

Most of this text is a summary and an amateur translation of Mariusz Urbanek's book 'Brilliant. Lviv School of Mathematics' – magnificently researched telling of the entirety of the history of said circle of mathematicians, strewn with anecdotes, a very pleasant read, unfortunately not yet translated to English.

This note focuses on the fates of Banach, Steinhaus and Ulam during and after World War II; it is a part of a project XXX

Every summer Ulam would gladly return to Lviv and spend his vacations at the Scottish Café with Banach and Mazur, doing what they had always done in the years prior to his departure. Banach and Ulam met for the last time at the Scottish Café in June of 1939, and, as recalled by Ulam, they came up with a handful of new problems for the Scottish Book, but as the imminent shadow of the upcoming war loomed over Poland, when professors met, less and less time was spent discussing mathematics. Boarding a ship to America, Ulam stepped into the unknown more than ever before in his life – his membership in the Society of Fellows expired and couldn't be prolonged, as he was too old – he'd just turned 30. He was promised a job at Harvard, but only for a year, and his career was very uncertain. Shortly after his arrival to New York, a friend called, telling him about the bombing of Warsaw.

As the academic year began in September, war caught the rest of the mathematicians on vacation. At first, in the Eastern parts of Poland, it seemed very distant, but when Russia joined the war, chaos and gang wars consumed Lviv's area. A few months after the Red Army stepped into the city, the situation stabilized and even cultural life flourished anew, at the cost of academics being sucked into the bureaucratic machinery of the Soviet Union.

In September of 1940, in the USSR-occupied Lviv, the official name of the Jan Kazimierz University was changed to Ivan Franko Lviv State University, its Polish rector replaced by a Ukrainian one and Lenin's statues appeared all around the campus. Although the new rector's role was to Ukrainize the university, Banach became the new dean of the Faculty of Mathematics and Physics, and out of six institutes, five of them had Poles as their directors. Banach's promotion is owed to many factors, mainly his apolitical attitude during Soviet regime – he remained an active academic all throughout the years of the occupation of the city, he engaged in newly formed scientific circles of the Ukrainian SSR, closely cooperated with the Soviet mathematical school, visited Moscow and together with Mazur became a member of the Lviv city council (despite the potential severe consequences, they frequently used their positions to help even their distant acquaintances). Banach even attempted to teach in Ukrainian at the request of the Soviet authorities. On top of that, his roots (illiterate parents) aligned with poetics of the Soviets. Circle of Lviv's mathematicians was enriched by some refugees from Warsaw; Steinhaus commented that 'in normal times, with such a gang we could have achieved quite a lot'. After a short break, Scottish Café meetings resumed, the Scottish Book gained new entries – more and more by visitant Russian scientists. As a result of one of such visits, some of Lviv's mathematicians got soviet degrees and offers of collaboration with Russian Academy of Sciences, and in turn could financially support their colleagues from humane departments, whom university's new administration deemed unnecessary.

Despite initial difficulties, Ulam's career took a regular path, and in his opinion, a very boring one. When at Harvard, Birkhoff advised him to move further to the West of the USA, as due to massive migrations, it was almost impossible to get a position at one of the universities on the East Coast. Ulam was very reluctant, as it meant he'd be further away from his beloved motherland, but finally he yielded and spent over 2 years at the University of Wisconsin-Madison. There, he became a United States citizen in 194 and married his wife, Françoise Aron. With time he grew bored with the relatively small town, as well as teaching army courses in mathematics, and felt he was 'on the margin of history'. He even attempted to enlist in the United States Air Force, but was rejected due to visual impairment. In 1943 he turned to Von Neumann to get a job in the army. He replied he had spare 2 hours on a train station during a change. Stan noticed something was up, when Von Neumann stepped out of the train with two security guards. After a short talk, Ulam got an invitation to Santa Fe. He wanted to learn a bit about New Mexico, so he borrowed a book on the area from the university's library. Looking at its card, he noticed a suspicious thing – students and colleagues who suddenly disappeared in the past few months, did so too. Later, he met them all in Los Alamos. He said the whole situation resembled a detective movie. In Los Alamos, apart from Ulam and Von Neumann, there were only a handful of mathematicians, all of them rather young. At times, the atmosphere of the institution reminded him of the cherished Scottish Café sessions years prior, though he felt they were more intimate in Los Alamos, because of the common goal and a sense of mission. In a way, working on the development of the atomic bomb was exactly what he needed. He yearned for something exciting, and after the war and during the development of the thermonuclear weapon he always said in the interviews he had never considered scientists responsible for the atrocities of the war – only the politicians and militaries. At the same time, he believed in their good will, as well as in humanity in general, and envisioned a peaceful future for humankind. Ulam, much like many of his colleagues, underestimated the impact the atomic bombs would have on the world. Later he characterized his position as 'midway between naïve idealism and complete chauvinism'.

From time to time, mathematicians in Lviv were interrogated by USSR organs (questions often managed to one up the usual bitter sweet theatrum absurdum of Soviet paranoia – e.g. what someone had been doing during October Revolution, at three years old) and only occasionally some scholar or artist inexplicably disappeared into thin air. Steinhaus managed to trick Soviet censorship by impersonating a lunatic classical philologist or an uneducated old Jewish lady and by creating ad-hoc codes he described the reality of occupied Poland in letters sent to Kac (who was in the US). The situation worsened when the German army stepped into the city and once again it was consumed by total chaos. German groups started arresting intelligentsia from lists prepared in advance, who were then murdered during the night. Massive executions of Jews and Poles lasted from 30th of June to 2nd of July. Kazimierz Bartel, who was one of the most active and influential Polish politicians of the interwar period, five times the prime minister, professor and rector of Lviv Polytechnic, joked to be a mathematician during short breaks from politics, was arrested on 2nd of July, kept in prison for a long time and offered a high position in the puppet government. After his final refusal he was executed by the order of Himmler on 26th of July. During the night from 3rd to 4th of July, 37 professors from Lviv's University and Polytechnic were murdered by the Gestapo. Among the victims was Stożek, one of mathematicians from the Scottish circle, and Tadeusz Boy-Żeleński, often simply called Boy, interwar culture persona, literary critic, poet, satirist and translator of French classics, a doctor by profession. Germans closed the universities, so academic life had to continue illegally through underground teaching that began in Lviv in 1942. During the liquidation of the Lviv Ghetto in September of 1940, Auerbach committed suicide; Schauder, also a Jew, was shot in 1943.

The day after the massacre of Lviv's professors, on July 4th, Steinhaus' household was invaded by SS-Manns and the mathematician himself was beaten up. Immediately after the

incident, he packed up his most important belongings, including all but one volume of 'Studia Mathematica', and left with his wife. For a few months they got shelter in their friends' properties in Lviv, changing their hiding places frequently, until finally the whole Steinhaus family split into three groups, and the mathematician hid together with his wife in university's administration worker's estate in Lviv's outskirts, but they had to leave soon after, due to a threat of denunciation. Mr. and Mrs. Steinhaus rented a small living compartment built for servants in a grange in today's southern Poland, where they spent the rest of the war, living a modest, self-sufficient life, even though every once in a while they heard about disturbing incidents in the neighboring areas. Steinhaus was occupied with following the war's course, underground teaching, composing a very accurate map of the area and designing and building a sundial for the community. After the war ended, even though Steinhaus got very attractive job offers, he took his time to return to the academia – he loved the sudden peace and quiet of the distant countryside, so recently breached by the Red Army – as he noted, the meek boys that fled three years earlier, returned bloodthirsty and battle hardened, no longer nagging about Marx or even Stalin, but pillaging and ravishing every village that was unfortunate enough to be on their way to Berlin.

Meanwhile, both Banach and Mazur stayed in Lviv. Mazur worked as a pâtissier until the Soviets returned. Banach's son believed that his father survived the massacre thanks to Ukrainians' help, to whom (students and colleagues) Banach had been remarkably friendly in the years preceding the war. Together with his son, Banach became a louse-feeder at Rudolf Stefan Weigl's lab at the Lviv Institute for Study of Typhus and Virology. Weigl's among many unsung heroes of the Nazi-occupied Poland, he developed the first effective vaccine against epidemic typhus and helped many Polish intellectuals, Jews and underground activists during the occupation, often via employing them as louse-feeders, which guaranteed them protection against repressions and provided food and other material means to survive. As a prolific pharmacologist, he was priceless to the German army, and as such they let him get away with this scheme and accepted other acts of rebellion, such as refusing to adopt German citizenship – though he was born in Austro-Hungarian Empire, he identified himself as a Pole. His vaccines were smuggled into Lviv and Warsaw Ghettos as well as concentration camps, and according to various estimates, Weigl saved about 5,000 people during the war. Scholars employed in the Weigl's institute killed the feeding time by deliberating and playing games at two tables – humane and mathematical. Szybalski, future world class oncologist, a witness of those conversations, remembered them as almost surreal. He had to make sure that the professors didn't prolong the feeding process, immensely gross, according to Banach, because overfed lice popped spraying the precious blood. Banach stayed at Weigl's lab until the Soviets returned to Lviv. Unlike his wife, he missed the exact moment – a Russian recon tank pulled all the way to the Banachs' tenement, then a soldier jumped out of it, rang the door and panting asked Stefan's wife if 'professor Banach was alive' – he was one of his students.

After the Soviets retook control of the city, Banach returned to lecturing, but he didn't work for long, as he was soon diagnosed with cancer, which caught him after a lifetime of smoking five packs a day. At the same time rumors started circulating Lviv: it was said that Stalin was about to offer him the role of the president of the Polish Soviet Republic. The fact is, he was offered the highest Soviet honor – Stalin Prize – but only if he accepted Russian citizenship, which he firmly refused. Up until the last moments, he hoped that Lviv would stay within Polish borders. Sobolew remembered him as the soul of Lviv's mathematical circle, and, as he made his dying breath on 31 August 1945, it certainly marked the end of an era. Only a handful of scholars hadn't yet moved out of the city, and 16 of them spoke during his funeral, attended by hundreds of people.

Lviv was no longer in Poland's borders (Russia started preparing for its removal in 1944 by drastically increasing its population via allocating there people from Ukraine and depths of the USSR, in result diminishing the percentage of Poles in the city), and universities in the

'Recovered Territories' needed professors. Steinhaus decided to move to Wrocław, Orlicz to Poznań, and Mazur to Łódź – he chose it to be closer to the capital, Warsaw, wishing to advance his political career. After becoming a parliament representative in 1947 (following rigged elections, won by unified communist parties), he moved to Warsaw itself – as a member of the party, he was offered an apartment much bigger than predicted in official decrees (every aspect of citizens' lives in Polish People's Republic was to be meticulously standardized), but in accordance to his unyielding idealism, he refused. It wasn't the only privilege that he avoided – via special coupons, he got access to goods not available to regular citizens, and hid them away from his wife, which she would find and use anyway. He became the general secretary of the Polish Academy of Sciences and soon got reelected for the parliament once more, which heavily limited his time at the university, to the great disappointment of his students, as he was considered an excellent lecturer. He would tell his listeners the tales and legends of the times at the Scottish Café, but never bragged about his own achievements. He kept his habit of never publishing his works and being completely absorbed by his inner world and thoughts – once his daughter, famous prima ballerina, jokingly bumped into him on the street, but he didn't recognize her, excused her and waddled off. He would always break into sweat when the cashier, knowing his profession, asked him to sum up the costs of the newspaper and a sandwich.

After the siege of Festung Breslau, it was all covered in debris; Mr. and Mrs. Steinhaus moved into a windowless house near Grunwald Square where Germans detonated all buildings in order to prepare an airfield. The city was constantly being robbed of whatever was left after the war, and many Germans still hadn't left the area. The entirety of the city center turned into a large flea market during the day, and at night it wasn't surprising for a dozen or so people to get murdered. In such conditions the scientific life of Wrocław gained momentum (while Steinhaus' house still lacked windows, due to a shortage of glass) and Wrocław is said to have continued Lviv's traditions – the Scottish Book, kept safe by Banach's wife during the war, was transported there in 1946, and the New Scottish Book was founded, though functional analysis was practiced mainly in Poznań and Łódź, as Steinhaus was more keen on applied mathematics and he frequently changed his field of interest. Steinhaus was the first dean of the reactivated Department of Mathematics, Physics and Chemistry at the University of Wrocław, which for a long time had only two mathematics students, one of which wasn't officially on the list, as he had lost his documents during the war. Steinhaus started publishing his aphorisms in the newspapers – they were praised by Julian Tuwim, one of the most prominent poets of interwar Poland, leader of the "Skamander" group, composed of young and brilliant poets celebrating the regained freedom of their country, breaking the traditions kept in stone since Romanticism, centering their writing around youth, technological advances and the exciting lifestyle of the city. Upon hearing in person presumably the most famous one – 'Earth - a ball and chain', or when translated literally from Polish, 'a ball beside [or underneath] one's leg' – Tuwim kneeled. He helped promote Steinhaus works, though his complete works came out many years after his death.

Briefly after the end of the war, Mark Kac wrote to Steinhaus that the latter was thought to have died during the war and that his popular science book 'Mathematical Snapshots' ('Mathematical Kaleidoscope' in direct translation from Polish, the American edition got its title altered) was a great success, though publishers wanted to 'Americanize' it, i.e. make it a bit easier. While on his visit in the USA, he didn't let Ulam convince him to move to America. Steinhaus attempted to kickstart a new robust mathematical center in Poland, already a second one in his lifetime, and Kac deemed his efforts successful and praised that he achieved it despite physical and psychological difficulties. Steinhaus returned his kind words by noting in his diary that 'Ulam, unlike Kac, didn't Americanize – he was too brilliant'. Though Steinhaus was very open with his critique of the government, he constantly reaped laurels. For example in 1948, during the World Congress of Intellectuals in Defence of Peace, a Soviet propaganda event, participated by artists and intellectuals from all around

the world, including, but not limited to: Pablo Picasso, Aldous and Julius Huxley, Paul Eluard, many of the "Skamander" poets and Polish logicians. Steinhaus, one of the delegates, when asked why he didn't welcome the Russian ('the world's most peaceful country') delegates at the airport, replied 'I was sick [physically], but not mentally ill'. Wherever he appeared, he was immediately recognized as a socialite, working a crowd with his aphorisms, jokes and anecdotes, which he must have had plenty of. Steinhaus was retired in 1961, at the age of 70, in accordance with the rules in force. He died in 1972.

In the year 1968, a series of students' and intellectuals' protests went off all around Poland, a symptom of dissatisfaction with the falseness of the promises of Kruschev Thaw and the Polish October. As a result, the leading communist party applied a series of repressions against dissidents and ensued an anti-Semitic campaign, persecuting citizens of Jewish descent, which was followed by emigration of the majority of the remaining Jews from Poland. Those events, along with the invasion of Czechoslovakia by the Eastern Bloc forces united by the Warsaw Pact, were a fatal blow to Stanisław Mazur's fading faith in the system. In reaction, he resigned from the University of Warsaw. His daughter remarked that as he died in 1981, he was completely disenchanted with communism.

Ulam decided to stay in the USA after the war, as he thought not a single member of his family had survived the Holocaust. Later he learnt some of his cousins were alive and lived in France and Israel. He left Los Alamos, as he deemed staying there a waste of time, and began working at the University of Southern California. In 1946 he suddenly lost speech and sensation in half of his body. Questions arised, whether this illness was related to the Manhattan Project (probably not, but the reasons are unknown to this day), and if recovered Ulam wouldn't be an easy target for Russian spies. Though he was cured by an emergency brain surgery, Ulam was very worried about his mental faculties. On his visit, Paul Erdős reassured him he was 'just like before'. During recovery, while playing solitaire, he came up with an idea on how to skip the rigorous considerations concerning the probability of the game being winnable, by treating the problem statistically. Combined with his experience from his work in Los Alamos, where he was occupied with approximate hydrodynamical calculations, he came up with the Monte Carlo methods. The name stems from the probabilistic nature of the results and Ulam's uncle, who was a gambler and a frequent visitor of Monte Carlo casinos. Early computer developed in Los Alamos Laboratories, ENIAC, made the calculations feasible. Special unit, later dubbed FERMIAC, mechanically simulated random diffusion in fissionable materials.

Ulam wasn't content with the USC, and when he got offered a job back at Los Alamos in 1946, he replied that he's interested 'in general', but the dispatch that reached Santa Fe read he's interested to 'be the general', so he did become elected as one. Together with Edward Teller (who he had already recognised at Los Alamos as overambitious) and Everett (friend back from Madison), they were to work on the development of the 'super', as Teller used to call the thermonuclear bomb. The morality, cost-effectiveness and sheer possibility of its construction were being questioned until the detection of the first Russian nuclear test in 1949, following which in 1950 president Truman ordered a program to develop the hydrogen bomb.

The atmosphere in the team was pretty tense, with frequent frictions between Ulam and Teller, who wanted to become the superstar of the whole enterprise (that was his goal since 1942), and as Hans Bethe, a nobelist, the discoverer of stellar nucleosynthesis, and one of the leaders of project Manhattan, famously said 'For the sake of history, I think it is more precise to say that Ulam is the father, because he provided the seed, and Teller is the mother, because he remained with the child. As for me, I guess I am the midwife'. Accounts of people engaged in the project are conflicting, some hinting at Teller's sudden stroke of genius, while others asserting that he would have gotten nowhere without Ulam and his ideas pushing the work forward. What could be more conclusive is still largely classified, and

the main mechanism used in the final weapon is now known as Teller-Ulam design. The first bomb, 'Ivy Mike' was successfully detonated in 1952; it was 700 times more powerful than the one dropped at Hiroshima.

Ulam didn't want to continue working on improving the bomb (he was against any further developments) and fights with Teller lead him to leaving the H-bomb team. He proposed that his idea, on which he worked with Everett (project Orion), of using a nuclear reactor to propel a rocket ship should be used to fly humans to Mars, but funding for this project was cut short. It is said that later, he was the one who suggested to Kennedy that he should aim for the moon. Ulam used to discuss the advances in the field of computers with Von Neumann on his frequent visits to Los Alamos, and together with physicist Paul Stein, Ulam wrote a program that defeated a human in a modified chess game in 1956. Ulam loved the intellectual freedom that Los Alamos gave him. He didn't have to teach the students and instead could play chess with the masters or observe the moon with the telescope with his children. Upon his visit, Steinhaus remarked it seems he would forever stay in his 'Los Ulamos', yet Ulam retired from Los Alamos in 1969 and moved to Colorado to take the seat of the dean of mathematics. With the help of his wife he composed an autobiography 'the Adventures of a Mathematician' (he wanted to title it 'Misadventures...'). In 1982 he added a preface, in which he wrote 'Sometimes I feel that a more rational explanation for all that has happened during my lifetime is that I am still only thirteen years old, reading Jules Verne or H. G. Wells, and have fallen asleep'. Paris became Ulam's new favorite city to spend summers in (as Lviv was no longer an option); after he died of a heart attack in 1984 he was buried in the Montmartre Cemetery. Nearing the end of his life he upheld his views about the physicists' (lack of) responsibility for the atomic bomb, pointing to biology as becoming far more dangerous, to the point of interfering with the 'sheer source of life'.

The last alive member of Lviv School of Mathematics, Władysław Orlicz, died in 1990.