# HISTORY OF POLISH MATHEMATICS

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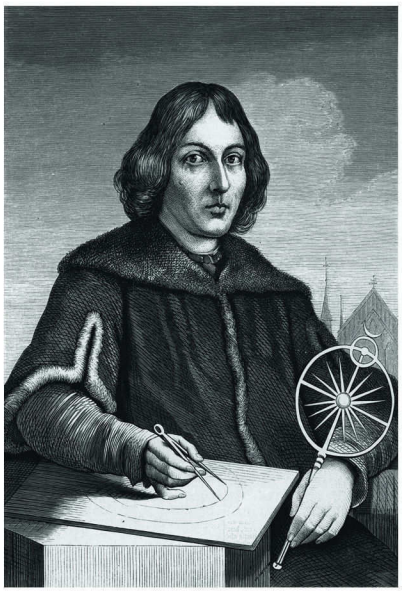
# INTRODUCTION

Poland and Polish scientists have put huge contributions over the centuries into European knowledge. This knowledge influenced life in whole Europe. One of the most known Polish scientists was Nicolaus Copernicus.

This Middle Ages mathematician, astronomer and physicist was the first astronomer to formulate a comprehensive heliocentric cosmology, which displaced the Earth from the center of the universe. His heliocentric model, with the Sun at the center of the universe, demonstrated that the observed motions of celestial objects can be explained without putting Earth at rest in the center of the universe. His work stimulated further scientific investigations, becoming a landmark in the history of science that is often referred to as the Copernican Revolution. To buttress his revolutionary heliocentric theories he used mathematics especially using trigonometry.



After almost five centuries during the World War II famous Polish mathematician and cryptologist Marian Rejewski and his colleagues Jerzy Różycki and Henryk Zygalski solved in 1932 the plugboard-equipped Enigma machine, the main cipher device used by Germany. Their success jump-started British reading of Enigma in World War II. The intelligence so gained, code-named "Ultra", contributed, perhaps decisively, to the defeat of Nazi Germany.

Another Polish mathematician Stanisław Ulam participated in the Manhattan Project and originated the Teller–Ulam design of thermonuclear weapons. He also invented nuclear pulse propulsion and developed a number of mathematical tools in number theory, set theory, ergodic theory, and algebraic topology.

However till the end of XIX century Polish contribution to mathematic world was practically unnoticeable. Polish mathematics never had a clout. There were no mathematics traditions in Polish nation either. The reason why we had poor mathematical traditions is rather clear. In 19th century a period of a great development of mathematics in Western Europe – Poland was not an independent country.

In 1795 it was partitioned between Austria, Russia and Prussia, and the independence was retrieved only at the end of 1918. Thus in 19th century the essential effort of the nation was set onto humanities, since literature and poetry were necessary for supporting the idea of independence and even for preservation of the language (in some periods the children in Prussian or Russian parts.

# POLISH MATHEMATICAL SCHOOL

It is worth pointing out that shortly before the outbreak of World War I the situation started to change. Scientists with broader knowledge made their appearance and serious editorial and organisational activities were developed. After the outbreak of the first World War lot of Polish scientist were internated by Russian.

One of them was Wacław Sierpiński who met several Russian mathematician. This meeting led to future collaboration of the Polish and Russian Schools of Mathematics. Still before the end of the war it was clear that Poland will obtain independence, people were very entusiastic about it and made lot of plans for the future. Such a plan for mathematics was proposed by Zygmunt Janiszewski. His main claim was that we have no chances in the well established theories, since we had no traditions and no great knowledge. However in the new fields, just emerging, we have the same chances as everybody else.

In the year 1919, the time when the famous Polish mathematical school was established, Polish mathematics was a great success and met with a high esteem on the international forum. Warsaw and Lviv grown in power if it goes about logic and mathematics. Work of Tadeusz Kotarbiński, Jan Łukasiewicz, Stanisław Leśniewski, Kazimierz Kuratowski was highly effective, particularly logic and mathematics basics.

In a book called „Foundations of Set Theory" written by Fraenkel i Bar-Hillel we can read that Polish Mathematical School was one of the most powerful on Earth. In Manchester, there were courses of Polish language because students from other countries wanted to read works of Polish logicians in their original language.

# STEFAN BANACH

Stefan Banach was a Polish mathematician who worked in interwar Poland and in Soviet Ukraine. He was a self-taught mathematics prodigy and the founder of modern functional analysis.

In 1916, in Cracov's Planty gardens, Banach encountered Professor Hugo Steinhaus, one of the renowned mathematicians of the age. Steinhaus became fascinated with the self-taught young mathematician. The encounter resulted in a long-lasting collaboration and friendship.

Steinhaus introduced Banach to academic circles and substantially accelerated his career. After Poland regained independence, in 1920 Banach was given an assistantship at Cracov's Jagiellonian University. Steinhaus backing also allowed him to receive a doctorate without actually graduating from a university.

From 1922, Banach headed the second Chair of Mathematics at University of Lviv. Young and talented, gathered around him a large group of mathematicians. The group soon gave birth to the "Lviv School of Mathematics." In 1929 the group began publishing its own journal, Studia Mathematica.

Following the invasion of Poland by Nazi Germany and the Soviet Union, Lviv came under the control of the Soviet. A lot of Polish scientists were sent to concentration camps or gulags. Following the German takeover of Lviv in 1941, all universities were closed and Banach was employed as lice feeder at Professor Rudolf Weigl's Typhus Research Institute. Employment in Weigl's Institute provided many unemployed university professors protection from random deportation.

After the Red Army recaptured Lviv in 1944, Banach returned to the University and helped re-establish it after the war years. However he began preparing to leave the city and settle in Cracow, where he had been promised a chair at the Jagiellonian University. He died on August 31, 1945 diagnosed with lung cancer.

Banach's most influential work was Theory of Linear Operations. In it he formulated the concept now known as "Banach space," and proved many fundamental theorems of functional analysis.

One time Hugo Steinhaus said of Banach: "Banach was my greatest scientific discovery."

## KAZIMIERZ KURATOWSKI

Kazimierz Kuratowski was born in 1896 and he spent his early life In Warsaw. When he left secondary school  he decided that he wanted to become an engineer. The University of Glasgow, in Scotland, had an engineering school with a long established history, the chair of engineering being established in 1840. It rightly appeared to him as an outstanding place to study engineering.

At the end of his first year Kuratowski was awarded the Class Prize in Mathematics. After that he went on a summer holiday back to Poland. The outbreak of World War I made it impossible to go back to Scotland. Kuratowski could no longer study engineering.

After reopening of the Warsaw University, Kuratowski was one of the first students to study mathematics. After graduating in 1919, Kuratowski undertook his doctoral studies working under Janiszewski and Mazurkiewicz. In 1921 Kuratowski was awarded his doctorate, but sadly one of his supervisors Janiszewski had died in 1920. Kuratowski was appointed as a professor at the Technical University of Lviv in 1927.

In 1934 he left Lviv and became professor of mathematics at the University of Warsaw.

Between the two world wars Poland had made a remarkable leap forward in mathematical teaching and research. At the end of World War II the whole educational system was destroyed and had to be completely rebuilt. It was Kuratowski who now took on the role of leader in this rebuilding process. Kuratowski was appointed the Director of the Mathematical Institute of the Polish Academy of Sciences in 1949.

Kuratowski's main work was in the area of topology and set theory. He used the notion of a limit point to give closure axioms to define a topological space. In 1922 he used Boolean algebra to characterise the topology of an abstract space independently of the notion of points.

Other major contributions by Kuratowski were to compactness and metric spaces. He was the author of Topologie, referred to above, which was the crowning achievement of the Warsaw School in point set topology. The first volume of this work was the major source on metric spaces for several decades.

His 1930 work on non-planar graphs is of fundamental importance in graph theory, he showed that a necessary and sufficient condition for a graph G to be planar is that it does not contain a subgraph homeomorphic to either $K_5$ or $K_{3,3}$.

His work in set theory considered a function as a set of ordered pairs and this made the function notion as proposed by Frege, Charles Peirce and Schröder redundant. He also considered the topology of the continuum, the theory of connectivity, dimension theory, and answered measure theory questions.

## JAN ŁUKASIEWICZ

Jan Łukasiewicz was born on December 21st, 1878 in the city of Lviv. He was one of several notable mathematicians specializing in logic during the first part of the twentieth century.

As a young man, Łukasiewicz studied mathematics and philosophy at the local University and was awarded a doctorate in 1902. He continued at the University of Lviv until 1915 when he accepted a lectureship at the University of Warsaw.

Between the wars he was the Polish Minister of Education and Dean of the School of Philosophy, also filling the post of Rector of the University for two terms. While at Warsaw he published some eighty articles and papers on psychology, mathematics and philosophy.

Like many in Poland, Łukasiewicz suffered greatly during the World War II. His house was burned, with the loss of his library and manuscripts, and he found it impossible to continue working. He started to give lectures at the underground university. He moved to Dublin where he accepted the Chair of Logic at the Royal Irish Academy and was made a member of the Institute of Advanced Studies. He was able to resume his studies and publication and remained in Dublin until his death on February, 1956.

A number of axiomatizations of classical propositional logic are owed to Łukasiewicz. A particularly elegant axiomatization features a mere three axioms and is still invoked down to the present day. He was a pioneer investigator of multi-valued logics; his three-valued propositional calculus, introduced in 1917, was the first explicitly axiomatized non-classical logical calculus. He wrote on the philosophy of science.

Łukasiewicz invented the Polish notation for the logical connectives around 1920. This notation is the root of the idea of the recursive stack, a last-in, first-out computer memory store proposed by several researchers including Turing, Bauer and Hamblin, and first implemented in 1957. This design led to the English Electric multi-programmed KDF9 computer system of 1963, which had two such hardware register stacks. A similar concept underlies the reverse Polish notation (RPN, a postfix notation) of the Friden EC-130 calculator and its successors, many Hewlett Packard calculators.

# CONCLUSIONS

Over the centuries Poland had a lot of very briliant mathematicians, physicists, engineers. They had a huge influence on world knowledge. However as we could see last three hundred years were really tough not only for Polsih scientists but to all of Polish people. Starting the invasion of Poland, Hitler gave order to totally anihilate Polish science. It seemed that Hitler was aware of the power of Polish mathematicians, physicists, engineers. He knew that in times of war, their intelect would be used against him and German army.

After the war, Poland fell under the influence of the USSR. During those times Poland had alot of good scientists, like for example Jacek Karpiński. He is responsible for the development of one of the first machine learning algorithms and techniques for character and image recognition.

He is also the designer of one of the first minicomputers, the K-202. Because of the policy on computer development in the People's Republic of Poland (influenced by USSR) of that time, it was never mass produced.

Nowadays Poland is famous for world-class IT specialists that can be considered as worthy heirs of knowledge, enthusiasm and willingness of Polish scientists from past centuries.

## MAP (PRESENT)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