to the university of Beirut. Later, in 1912, he enrolled at the Royal University as an ordinary student at the Faculty of Sciences. He took courses in

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<sup>19</sup> Among the members of the group there were a painter and poet Tytus Czyżewski (1880–1945), painters and stage designers brothers Zbigniew Pronaszko (1885–1958) and Andrzej Pronaszko (1888–1961), a sculptor August Zamoyski (1893–1970), a painter Tymon Niesiołowski (1882–1965), a painter, playwright and philosopher Stanisław Ignacy Witkiewicz (1885–1939)

<sup>20</sup> Bartosz Troops (Drużyny Bartoszone) were a military organization active in Lwów since 1908, bringing together the academic youth of peasant origin. In 1914 they were incorporated into the Eastern Legion.

<sup>21</sup> Leja worked mainly in potential theory, approximation theory in complex domain and topological groups. He was also a pioneer researcher in several complex variables and is considered a founder of Kraków scientific school of complex analysis.

mathematics from Giuseppe Peano (1858–1932), Guido Fubini (1879–1943) and Corrado Segre (1863–1924). Under the direction of Peano he prepared his PhD thesis concerning the theory of Lebesgue integral and in 1914 he obtained his doctoral degree. With the eruption of World War I he was called to return to the Austro-Hungarian Empire.<sup>22</sup> In the first year of the war he fought in the Polish Legions. Then he continued his studies in mathematics at the Jagiellonian University, which he finished in 1917. It was impossible for him to nostrify his diploma after returning to Kraków, but in 1918 he obtained the degree of the doctor of philosophy for the thesis “Z teoryi funkcyi absolutnie ciągłych i całek Lebesgue’a”. (On the theory of absolutely continuous functions and the Lebesgue integrals). The supervisor Stanisław Zaremba noted in his report that the thesis made a valuable contribution to modern analysis. Among other things, Wilkosz corrected a mistake noticed in one of the papers by Charles De la Vallée Poussin (1866–1962). He also included a thank-you note to Banach, reflecting their discussions on mathematics. In the years 1917–1918 Wilkosz taught at private gymnasia in Zawiercie and Częstochowa. He also audited courses in law (Średniawa 1961).

**Stefan Banach (1892–1945)** got interested in mathematics as a gymnasium student in Kraków. However, he was not convinced that he could make a significant contribution to mathematics. So after finishing gymnasium in 1910 he started a course of studies in civil engineering at the Lwów Polytechnical School. In the late spring 1914 he obtained the so-called half-diploma, having passed all compulsory exams for the first and second year of studies as well as the first state licensing exam. After the war erupted in August 1914, the main building of the Polytechnical School was requisitioned by the Austro-Hungarian army for a war hospital, and when the Austro-Hungarians retreated in September 1914, it was occupied by the Russian army. Banach remained in Kraków until the end of the war, even though the classes at Polytechnics resumed in 1915, after Austro-Hungarians recaptured Lwów. He was rejected in the draft because of being left-handed and having poor vision in his left eye. During the war he first worked as a private

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<sup>22</sup> Italy was a member of the Triple Alliance with Germany and Austro-Hungary, but in May 1915 it revoked the alliance and entered the war on the side of the Allied Powers.

tutor in Kraków, then he held a job on road construction, supervising a team of workers (Jakimowicz 2011; Nikonowicz 1992; Kaluża 1992; Ciesielska, Ciesielski 2013).

It was in the wartime Kraków that Banach embarked on his amazing mathematical career, when Hugo Steinhaus met him by chance one day in 1916 (cf. Ciesielska, Ciesielski 2017). Here is how Steinhaus recounted his meeting of two men sitting on a bench in the Planty park surrounding the city center and engaged in an advanced mathematical discussion (Steinhaus 1992):

Even though Kraków was formally a fortress, one could take walks in Planty in the evenings. During such a walk I heard the words “Lebesgue measure” – I went to the bench and introduced myself to two young adherents of mathematics. They told me that they had another companion, Witold Wilkosz, whom they highly praised. They were Stefan Banach and Otto Nikodym. Since then, we met regularly (...) (Steinhaus 1992).

Banach and Steinhaus started collaborating on mathematical problems. After the war Steinhaus arranged for Banach to work as an assistant to Antoni Łomnicki in Lwów.

**Hugo Dyonizy Steinhaus (1887–1972)** studied mathematics in Lwów (in 1905–1906), then (in 1906–1911) in Göttingen. In 1911 he received there PhD degree (under David Hilbert) on the basis of his dissertation entitled *Neue Anwendungen des Dirichlet’schen Prinzips*. Afterwards he traveled over Europe and published mathematical papers as a private scholar. At the beginning of the war he moved with his family to Vienna. Then he went by himself to Kraków, reported to the recruiting office of the Polish Legions and was assigned to the Military Department of the Principal National Committee (Naczelny Komitet Narodowy, NKN). Initially he did some office work in Vienna, but soon he was sent to the front, to the 1st Regiment of Artillery of the Polish Legions. He served along with Zygmunt Janiszewski. In 1915 he participated in the war operations in Volyn. His cousin Władysław Steinhaus was mortally wounded in a battle and Hugo obtained a leave to attend his funeral. He did not come back to his regiment, as his mother managed to have him recalled from the service. In July 1916 he took a job in the Center for Reconstruction

of The Country (Centrala Odbudowy Kraju) in Kraków. Then he met Stefan Banach, **Otto Nikodym (1887–1974)**<sup>23</sup> and Witold Wilkosz. They started to meet regularly for mathematical discussions in Steinhaus's rented room, joined also by **Władysław Ślebodziński (1884–1972)**<sup>24</sup>, Leon Chwistek, Włodzimierz Stożek and **Jan Norbert Króó (1886–1942)**.<sup>25</sup> Steinhaus (1992) wrote "...we decided to start a mathematical society", referring to these meetings.<sup>26</sup>

In 1917 Steinhaus got his habilitation at the Lwów University on the basis of the dissertation "On certain properties of the Fourier series" (O niektórych własnościach szeregów Fouriera). He arranged to be transferred to Lwów for his job, which he combined with teaching at the university. His lectures on the Lebesgue integral were poorly attended, as nearly all students enlisted in the military. When the Polish-Ukrainian war started in November 1918, he decided to join his parents, in-laws, wife and daughter in Jasło. It took him four days to travel the 230-kilometer distance through Ukrainian and Polish posts as well as no-man's land. Because of his age, he was exempted from the service in the Polish army. He remained in Jasło working as a mathematical expert at a gas company until normal activities resumed at the University of Lwów in 1920 (Steinhaus 1992).

There was no specialized mathematical society in Kraków until 1919, but mathematicians were active in other scientific organizations, even during the war. For example, on November 29, 1917, Sleszyński gave a talk "On traditional logic" at the Philosophical Society in Kraków,

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<sup>23</sup> Nikodym taught at the Real Gymnasium IV in Kraków during the Great War.

<sup>24</sup> Ślebodziński studied at the Jagiellonian University in 1903–1908. In 1913 he went to Göttingen, but had to return in 1914 because of the war. In the years 1919–1939 he worked in Poznań. He got his PhD in Warsaw under the supervision of Żorawski in 1928. His main research area was differential geometry.

<sup>25</sup> Króó received PhD in physics in Göttingen in 1913 for the thesis "Zur statistischen Elektronentheorie der Dielektrizität und des Magnetismus". (The date 1931 given at the Math Genealogy Project seems to be a misprint, since one of Króó's advisors, Woldemar Voigt, died in 1919.) He published several papers in atomic and statistical physics. In the year 1925/26 he taught theoretical mechanics at the Free Polish University in Warsaw. We were not able to find information about the circumstances of his death (Tatarkiewicz 1995; NN2 2010; Kragh 2011, Duda 2012).

<sup>26</sup> This informal society should not be confused with the Mathematical Society in Kraków, which was founded on April 2, 1919.

which he later expanded into a book (published in 1921). Also at the Philosophical Society, on March 1, 1917, Smoluchowski gave a talk “Remarks on the role of chance in physics” [Uwagi o roli przypadku we fizyce] (Polak 2015; 2017).

As the Austro-Hungarian empire was collapsing, Kraków became the seat of Polish Commission for Liquidation (Polska Komisja Likwidacyjna), which held the temporary authority over Galicja and Cieszyn Silesia. It was also the first Polish city to be liberated. On October 31, 1918, a group of Polish soldiers and boy scouts under the command of Lieutenant Antoni Stawarz (1889–1955) took over the railway station in Płaszów and the army barracks in Podgórze and then disarmed an Austrian garrison stationed in the City Hall Tower at the Main Market. The military commander Feldzeugmeister Siegmund von Benigni (1855–1922) handed in power to Polish authorities. In the book of doctoral promotions at the Jagiellonian University, the words “Finis Austriae” were entered. Lieutenant Edward Stamm raised Polish white-and-red flag on the radiotelegraph station in Dębniki (Jakubowski 2008). Civilians aided the military in the effort of keeping the newly gained freedom. **Tadeusz Ważewski (1896–1972)**<sup>27</sup>, who enrolled as a student at the University in 1915 (first in physics, then in mathematics), served on the Citizen Patrol in Kraków in November and December 1918.

## 2.2. Lwów

Lwów was the capital of the Kingdom of Galicja and Lodomeria since 1772 (the first partition of Poland). In 1914 at the Lwów Polytechnical School, 723 out of 1865 students were studying Civil Engineering, 586 – mechanical engineering, 251 – Technical Chemistry, 243 civil engineering (or architecture), 62 – Engineering Management, which was the first such faculty in Austria. At the Lwów University, in the winter semester of the year 1913/1914 there were 5871 students enrolled. On September 1, 1914, the city was conquered by the Russians. Eastern Galicja and Lemkovyna were incorporated into the Russian Empire. Count Georgii Bobrinskiï (1868–1928) was made the general-governor of the newly

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<sup>27</sup> Ważewski’s achievements were in topology and differential equations. He was a professor at the Jagiellonian University since 1933 and is considered the founder of the Kraków scientific school of differential equations.

acquired territories. In the 1914–1915 academic year lectures were not held. Like in Kraków, some academic buildings were requisitioned for military purposes (e.g., the main building of the Polytechnics served as a hospital). Part of the population was evacuated. Some faculty and students went to Vienna, where teaching and research could be continued. As a result of breaking the front lines in May 1915, the Russians withdrew on June 20, 1915, and the Austrians came back on June 23, starting a military rule and repressions against real or perceived supporters of Russia. The academic institutions reopened. The Polytechnical School had 130 students in the academic year 1915/16; 198 in 1916/17, 670 in 1917/18, and 989 enrolled for 1918/1919.

On November 1/2, 1918, Lwów was taken over by the Ukrainians serving in the Austro-Hungarian army, who proclaimed independence of the Western-Ukrainian People's Republic. This started the Polish-Ukrainian war, which lasted until May 22, 1919. Poland reconquered Lwów thanks to the reinforcements from Przemyśl under the command of Lieutenant-Colonel (*podpułkownik*) Michał Karaszewicz-Tokarzewski (1893–1964).

The chairs of mathematics at the university were held by **Józef Puzyna (1856–1919)** and (until 1918) **Wacław Sierpiński (1882–1969)**.<sup>28</sup> **Zygmunt Janiszewski (1888–1920)** lectured as a private docent. Janiszewski obtained his doctorate in Paris in 1911 on the basis of the thesis “Sur les continus irréductibles entre deux points”. In 1911–1912 he gave lectures in Warsaw at the Society for the Scientific Courses. In 1913 he was nominated to the position of an assistant in the chair of Józef Puzyna at the Lwów University. Also in 1913, he got his habilitation at the Lwów University on the basis of the thesis “On dissecting the plane by continua” (“O rozcinaniu płaszczyzny przez continua”, published in *Prace Matematyczno-Fizyczne* 26 (1913), pp. 11–63. His habilitation lecture was “On realism and idealism in mathematics” (“O realizmie i idealizmie w matematyce”, published in *Przegląd Filozoficzny* 19 (1916), pp. 161–170). On August 30, 1914, Janiszewski enlisted in the Polish Legions. He took part in the Carpathian campaign in 1914/1915. When the Germans took Warsaw, Janiszewski was summoned to a post there. He related later to Hugo Steinhaus that, when he

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<sup>28</sup> In 1909 Sierpiński taught the first course on set theory in Polish territories.



arrived, his driver from the train station to the command was the geometer Max Dehn (1878–1952), a former student of Hilbert in Göttingen.<sup>29</sup>

The military service of Janiszewski (then already at the range of a sergeant)<sup>30</sup> and the internment of Waclaw Sierpiński in Russia left Puzyna as the only person to teach courses (analytic geometry of space and higher analysis) and to run the lower and higher seminar in mathematics in the academic year 1915/16. This made it very difficult for the university to offer regular lectures and seminars in mathematics. Because of this difficult situation, in October 1916 the Philosophical Faculty petitioned the Rector to apply for Janiszewski's recall. He was appointed to the position of an assistant for the years 1917–1919 and a request was made to the Imperial and Royal Regency in Lwów to apply for approval of this appointment by the Ministry of Religions and Education in Vienna as well as for allocation of funds for his salary. However, Janiszewski did not take this post. After the Oath Crisis he went into hiding to avoid internment. He lived in the Radom region and run (with his own funding) a shelter and a school for homeless children. In 1918 he accepted a chair at the Warsaw University. Before that (in 1917) he published the article “On the needs of mathematics in Poland (O potrzebach matematyki w Polsce), where he expressed the idea of creating a mathematical school in Poland. He died in the pandemic of the Spanish influenza<sup>31</sup> (Knaster 1960; Domoradzki 2011).

The nostrification of Janiszewski's doctorate, started in 1914, was delayed because of the war and was finalized only in 1917. It was necessary for the university to award the right to lecture in order to remedy the staffing shortages. Hugo Steinhaus got his habilitation in 1917. **Stanisław Ruzewicz (1889–1941)** obtained doctorate in philosophy in 1913 at the Lwów University with a thesis “On a continuous, monotone function which does not have derivative in an uncountable set of points” (O funkcji ciągłej monotonicznej nie posiadającej pochodnej w nieprzeliczalnej mnogości punktów), under the supervision of

<sup>29</sup> We were not able to find other accounts confirming Dehn's service in Warsaw; cf. Burde, Schwarz, Wolfart 2002; Steinhaus 1992.

<sup>30</sup> In 1917, Janiszewski was the first commander of the men's troop of Polish Military Organization (POW) (Kiepuska 1981).

<sup>31</sup> It is estimated that 50 to 100 million people died in the pandemic in the years 1918–1920, i.e., three to five percent of the world's population (Chwalba 2014).

Józef Puzyna.<sup>32</sup> In July 1918, while on a leave from the army, he got his habilitation at the Lwów University for the work “On the monotone continuous functions with intervals of constancy almost everywhere”. Waclaw Sierpiński, back from his internment in Russia, took part in the proceedings (Więśław 2004). Also in 1918, **Lucjan Emil Böttcher (1872–1937)**<sup>33</sup> applied again for habilitation at the University (he already got one at Polytechnical School, where he worked), but did not succeed. During the wartime (in 1916) one doctorate was awarded at the University: to **Adam Patryn (1887–1939)**, a gymnasium teacher in Stryj. The supervisors were Józef Puzyna and Marcin Ernst (1869–1930).<sup>34</sup> The title of the thesis was “Research on functions solving the identity relation (Badania nad funkcjami rozwiązującymi związek identycznościowy  $(1-x)^m\Phi(x)+x^m\Psi(x)\equiv 1$ ”) (Prytuła 2013). In his evaluation of the thesis, Puzyna wrote:

Mr. Candidate, in his thesis entitled “Research on functions solving the identity relation  $(1-x)^m\Phi(x)+x^m\Psi(x)\equiv 1$ ”, in his investigations utilized properties in theory of power series, differential equations and combinatorics. He treated the material in a systematic and interesting way, proceeding from details to more general cases.

During the war the following mathematics faculty were active at the Lwów Polytechnical School (Domoradzki 2011; Duda 2014; Popławski 1992):

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<sup>32</sup> In 1913–1914 Ruziewicz received a scholarship from the Academy of Arts and Sciences in Kraków from the foundation of Władysław Kretkowski. He went to Göttingen for the year, which gave him a chance to get acquainted with the problems of contemporary European mathematical research. In June 1915 he was drafted into the Austrian army. At the beginning he was stationed in Kalusz, later was commissioned to Hungary and finally to a unit involved in the military censorship in Lwów. In January 1918, together with the Revision Committee, he was in Bukovina. In February Ruziewicz was assigned to the reserve writers in Löbnitz, and then was called again to military censorship in Lwów. He contracted typhus in Löbnitz and, in April 1918, was placed on leave until the end of the year. He stayed in Łańcut, where he taught in a high school.

<sup>33</sup> Böttcher got his PhD in 1898 in Leipzig under Sophus Lie (1842–1899). He worked on iteration theory and obtained some pioneering results in holomorphic dynamics (Domoradzki, Stawiska 2014).

<sup>34</sup> Ernst was a professor of astronomy at Lwów since 1907.

Ocena pracy doktorskiej pana kandyda  
Adama Patryna.

Pan kandydat w swej rozprawie p.t.  
„Badania nad funkcjami rozwiązanymi  
związek i dątkowy postaci  $(1-x)^m \Phi(x) + x^m \Psi(x) = 1$   
w porównaniu z teorią przewidywania, potęgowa,  
wzrostu i różniczkowych i kombinatoryki.  
opracował materiał systematycznie i  
interesyjnie, wykazuje rezerwy i  
do ogólniejszych wypadków. Prace uważa  
na że wystarczająco  
We Lwów dnia 31<sup>go</sup> grudnia 1915 r.  
Prof. Józef Kuryla

Prace interesujące, wykonane ponadto,  
uważa że za wystarczające, jako wymagane  
doktoru

Lwów d. 10. I. 1916. Prof. S. Marcin Ernst

Fig. 3. Evaluation of A. Patryń's doctorate; signatures of J. Puzyna and M. Ernst (Lviv District Archive; copy received by the first named author from Professor Yaroslav Prytula from Lviv State University for non-commercial use)

**Placyd Dziwiński (1851–1936):** In 1898 he led the 1<sup>st</sup> Chair of Mathematics at the Polytechnical School and held this position until his retirement in 1925.

**Zdzisław Jan Ewangeli Antoni Krygowski (1872–1955):** In 1908 he became an associate professor and in 1909 ordinary professor of mathematics in the Polytechnical School in Lwów, of which he was the rector in 1917–1918. In the years 1913–1915 he was the dean of the

Department of Water Engineering of the Lwów Polytechnical School. In the independent Poland he became a professor at the newly created University of Poznań.

**Kazimierz Bartel (1882–1941):** After graduating from the Polytechnic School he worked there as an assistant (1907–1911), then Privatdozent of the I Chair of Descriptive Geometry (1911–1912), associate professor (since 1912) and full professor of this chair (since 1917); in 1912–1939 he led this chair. During the war he served in the Austro-Hungarian army. In 1919 he took part in the Polish-Ukrainian war as the commander of the 1<sup>st</sup> Railway Battalion. He commanded the defense of the Lwów Main Railway Station. In the independent Poland he held many important political functions, including that of the prime minister (Kalbarczyk 2015).

**Antoni Łomnicki (1881–1941)** From 1903 to 1919 he worked as a school teacher in Lwów and Tarnów. In the academic year 1913–1914 he was lecturing as a Privatdozent at the Polytechnical School in Lwów in the Department of Machine Construction, and at the Department of Mechanical Engineering there. In 1917–1918 he published two works, “The systems of necessary and sufficient rules for the definition of the concept of quantity” and “On the univalued explicit functions of real variable.” He also got the title of a docent and then became a professor of mathematics, succeeding Zdzisław Krygowski. In 1918–1919 he fought in the Polish-Ukrainian war.

**Antoni Karol Plamitzer (1889–1954)** worked as the assistant at the Lwów Polytechnical School since 1911. In 1913 he passed the exam for a secondary school teaching licence in mathematics and descriptive geometry. In 1914 he obtained a doctorate degree in technical sciences at the Polytechnical School on the basis of a thesis *A Contribution to the theory of flat and curved surfaces* under the direction of Kazimierz Bartel (published in *Wiadomości Matematyczne* 1915, v. 18, 19)

On December 3, 1917, Polish Mathematical Society in Lwów had its inaugural meeting.<sup>35</sup> It was established at the initiative of Puzyrna, Janiszewski, Steinhaus, Łomnicki, Dziwiński, Krygowski, and **Tadeusz Czeżowski (1889–1991)**, a philosopher whose early work had

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<sup>35</sup> Lwów mathematicians were members of other professional organizations before and after World War I. They were particularly active in the Scientific Society in Lwów (Towarzystwo Naukowe we Lwowie).

mathematical character.<sup>36</sup> The goals of the Society were: support for research in mathematics and related areas, dissemination of mathematical knowledge by scholarly meetings (organized usually every 2 weeks), talks, competitions, publications and collecting the means for learning. The first president was Józef Puzyna. On the board there also were Eustachy Żyliński, Antoni Łomnicki and Stanisław Ruziewicz. After Puzyna's death in 1919, Marcin Ernst became the president. In the years 1917–1918 the following talks were given (in Polish) at the meetings of the Lwów Mathematical Society: H. Steinhaus: “Solved and unsolved problems in the theory of Fourier series”; L. Grabowski “The harmonic analyzer of Henrici”<sup>37</sup> (in 1917); J. Puzyna: “On the zero traces of power series”; A. Maksymowicz: “On Cesàro series”<sup>38</sup>; Z. Krygowski: “On Tschirnhausen maps in algebra”; W. Sierpiński: “Recent studies on measurable functions”; H. Steinhaus: “On linear and continuous operations in a function field”; W. Sierpiński: “On the continuum hypothesis”; W. Sierpiński: “Definition of the Lebesgue integral without the measure theory”; H. Steinhaus: “Power series in the disk of convergence” (in 1918).

The activities were disrupted by the Polish-Soviet war. In 1920 the Society was dissolved and re-constituted as the Lwów branch of the Polish Mathematical Society.

## 5. Conclusion

During the Autonomy period Galicia was the heart of Polish culture and science. The Great War disrupted academic and scholarly activities in Kraków and Lwów, but did not obliterate them. In the independent

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<sup>36</sup> Czeżowski taught mathematics and physics in Gymnasium VI in Lwów from 1912 to 1914. In 1915–1918 he held a post of the director of the University Chancellor's Office. In 1914 he obtained his doctorate under the supervision of Kazimierz Twardowski with a dissertation on the Theory of Classes (Teoria klas). In the independent Poland he first worked for the Ministry for Religious Denominations and Public Education, and in 1923 he took a chair of philosophy at the Stefan Batory University in Wilno (Vilnius). See Czeżowski 1977; NN1 2007; Łukasiewicz 2018.

<sup>37</sup> **Lucjan Grabowski (1871–1941)** studied astronomy and physics in Kraków, Bonn and Munich, got PhD in Munich; a professor of the Lwów Polytechnical School (later Lwów Polytechnics): of surveying in 1909–1912 and of spherical astronomy and higher geodesy since 1912.

<sup>38</sup> **Adam Maksymowicz (1880–1970)**, taught mathematics in Lwów gymnasia and the Polytechnics.

Poland mathematicians at the Jagiellonian University continued their research and teaching mostly in classical disciplines such as differential equations and geometry, while also opening themselves to new trends in mathematics (Domoradzki, Stawiska 2015). Lwów (especially the Lwów University, renamed Jan Kazimierz University) became a world-renowned mathematical center, forming its own Lwów school of mathematics, focused mainly on the new disciplines of functional analysis and measure theory. A group of mathematicians (Janiszewski, Mazurkiewicz, Sierpiński) formerly affiliated with the Lwów University co-founded the Warsaw school of mathematics, strongly concentrated on topology, set theory and foundations of mathematics. Many mathematicians contributing to these developments started their academic careers during the war. The reborn Second Republic was fortunate to have these talented and dedicated people.

## 6. Acknowledgments

This article originated from the lecture “Mathematicians from Polish territories in WWI” given by the first author at the conference “Mathematics, Mathematicians and World War I”, 20 May 2015 – 25 May 2015, Scuola Normale Superiore Pisa, Italy. It started taking its present shape during the second author’s visit to Jagiellonian University in Kraków on her study leave from American Mathematical Society in February – June 2017. The work of both authors is partially supported by the project 18-00449S of Czech Science Foundation. The work of the first author was also partially supported by the Centre for Innovation and Transfer of Natural Sciences and Engineering Knowledge, University of Rzeszów.

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