CHAPTER 1

The University and the Polytechnic in Lvov

Lvov University was the third oldest and the third ranked seat of learning to be established in the First Republic[2]. Similarly as in Vilnius, the capital of the Grand Duchy of Lithuania, it started off as a Jesuit college, one which had existed since 1608. King Jan Kazimierz transformed it in 1661, "conferring upon it the status of a university and the title of academy" [B: Finkel & Starzyński]. The Sejm, however, did not ratify the king's decree and the college remained a modest two-department academy (philosophy and theology) without the authority to award academic degrees. The act of foundation was passed by King August III in 1758, and one year later Pope Clement XIII issued a papal bull of approval. But the Cracow Academy (Akademia Krakowska) retaliated, using its power and influence to protect its monopoly in the Korona[3], and in 1764 the papal bull was revoked.

Starting in 1772, the Republic began being partitioned off, its lands systematically annexed and carved up between Austria, Prussia, and Russia. With it the Polish state was wiped off the political map of Europe for a period of 123 years (1795–1918). The occupying powers imposed a policy of assimilation on the territories they had seized, enforcing Germanization or Russification while suppressing the activities of Polish nationalists. The specific situation was different for each of the three seized territories.

Lvov became part of Austria in 1772 and stayed in its hands for almost 150 years, until the breakup of the Austro-Hungarian Empire in 1918. During this long period the land annexed by Austria was one of the largest Imperial provinces, known by the invaders as the Kingdom of Galicia and Lodomeria (or Galicia for short)[4].

The Academy in Lvov continued to function until 1773, when the Austrians closed it down after the abolition of the Jesuit order. They did not close it down for long, and for the next 100 years Lvov University managed to struggle on, but it never progressed much either. Modernized in 1784 by Emperor Joseph II into a four-department university with Latin as the language of curricular instruction, it lasted

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[2]The one in Cracow was established in 1364, the one in Vilnius in 1578, and the one in Lvov in 1661. There were also smaller colleges, such as the Academy in Zamość, but which did not attain university status. From 1572 onwards, kings of the Polish-Lithuanian Commonwealth were elected and the role of Parliament grew stronger. For that reason the Commonwealth (up until 1795, when it ceased to exist) is customarily called the First Republic. Cf. N. Davies, *God's Playground. A History of Poland*, Vol I: *The origins to 1795*, Columbia Univ. Press, New York 1982.

[3]The First Republic actually consisted of two states. Sometimes known as the Two-Nation Republic, it formally consisted of the Kingdom of Poland and the Grand Duchy of Lithuania. The Korona (literally *The Crown*) refers to the old Polish part, i.e. Poland's ancient lands.

[4]A colorful description of Galicia between 1772–1918 is given in the book [B: Fras, 1999] and contains informative bibliographic references.

until 1805, when Emperor Francis I had it moved to Cracow. Revived once again in 1817 by Emperor Francis I, but now with German as the language of instruction, it remained a provincial Austrian seat of learning. In the nineteenth century Lvov emerged as one of the most important centers of Polish national culture. Galicia won regional autonomy in the 1860s, and its authorities (local governors, Sejm) were based thereafter in Lvov. In 1871 Polish was introduced as the language of curricular instruction. Its best period began in the years immediately preceding World War I, culminating in Lvov's twenty-year-long golden age of mathematics during the interwar years 1920–1940. Between 1919–1939 the university was known as Jan Kazimierz University (UJK for short), while from 1940 onwards it functioned as a Ukrainian university, named after the Ukrainian poet Ivan Frank.

The first mathematics department at Lvov University was set up in 1744. Over the course of the subsequent 200 years it would have many mathematics lecturers. In accordance with the prevailing tradition, universities concentrated on teaching (the cause of science being advanced through scientific societies and academies). Consequently university lectures tended to be at a rather elementary level. The National Education Commission (Komisja Edukacji Narodowej) implemented various reforms, including university reforms, during its active lifetime (1773–1994), but because Lvov found itself outside the state borders, it remained unaffected by the commission's reforms. After 1817, mathematics lectures were only given during the first year of study at the philosophy department, and for many years mathematics was at an elementary level. Kodesch was the first person to assume the mathematics chair. He was briefly succeeded by L. Schulz von Strasznitzki, a high-profile mathematician of the day, who was the first person to lecture higher level mathematics at Lvov (during the years 1834–1839). He was then succeeded by Ignacy Lemoch. All of them lectured in German. But the situation only really started to improve when Wawrzyniec Żmurko assumed the mathematics chair, a position he headed between 1871–1889. He also trained several mathematicians. The situation improved even further when Józef Puzyna took over in 1892. Puzyna is recognized in Poland as the first person in the world to write a monograph on analytic functions [A: Puzyna, 1898–1900][5]. Wacław Sierpiński obtained his habilitation degree in 1908 at Lvov University and was made an ordinary professor there in 1910[6]. Puzyna and Sierpiński were good mathematicians and mathematical life in Lvov benefitted accordingly, becoming much more dynamic (see Chapter 3). The fact that the theoretical physicist Marian Smoluchowski was at Lvov University (between 1900–1913) shows that it attained a rather high academic status in the years immediately preceding World War I. The lectures of those three people—Puzyna, Sierpiński, and Smoluchowski—were attended by Otton Nikodym, among others.

Besides the university, a technical school was established in Lvov during the nineteenth century. At first it was an intermediate-level school with a technical profile (1817–1825). In 1835 it became the Academy of Trade and Real Estate (Akademia Realno-Handlowa), and some of its students attended two-year courses. From 1844, when it became the Technical Academy (Akademia Techniczna), it

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[5]See a description about it in the monograph [C: Saks & Zygmund, 1939] and in the article [B: Płoski, 1988].

[6]The decision of the philosophy department in 1913 to appoint W. Sierpiński to an ordinary professorship (he held an extraordinary professorship at the time) was blocked by the authorities. This may have been because of cost-cutting measures introduced by the Austro-Hungarian government, following the annexation of Bosnia and Hercegovina.
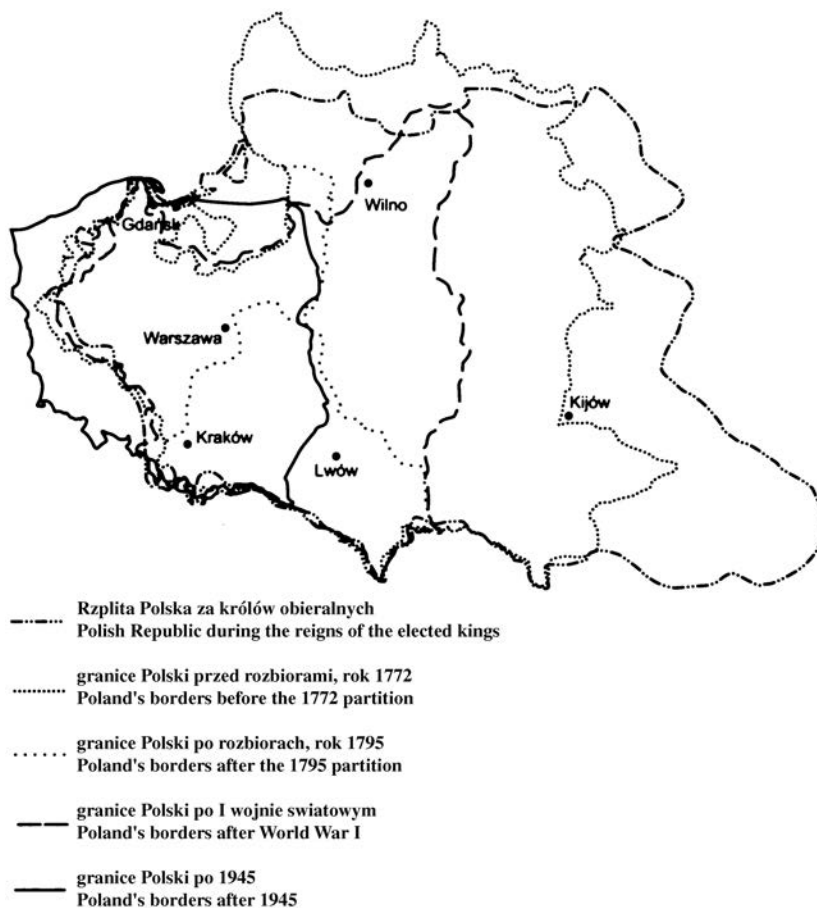
FIGURE 1. Lvov's changing borders 1772–1945. Established in the mid-thirteenth century, Lvov was a Polish city from the time of its acquisition in 1349 by King Kazimierz the Great until World War II. The war years 1939–1945 were the city's most tragic period. First the Soviets came and imposed Soviet order, which included the mass deportation of people. After the Soviets came the Germans, who cracked down heavily on the Polish intelligencia and committed genocide on the Jewish population. When they returned in 1944, the Soviets removed the entire remaining Polish population. Today Lvov is a totally different city—a Ukrainian city.

provided three-year courses, by which time it already had chairs in mathematics, physics, mechanics (which included descriptive geometry), and practical geometry (geodesy). After 1877, the academy (since changed to the Royal and Imperial Polytechnic School) was authorized to deliver lectures in the Polish language, but it was not until 1901 when it was given the right to award doctorates. In 1921 the polytechnic school became Lvov Polytechnic (Politechnika Lwowska).

The polytechnic school, just like the university, had some good mathematicians during the latter half of the nineteenth century and at the start of the twentieth century. Educated in the homeland, but completing their studies abroad, they published original mathematical papers and also wrote textbooks. They included Władysław Zajączkowski (ordinary professor during 1872–1898), Placyd Dziwiński (habilitation 1886, ordinary professor 1889–1928), Kazimierz Żorawski (habilitation 1892, private reader until 1895), Stanisław Kępiński (habilitation 1893, ordinary professor 1898–1908), and Zdzisław Krygowski (lecturer 1901, ordinary professor 1908–1919).

The last decades of the nineteenth century and the start of the twentieth century were a period of dynamic development in Lvov. As the city grew in importance, it grew in physical size too (this was the time when its most beautiful and most monumental buildings were constructed, such as the Galician Sejm, which later became the main building of UJK, and such as the theater, as well as others). With it, an interesting intellectual community emerged, revolving around the university, the polytechnic school, and the Ossolineum[7]. Kazimierz Twardowski's School of Philosophy gained ever greater status, physics was in a good state under Marian Smoluchowski, and mathematics was shaping up nicely for the foreseeable future (see Chapter 3).

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[7]The Ossolineum is Poland's national archives institute. Originally founded in Lvov in 1817 from the private funds of an aristocrat, Count Ossoliński (1748–1834), it is now situated in the city of Wrocław, Poland.

The Mathematical Community in Lvov
after World War I

Mathematics in Lvov sprang into life at the same time that the Warsaw School of Mathematics was starting up. It did so over the rubble of three wars (World War I, the Polish-Ukrainian War, and the Russo-Polish War), which had been ruinous for mathematics in Lvov. Sierpiński had left Lvov. Let us recall that he had been interned by the Russians during 1914–1917. It is true that he came to Lvov in 1917 for a few months and that he lectured there during the summer semester 1917/1918, but he had *de facto* moved to Warsaw, where he assumed the third mathematics chair. Z. Janiszewski and S. Mazurkiewicz had already left earlier, and the two of them asssumed the first two mathematics chairs at Warsaw University (though the former died at the beginning of 1920). S. Ruziewicz was the only one of Sierpiński's original group still remaining in Lvov. Among the mathematicians still active there were A. Łomnicki and J. Puzyna.

However, changes were happening. The Lvov Mathematical Society, with J. Puzyna as its appointed president, was established as early as 1917, despite the difficult war conditions and thanks to the efforts of Z. Janiszewski. While visiting Cracow in that same year of 1917, J. Puzyna persuaded H. Steinhaus, at the time a "private scholar", to go and deliver his habilitation lecture at Lvov University. A year later S. Ruziewicz would also obtain his habilitation degree. The Lvov Mathematical Society was not making much progress, and then J. Puzyna died in 1919. After W. Sierpiński's departure and J. Puzyna's death, the two mathematics chairs at Lvov University remained vacant. Military and political events saw Lvov become part of Poland, but the city was Polish not only because of its formal territorial status. It had a dominant Polish population and a predominantly Polish culture (in 1938, 63.5% of Lvov's inhabitants spoke Polish as their native language, while 85% spoke it on a daily basis).

Despite its predominantly Polish character, the city was nonetheless multilingual and multicultural. Ukrainians considered it to be just as much their city too. There were not that many of them (in 1938 only 11.3% of inhabitants declared Ukrainian as their native language), but they did constitute an important part of the population, with aspirations of their own. The Polish authorities tried to curb Ukrainian ambitions. For example, they closed down the unofficial Ukrainian University and did not allow it to continue in any official capacity. However, the Ukrainian Science Society, named after Taras Szewczenko, did function, albeit as a substitute for the nonexistent Ukrainian Academy of Sciences. There were Ukrainian secondary schools and high schools. Books and journals in the Ukrainian language were also produced. The first Ukrainian mathematicians were

there: M. Czajkowski (who later went to Soviet Ukraine and got sent to a labor camp), W. Lewicki (the author of the first mathematical work in Ukrainian), M. Zaryckij (H. Steinhaus thought highly of him and persuaded him to move to Lvov in 1925). They taught in high schools, with a preference for Ukrainian ones, they lectured at the underground Ukrainian University until it was closed down in 1924, and they were active in the Taras Szewczenko Science Society. M. Zaryckij was the only one of those three who could genuinely claim to belong to the Lvov mathematical school. While life in Lvov and Eastern Galicia was better for Ukrainians from an aspirational perspective in comparison with Soviet Ukraine, where Ukrainian "nationalist" sentiments were becoming ever more ruthlessly stamped down, Polish-Ukrainian tensions did exist and became dramatically evident during World War II.

All that was to come later (see Chapter 25 in particular), but back in 1920 peace had at last come and Lvov University, having been changed to the Jan Kazimierz Univeristy of Lvov (abbreviated to UJK), started afresh, as did its mathematical section. Its leading figure was to be H. Steinhaus. Hugo Steinhaus came from Jasło. After passing his matura exam with distinction in 1905, at the high school there, he started studies in mathematics and philosophy at Lvov University, where he attended lectures given by J. Puzyna and K. Twardowski. But after his first year of study, and at the instigation of a family friend, Professor S. Jolles from Charlottenburg Polytechnic (Berlin), he moved to Göttingen, at that time the Mecca of mathematics. D. Hilbert, F. Klein, H. Minkowski, H. Weyl, E. Landau, among others, gave lectures there. In 1911 he passed his rigorosum before a commission consisting of D. Hilbert, C. Runge, and P. Hartmann and was awarded the title of Doctor of Philosophy *summa cum laude* for his thesis on Dirichlet's principle [A: Steinhaus, 1911]. Upon obtaining his doctorate he returned to his homeland and worked as a "private scholar". He published some notes in Polish journals, including a construction, remarkable for its time, concerning a trigonometric series whose terms converge to zero but which diverges everywhere [A: Steinhaus, 1912].

During 1914–1918 Steinhaus served as a soldier in World War I (he took part in the Wolhynia Campaign of 1915 as a volunteer legionary), was a clerk in the Central Office for Country Reconstruction, and also pursued academic work. Encouraged by J. Puzyna, he did his habilitation in February 1917 at the university in Lvov. The procedure looked much as it does today: first the departmental council heard J. Puzyna's talk detailing his academic achievements, there then followed a habilitation colloquium, and at the end H. Steinhaus delivered a so-called inaugural lecture. His was entitled "Zwodnicze Drogi Matematyki" [Misleading Mathematical Pathways]. After that he was awarded his habilitation degree. With it, he obtained his *veniam legendi*, authorizing him to lecture. He consequently left the Central Office in Cracow and moved to its branch in Lvov. He considered himself a poor clerk because he was much more interested in lectures and doing mathematical research, but from May 1, 1918, he had a permanent assistantship position. When the Polish-Ukrainian War of 1918 broke out, he moved back to more peaceful Jasło, and from there he returned in 1920 to accept a position as professor extraordinary at UJK (he became an ordinary professor there in 1923). The quarter-century 1917–1941 he spent at Lvov was the happiest and most productive years of his life. Only with the outbreak of the German-Soviet War in 1941 was he ousted from Lvov.

FIGURE 2. This photo, taken in 1898, shows the Diet of Galicia province, then part of the Austro-Hungarian empire: it became the main building of Lvov University after World War I.

H. Steinhaus's predecessor as mathematics professor at Lvov University was Eustachy Żyliński, who had come to Lvov in 1919 after J. Puzyna's death. They did not really understand one another; Żyliński was a professor from an older era. He focused on teaching, whereas Steinhaus, having attended Göttingen University, believed mathematicians are only as good as the theorems they prove. Nonetheless, they did tolerate each other. Steinhaus became more active both researchwise and in his teaching responsibilities. He was the first Polish mathematician to write a paper on the newly emerging field of functional analysis, finding a canonical representation of a functional in the space of Lebesgue integrable functions [A: Steinhaus, 1919][41]. Another paper that he wrote around that time [A: Steinhaus, 1920], concerning the set of distances between points lying in a set of positive measure, was often cited later.

H. Steinhaus was a great scholar, but he considered his greatest mathematical discovery to be . . . Stefan Banach. It began thus:

> One summer, in 1916, as I was walking along the "Planty"[42], I overheard a conversation, or rather only a few words. I was so struck by the words "the Lebesgue integral" that I came nearer to the bench on which the speakers were sitting and, then and there, I made their acquaintance. The speakers, Stefan Banach and Otton Nikodym, were discussing mathematics. They told

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[41]This work entered the history books of functional analysis; see [B: Dieudonné, 1981; p. 128].

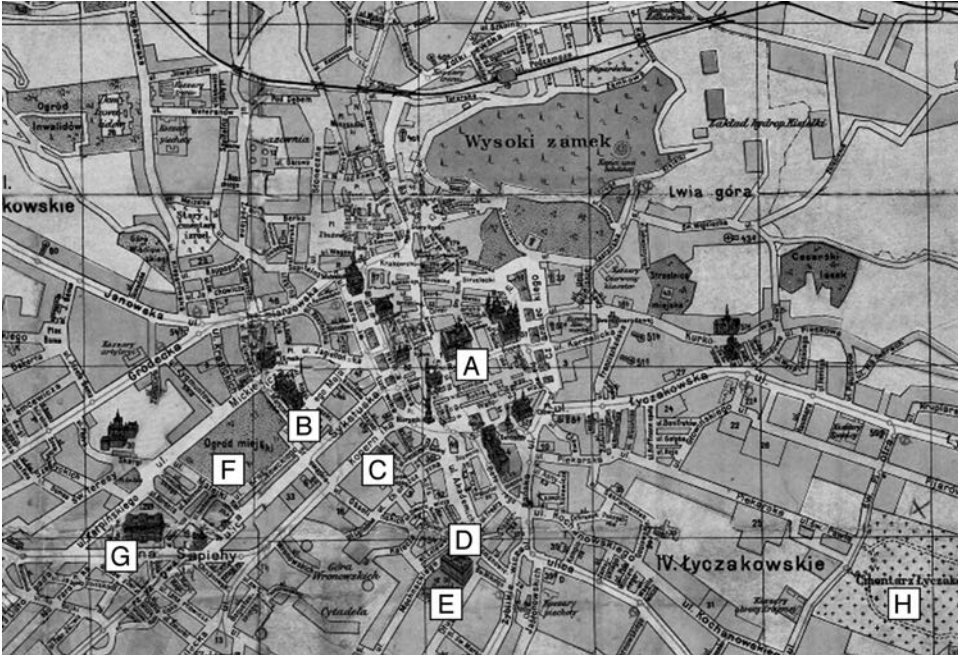[42]The Planty is a garden park area surrounding the old city of Cracow.

FIGURE 3. Grand plan of the center of Lvov, 1910: A—the old city, B—the main building of UJK, C—the Ossolineum, D—Fredro Square (where the Roma Café and the Scottish Café were located), E—the "Old 'Versity", F—Kościuszko Park, G—the main building of Lvov Polytechnic (PL), H—the Łyczakowski Cemetery (where Banach's grave is located).

me they had another chum—[Witold] Wilkosz. It was not only mathematics that bound together those three young men, it was the hopeless situation of young people in the "fortress Cracow" (such was the official status of Cracow in those days of war), the insecurity of the future, the difficulty of earning one's living, the lack of contacts not only with foreign scientists, but even with the Polish ones—such was the atmosphere of this city in 1916. But all that did not prevent the three young men from spending a lot of time in cafés discussing mathematical problems amidst a noisy crowd.

[B: Steinhaus, 2010; p. 93]

From that time we met regularly. And since in Cracow there were also Władysław Ślebodziński, Leon Chwistek, Jan Króo, and Włodzimierz Stożek, we decided to establish a mathematical society [. . .]. The society was developed.

[B: Steinhaus, 2010; p. 93]

Settling down in Lvov, H. Steinhaus arranged for S. Banach to become an assistant under A. Łomnicki at the polytechnic and later helped him obtain his doctorate (which was not easy as Banach had only studied for two years at Lvov Polytechnic,

FIGURE 4. "Old 'Versity" beside St. Nicholas Church.

meaning he had not completed a formal course of higher study), his habilitation at UJK, and a position as professor extraordinary in 1923. S. Ruziewicz likewise progressed professionally: as of January 1, 1921, he was made professor extraordinary and a full professor at UJK in 1924. In 1924 the UJK philosophy department was split into the Department of Humanities and the Department of Mathematics and Natural Sciences. In 1926 UJK introduced a master's course. At the Department of Mathematics and Natural Sciences there were four mathematics chairs, held by the following four professors (named in the order of the appointments): Eustachy Żyliński, Hugo Steinhaus, Stanisław Ruziewicz, and Stefan Banach.

A contemporary student, K. Szałajko, describes the mathematics staff at UJK and the topography of the place at the start of the 1930s:

> The main building of Jan Kazimierz University [Figure 2] was located on Marszałkowska Street, at the edge of Kościuszko Park. The university authorities had their offices there, meaning the rector, the deans, clerks, part of the law department, the chairs of philosophy, the theology department and part of the humanities department. It also included lecture rooms, including one of the largest, the Copernicus lecture hall, where some mathematics and physics lectures were given, and where, in particular, Professor Kazimierz Ajdukiewicz, director of one of the two humanities departments, delivered his lectures in philosophy and logic. The annual inaugurations took place in the beautiful lecture theater in the main building.
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> Going along Słowacki Street, Ossoliński Street, and a few other minor ones led to Fredro Square, where there were two cafés situated close to each other: one was called "Roma"; the

other would become known in the mathematical world as the "Scottish Café" [Figures 10 and 11]. The opposite side of Fredro Square led on to St. Nicholas Street, where standing next to the Church of St. Nicholas, on a small hill, was the old university building known as the "Old 'Versity" [Figure 4]. Here, leading on from the stairs on the first floor along a corridor and passing two "mathematical" lecture rooms, one came across another corridor, perpendicular to the first, which led directly to a room used by professors and mathematics students. Professor Eustachy Żyliński, the head of Mathematics Chair A, had his office in a corner room, next to which was the room for assistants and the mathematics library, which housed a large collection of books. Next in the enfilade was a student reading room, then the journals reading room and the office of Professor Stanisław Ruziewicz, head of Mathematics Chair D. The two offices further on belonged to Professor Stefan Banach, head of Mathematics Chair C, and Professor Hugo Steinhaus, head of Mathematics Chair B. The offices of Professors Żyliński and Ruziewicz could be entered directly from the corridor, whereas those of Professors Banach and Steinhaus were accessible from the corridor via a small anteroom. On the second floor there were two rooms for readers. And that was all that was available to the four mathematics chairs of Lvov University.

The building referred to above had other lecture rooms and was where other chairs of the Department of Mathematics and Natural Sciences were situated. Two rooms on the first floor were reserved exclusively for mathematics lectures and equally for students of mathematics, physics, and astronomy. Lecture Room 14, the largest in the "Old University", was on the second floor and was where, among other things, Professor Kazimierz Twardowski gave his philosophy lectures, which were immensely popular with students and attendees "from the town". Professor Leon Chwistek, who came to Lvov from Cracow, also lectured there. His lectures were also very well received.

Very near to the old university building, namely on Długosz Street, a side street of St. Nicholas Street, were the physics and chemistry buildings. On Maurice Mochnacki Street, at the other side of the old building, was the university library, on which, engraved at the front, were the words ARS LONGA, VITA BREVIS [Art is long, life is short]. A botanical garden stood between Mochnacki Street, Mikołaj Street, and Długosz Street. Part of it was accessible as a park, where students from the Department of Mathematics and Natural Sciences would go for a walk. [...]

A mathematics library and a student reading room, serving the needs of a broad program of mathematical studies, were commonly available to everyone from any of the four mathematics

FIGURE 5. The main building of Lvov Polytechnic, the view of the façade seen from Leon Sapieha street. The Church of St. Mary Magdalene lies in the background.

chairs. Together they formed the so-called mathematical seminar. One could effectively stay all day in the mathematical seminar, consulting books lent by assistants or student assistants on duty between the hours 8:00 am–1:00 pm and 3:00 pm–8:00 pm. Taking books home was forbidden. Furthermore, it was rare for there to be two copies or more of the same textbook, and even then the number was very limited, so students had to come early if they needed a particular book. The reading room was often full because for most people it was the only opportunity to study textbooks. Going through the student reading room led to the room for assistants, while going in the opposite direction led to the journals reading room. Here was the journals library, where journals were laid out on open shelves. The journals reading room was mainly used by academics and older students preparing for their diplomas. The journals reading room was also used for seminars and meetings of the Polish Mathematical Society.

<div align="right">[B: Szałajko, 1984; pp. 85–87]</div>

Readers had one or two rooms on floor II. The "mathematical seminar" was assigned only one "mathematical" lecture room, having the number 2, while others could be "borrowed" when needed. As one can see from this account, the space available for mathematics was modest, but so too was the number of salaried positions. There was only one salaried position as an assistant professor for all four mathematics chairs, serving Mathematics

> Chair A and it was held by Reader Herman Auerbach, as well
> as some other positions for younger and older assistants.

[B: Szałajko, 1994; p. 252]

The main UJK building looked onto Kościuszko Park, and, situated on the other side, on L. Sapieha Street, was Lvov Polytechnic, denoted PL [Figure 5]. A singular feature of PL was its placement, next to four technical departments, the agro-forestry department, and the general studies department. Mathematical chairs at PL were allocated to departments. Mathematics Chair I was allocated to the Department of Land and Water Engineering, Mathematics Chair II to the mechanics department, Mathematics Chair III to the general studies department. Responsible for these chairs were Placyd Dziwiński (until his retirement in 1925: Chair I), Włodzimierz Stożek (between 1922–1941; first with Chair III, later with Chair I), Antoni Łomnicki (between 1919–1941; Chair II) and Kazimierz Kuratowski (between 1927–1933, i.e. until the liquidation of the general studies department; Chair III). Besides this there was the Department of Descriptive Geometry, run by Kazimierz Bartel. From 1937 Kazimierz Szałajko was a senior assistant at Antoni Łomnicki's chair, while Andrzej Turowicz was senior assistant at Włodzimierz Stożek's chair, and Stanisław Mazur was an assistant professor or adjunct.

> [Professor Łomnicki] was above all a teacher and expositor of applied mathematics. His three-volume textbook entitled *Differential and Integral Calculus*, having the subtitle "for natural scientists and technicians", was, it is fair to say, a pioneering work [...]. Profesor Łomnicki was the first to initiate a mathematics lab into the mathematics teaching and higher technical schools, having of course only modest means at his disposal, and he engaged a whole team of mathematicians, taken from both chairs, to run it. Thanks to the professor's efforts there were many pictures stuck to boards, cartographic projections, and nomograms showing nets and ladders. He used those boards for his lectures. As a mathematical cartographer he was known across Europe, and therefore a member of the Paris-based International Cartography Society. Łomnicki was one of the first [...] pioneers of axiomatic probability theory. And who could have been unfamiliar with his geometry textbooks?

[B: Szałajko, 1994; p. 262]

The task of the PL general studies department was to prepare students in the other departments with basic knowledge (mathematics, physics, etc.) and to train teachers of technical subjects. Its benefit for mathematics was that it offered more jobs to mathematicians. However, Minister Jędrzejewicz had it abolished on September 25, 1933, and Kazimierz Kuratowski returned to Warsaw, where he was made an ordinary professor at the university there.

K. Kuratowski had a very productive time in Lvov, during which he published some forty papers, including joint papers with S. Banach and S. Ulam. His tutees included S. Ulam and E. Otto.

The PL general studies department worked closely with UJK mathematicians. Apart from professors from the politechnic (K. Bartel, K. Kuratowski, A. Łomnicki, W. Stożek), professors and readers from the university (S. Banach, S. Kaczmarz,

W. Nikliborc, W. Orlicz, S. Ruziewicz) also lectured there. It was a superb faculty. S. Banach's interest in mechanics doubtless dates to the time he spent meeting the needs of that department, as shown by the monograph he wrote [A: Banach, 1938b].

There were few positions with paid employment at UJK and PL, obtaining one was difficult, and the pay was low. Herman Auerbach is an illustrative case. Upon completing his mathematics studies at UJK in 1923 he obtained a position as a "demonstrator for the mathematical seminar" for the year 1923/1924 for which he was required to work twenty hours per week on a salary 50% lower than an assistant in [salary] group VIII, amounting to 130 zloties per month. The pay and conditions changed almost every year (as did "daily employment"), but his salary was always low and his hours long. The responsibilities of a demonstrator were not precisely stated, so one can safely assume he ended up doing just about everything asked of him, whether it was administrative work or lecturing on articles for seminars as requested by the professors. Employment on the lower rungs of the academic ladder meant a yearly contract. In H. Auerbach's case, the department applied to the UJK Academic Senate every May or June to have it renewed for the subsequent year, which it always was, allowing him to slowly progress professionally. So for the two years 1923/1925 he was a "demonstrator" and a "junior assistant" on a group IXb salary for the years 1925–1930. In 1930, when he got his doctorate, he was promoted to "senior assistant at Mathematics Chair A", on a group VIII salary. And thus it continued. Even when he obtained his habilitation in 1935, thereby authorizing him to deliver lectures, he was still registered as a senior assistant, the difference being that as a reader he received a group VII salary, i.e. 335 zloties per month. It still wasn't much, because he admitted he was earning about 130 zloties per month extra at a private junior high school. The last document in his personal file is dated July 24, 1939, and is a nomination, signed by the UJK rector, for H. Auerbach to be appointed as senior assistant for a one-year period September 1, 1939–September 30, 1940. The dean submitted the nomination "for the attention of the director of Mathematics Section A" on September 1, 1939, but that was the very day war broke out: Germany had invaded Poland.

The list for the mathematics chairs at UJK for the academic years 1936/1937 and 1937/1938 reads as follows:

Chair A. Head: Professor Dr. Eustachy Żyliński. Senior assistant: Reader. Dr. Herman Auerbach.

Chair B. Head: Professor Dr. Hugo Steinhaus. Senior assistant: Reader. Dr. Juliusz Schauder. Deputy assistant (volunteer): Helena Plamitzer.

Chair C. Head: Professor Dr. Stefan Banach. Deputy assistant: Kazimierz Szałajko MSc. Senior messenger: Józef Góral.

Social Life
(the Scottish Café, the *Scottish Book*)

Lvov liked to have fun and social life thrived.

> The dance craze, excursions, libertine excesses, betrayals, and short-term relationships, in other words enjoyment of freedoms dreamed of for years: helping oneself to rewards after the pressures and dark days of the war years—all of this was typical of the years 1920–1923.
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> <div align="right">[B: Steinhaus, 2010; p. 99]</div>

As the "dark days of war" receded from memory, the prime order of the day was a desire for success, to prove to ourselves that Poles deserved a free state, that they were capable of uniting ourselves after three partitions and to build anew, and that, most particularly, Polish learning (Lvov included) could "strike out for independence". And the attainment of that freedom was followed with remarkable successes—an enduring joy of life. A contemporary student reminisces on the period 1925–1929:

> I was someone who belonged to that generation. Mathematics for those fascinated by it was something akin to a burning fever. We went together to all manner of places at various times of the day or night, talking endlessly about mathematics. In a place, which was a cross between a room and small library, there stood a big, old, tiled stove, one side against the wall. I remember having long discussions when it was freezing outside, when we would glue ourselves against the tiles of the three remaining sides, talking about mathematics around the corners of the stove.
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> <div align="right">(Z. W. Birnbaum, quoted from [B: Woyczyński, 1997; p. 140])</div>

A singular joie de vivre and a fascination with mathematics were manifest in the vibrant café culture.

> A significant part of our mathematical discussions took place in cafés neighboring the university. The first of them was called "Roma". After a year, maybe two, Banach decided to move our sessions to the "Scottish Café", situated on the other side of the street. [...] The tops of the café tables were marble slabs on which one could write in pencil and were, even more importantly, quickly erasable. In our mathematical discussions a single word or gesture, requiring no further explanation, often sufficed to understand what was being meant. Sometimes an entire discussion consisted of just a few uttered words punctuating long periods

of thought. An observer sitting at another table could overhear short bursts of conversation and see lines being scribbled on the table, sometimes interspersed with a laugh from one of the people seated, followed by long periods of silence, during which we consumed coffee and looked vacantly at each other. The acquired habit of persistence and concentration, sometimes lasting hours, was for us one of the most important elements of mathematical work.

[B: Ulam, 1969, p. 52]

FIGURE 10. View of Fredro Square, as seen from St. Nicholas Street. Straight ahead is Łoziński Street, where the "Łoziniec" was located, the Scottish Café was on the right, the Roma Café was on the left.

The table used by Banach, Mazur, and Ulam was the most important one in the Scottish Café. One session there even lasted seventeen hours—resulting in the proof of an important theorem on Banach spaces—but nobody wrote it down, and even today nobody has recovered it [...]. A table cover with traces of pencil lead was probably all that remained of that session and was most likely scrubbed off by the café cleaner. So therefore a great service was done by Łucja Banach, who now rests in a cemetery in Wrocław—when she purchased a thick exercise book with a thick cover and entrusted it to paying customers of the Scottish Café—that was where mathematical problems were written down, on the first side of consecutive pages so that solutions could be added in later, next to the problem statements. The original "Scottish Book" was available to every mathematician

who asked for it at the café: some problems promised the re-
ward of a prize for a solution—the prizes ranged from a small
cup of coffee to a live goose.

[B: Steinhaus, 1961a; p. 257]

The exercise book purchased by Mrs. Łucja Banach, the wife of Stefan Banach,
quickly became known as the *Scottish Book* (and is cited as *"The Scottish Book"* in
the literature). In the few years of its existence it played a big role in the life of Lvov
mathematicians. The first problem in the *Scottish Book* was written in by Stefan
Banach on July 17, 1935, the last by Hugo Steinhaus on May 31, 1941. All together
it includes 193 numbered problems, some with solutions, encompassing such fields
as summability theory, functional analysis, classical analysis, group theory, measure
theory, set theory, probability theory, and topology.

FIGURE 11. Inside the Scottish Café during its heyday.

The *Scottish Book* was thus in use for almost exactly six years, from July
17, 1935, to May 31, 1941. The first year was the best because in the summer
and autumn of 1935 almost half the problems were entered into it. The precise
number is difficult to state because not every author included the date. In any
case, the last problems dated for 1935 have the numbers 109 and 110 (October
1935), while the next problem bearing a date is problem number 132 and is dated
as late as February 25, 1936. So certainly 110 problems were entered into the
Scottish Book in 1935, and almost certainly so were a few more, possibly even a
dozen or so more. Such a large number of problems testifies to the newly found
popularity of the *Scottish Book*, though many of them had arisen in earlier years
and had not been solved. The authors of problems 1–110 are exclusively all Lvov
mathematicians (in the order of the entries, if there are several authors, we note
all their names): Stefan Banach, Stanisław Ulam, Józef Schreier, Stanisław Mazur,
Władysław Orlicz, Herman Auerbach, Juliusz Schauder, Hugo Steinhaus, Stanisław
Ruziewicz, Zbigniew Łomnicki, Kazimierz Kuratowski.

Another forty-five problems were added between October 1935 and the end of
1936 (the last entry, dated November 18, 1936, was number 155) and only then
are there entries from other Lvov mathematicians and guests from outside Lvov.
In the remaining calendar years 1939–1941 only thirty-eight problems were written
in and they were distributed almost equally (see Figure 13), though in the last

FIGURE 12. S. Mazur and S. Ulam on a street in Lvov, sometime around 1935.

years of peacetime there was a rising number of guest contributors (A. J. Ward, S. Stoïlov, J. von Neumann, Edward Szpilrajn (Marczewski), Karol Borsuk, C. Offord, M. Kampe de Feriet, and others). During this time Meier Eidelheit made his contribution, entering five problems. It is curious that even after the Soviets took over Lvov, the *Scottish Book* continued to be in use, because in that period the last twelve problems were written in, principally by those who had fled Warsaw (B. Knaster, S. Saks, E. Szpilrajn (Marczewski) and Soviet mathematicians (N. N. Bogolyubov, P. Aleksandrov, S. Soboloev, A. P. Bermant, L. Lusternik)). The only locals to write in their problems were S. Banach and, lastly, Hugo Steinhaus.

Although the last problem in *The Book* bore the number 193, there were in fact many more entries. Ignoring the fact that some problems actually consisted of many others, there were also unnumbered entries, specifically occurring after
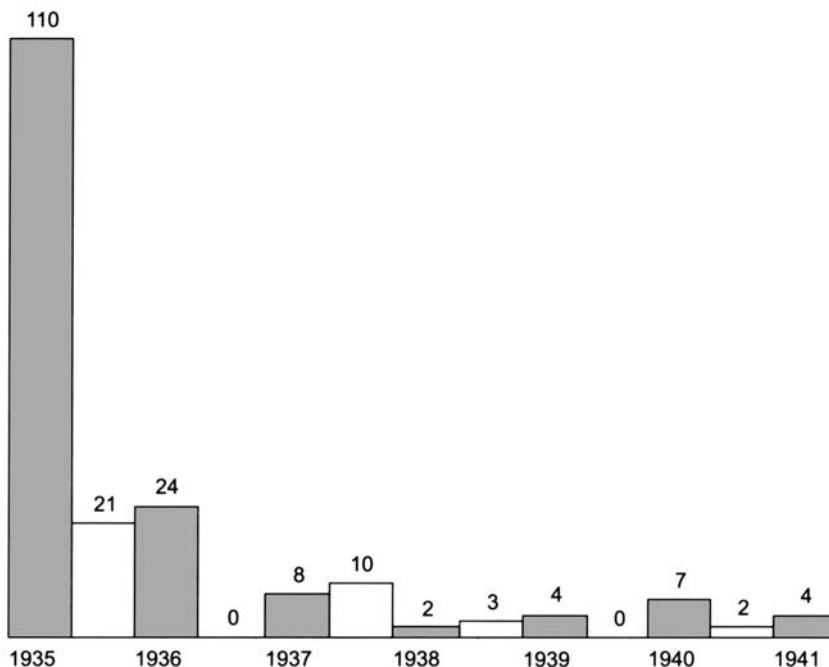
FIGURE 13. The *Scottish Book* in numbers. The chart shows the number of problems entered into the *Scottish Book* over successive years. Since there is no date for many of the entries, the shaded columns denote unambiguous data, whereas the unshaded columns denote the number of problems entered between the last dated entry of the previous year and the first dated entry of the subsequent year.

numbers 10, 15, 17, 20, and 188 (in the monograph [B: Mauldin, 1981] they are labelled 10.1, 15.1, etc.). In total there were thus 198 problems and the statistics below will refer to that number. S. Banach wrote fourteen of his own problems and another nine with others: four with Mazur, four with S. Ulam, and one with both of them. S. Mazur had more, since he wrote twenty-two problems of his own and another twenty-five with other mathematicians, including W. Orlicz (twelve) and S. Ulam (seven). The record holder, in terms of the number of entries, was S. Ulam, who made forty independent entries and twenty-two joint entries, including Banach (five), J. Schreier (six), and S. Mazur (seven). W. Orlicz made three independent entries and twelve joint entries with S. Mazur. H. Steinhaus made nine independent entries. Approximately five to ten further problems were written in by J. Schreier (four independently, six with Ulam), H. Auerbach (four independently and four together with Banach, S. Mazur, or S. Ulam), S. Ruziewicz (five independently), M. Eidelheit (five independently), S. Eilenberg (a series of six problems, written in a single day). The statistics reveal those who were both active mathematicians as well as frequent visitors of the Scottish Café. It also reveals who worked closely with whom; for example Banach's mathematical partners were S. Mazur and S. Ulam (the academic paths pursued by S. Banach and H. Steinhaus had diverged by that

time). Some of the problems were of an elementary nature, such as problem number 59, of S. Ruziewicz, asking whether one can break up a square into finitely many different squares, and problem number 123, known as the Steinhaus "sandwich" problem. However, there were also some problems which led to many years of research, such as problem number 43 of Mazur with the definition of "Mazur's game"; problem number 54, of Schauder, about fixed points; problem number 77 of Ulam (if A^2 and B^2 are homeomorphic (isometric, isomorphic) does it follow that A and B are homeomorphic (isometric, isomorphic)?); problem number 153 of Mazur, with the promised reward of a live goose for the solution (see Chapter 21); or problem number 175 of Borsuk (is the product of a triod—i.e. a space homeomorphic to the letter "T"—and a Hilbert cube also a Hilbert cube?). Just about every problem entered into the *Scottish Book* can be said to have inspired interesting ideas and led to interesting and important research. Some questions in it remain open to this day.

After the war and after the death of her husband, Łucja Banach and her son Stefan (who later became a medical doctor) were "repatriated" (meaning compulsory resettlement in Poland, within its new borders) to Wrocław. Knowing the importance of the *Scottish Book*—she took it with her. While in Wrocław and right up until her death after the war (she died in 1954, in Wrocław), she kept in contact with Wrocław mathematicians, above all with Hugo Steinhaus.

> After the war Steinhaus wrote out by hand (word for word!) the contents of the book and in 1956 he sent a copy[48] to Stanisław Ulam in Los Alamos. Ulam transcribed it into English and then had 300 copies made (at his own expense), sending them to friends and various universities around the world. The book became famous and many mathematicians requested Ulam to send further copies. After a few years there were so many requests that it was decided, in Los Alamos, to issue another edition (together with various corrections), but no longer at Ulam's own expense, and which was realized in 1977. In May 1979 at North Texas University a "Scottish Book Conference" took place (Ulam, Kac, and Zygmund were among the participants). Together with updated material regarding the solutions of problems and other problems on associated themes, a book (with additional papers from the conference, most particularly including reminiscences) was published by Birkhäuser in 1981 (edited by Daniel Mauldin).
>
> [B: Ciesielski, 1993a; p. 66], [B: Mauldin, 1981]

Today the original *Scottish Book* is in the custody of the Banach family, and a copy of the original is in the Library of the Mathematical Institute of the Polish Academy of Sciences in Warsaw. Of the various versions and updates, the most worthy is the monograph [B: Mauldin, 1981], referred to above by K. Ciesielski and including much interesting information about every single problem in the *Scottish Book*.

> For those of us who were brought up in the golden age of functional analysis, the *Scottish Book* was and remains a romantic

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[48]It was a "typewritten copy"; see [B: Maudlin, 1981; p. xii].

source of our mathematics [. . .]. The astonishing problems in the *Scottish Book* expressed the spirit of contemporary mathematics.

(G.-C. Rota, quoted in [B: Mauldin, 1981; dust cover]).

But let us return to mathematics.

Mathematics evolved ever more vigorously in Lvov. [. . .] Specialists emerged in different fields. Mazur worked on linear methods in summability, Auerbach on differential geometry, Schauder on partial differential equations, Kaczmarz and Orlicz on orthogonal series, Nikliborc on celestial mechanics and balanced shapes—to mention but a few.

The most interesting aspect was the joint work. For example, the work on the principle of condensation of singularities was written jointly by myself and Banach. The work on the decomposition of a ball into parts, from which one can assemble a larger ball, was undertaken by Banach and Tarski. Mazur and Orlicz wrote joint papers, as did the younger Łomnicki with Ulam, Ruziewicz with Sierpiński, etc. If one were to link together all the names of people who wrote joint papers, one could find paths of names from Polish mathematicians to mathematicians in the world's major countries.

One could identify the different "schools" as well. Banach's school focused on operator theory, Kuratowski's school focused on topology, Chwistek's on mathematical logic: I tried to steer my students towards probability theory and applied mathematics. At the Polytechnic, Bartel worked on the relationship between descriptive geometry and the spatial representation of art; accordingly, he studied Italian paintings and engravings and produced a beautiful treatise on them.

[B: Steinhaus, 2010; pp. 120–122]

K. Kuratowski bears interesting testimony about life in Lvov at the time:

Taking up the chair in Lvov, I kept my readership position in Warsaw (taking an annual leave as a reader), because I wasn't sure if I could bear to live away from my home city of Warsaw.

It turned out differently: after a year I resigned from my readership position in Warsaw and became fully enticed by Lvov.

How did that happen? The uncommon beauty of the city, which I remember even now with a certain emotion, and the academic way of life, which absorbed me with lightning speed. In particular that part of the academic environment in which I could work closely with others, that is the mathematical environment, was especially appealing to me. Above all, Banach and Steinhaus were there [. . .].

This Lvovian "climate" was equally conducive to my creative output, so that the years I spent in Lvov were the most active period in my academic life.

[B: Kuratowski, 1981; pp. 86, 89]

A characteristic feature of this academic climate was a fondness for jokes. Once H. Auerbach bought himself a new hat. Shortly afterwards somebody switched it in the Scottish Café for an old and dirty one. Auerbach began wearing it, and when asked why he never cleaned it, he answered that he was not going to clean a hat on behalf of a thief.

One time L. Chwistek came to a lecture wearing one brown shoe and one black one. One of the students noticed this. Chwistek was embarrassed: "It's strange. At home I have another pair just like it."

One of the outstanding Lvov mathematicians was referring to something in a chaotic manner. Somebody caustically observed: "You, sir, are thinking about A, say B, write C, but it should be D."