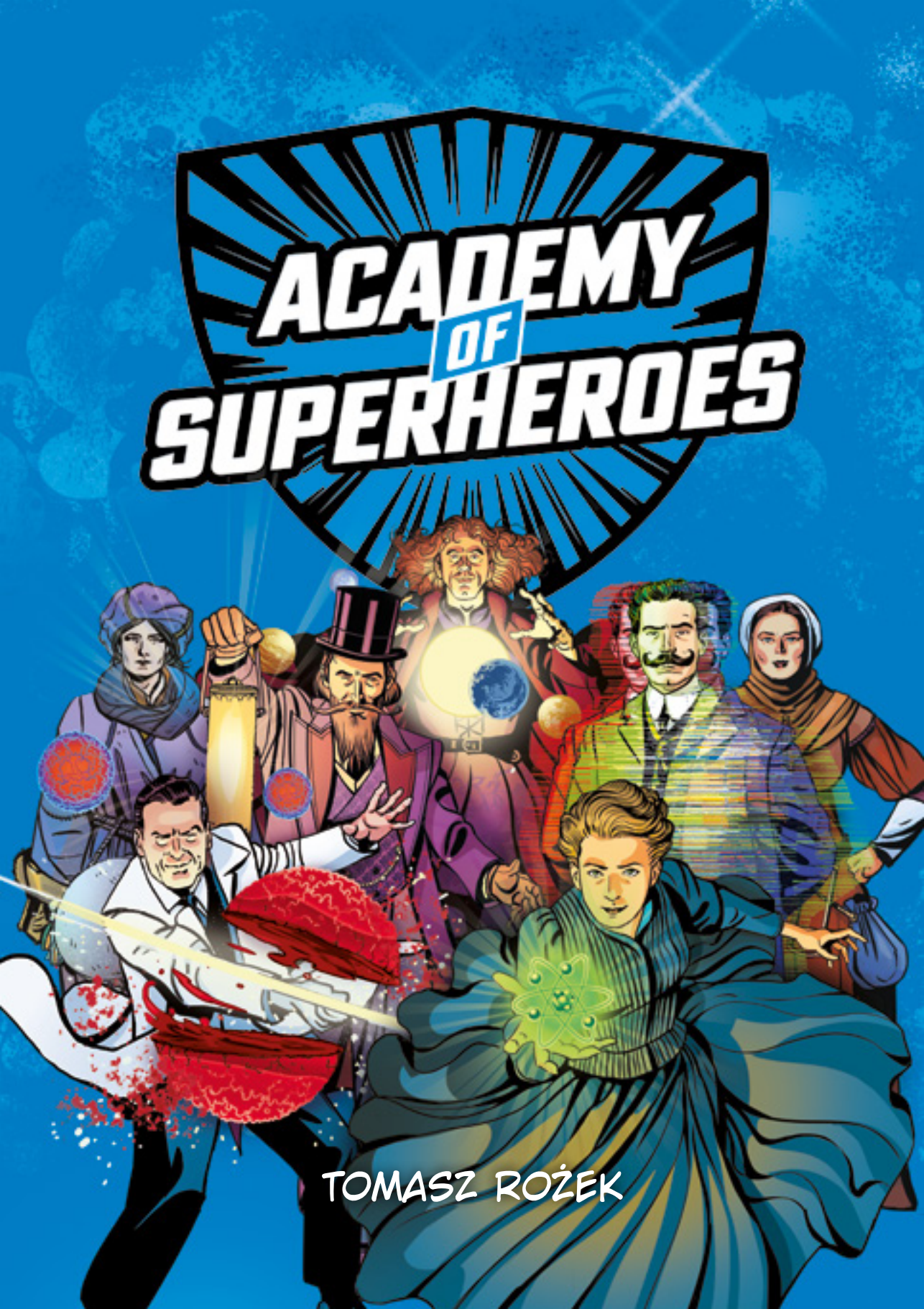
ACADEMY OF SUPERHEROES



TOMASZ ROŻEK


ACADEMY
OF
SUPERHEROES

Nauka to lubię

Tomasz Rożek
“Akademia Superbohaterów”

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Cooperation:
Małgorzata Gogól-Górecka
Mariusz Gogól
Karol Kopańko
Kamila Rajfur
Karol Wyszyński

Translation:
Magdalena Gendźwiłł
Gabriela Sanek

Designed by:
Marek Oleksicki
Ewa Kwaśniewska

Proofreading:
Piotr Pyzik
Angelika Tes
Gabriela Sanek

Typesetting:
Jarosław Danielak

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Fundacja Nauka. To Lubię
ul. Konarskiego 18 C
44-100 Gliwice
biuro@naukatolubie.pl

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Ministry of Foreign Affairs
Republic of Poland

Introduction

Everyone knows at least one superhero. Some of them can run quickly, some of them can fly, some possess super resistant amour. What do they have in common? The fact that they permanently save the world and the people from trouble. Sometimes, we are the source of these troubles.

Superheroes are not just protagonists from fairy tales. They truly exist! Some of them design airplanes, submarines, and even vehicles that can drive on other planets. Others discover new particles or explore unknown lands, including the ones that no human being has explored. They develop medicines, build bridges over chasms that make you feel dizzy only by looking at them. Some want to transmit images and sound. They live in different times, specialize in various fields, and possess multiple superpowers – but as the fairy-tale heroes, they have one thing in common: they save people and the world.

Can you imagine the world without radio transmission, electricity, transportation, modern medicine, like antibiotics and vaccines? A world without geographic discoveries, bridges, roads, computers? We could endlessly go on and on. How would such a world look like?

Scientists are our superheroes who move the world forward, develop it, keep on inventing and discovering. Through this book you can learn about them – it really pays off. You can realize something important as well. All of them – all these Polish superheroes – made it possible thanks to their own work. They were not born smarter, stronger or better in any way.

Some of them were born in low-income families, some of them were born in difficult times. Sometimes they received no support from their community. Some of them received poor grades at school. Just like us, they faced victories and failures. Sometimes they felt overwhelmed, as fulfilling their dreams required a lot of work. Hopefully, after reading this book, you will start believing that everyone can be a superhero, including you. Maybe one day you will also join the *Academy of Superheroes*? Maybe one day somebody will write a book about you? A world full of superheroes, both scientists and discoverers, becomes a better place.

In your hand you are holding a special edition of the book, which was created thanks to cooperation with the Ministry of Foreign Affairs of the Republic of Poland. Thanks to this cooperation, we want to remind you that superheroes also come from Poland. Let the awareness of the great achievements of our compatriots inspire you to develop your own talents.

I hope you enjoy reading this book!

Tomasz Rożek
(Author)

Ministry of Foreign Affairs
of the Republic of Poland
(Partner)

Poland: where superheroes
come from.

Maria Skłodowska-Curie
(1867–1934)

She was outstandingly intelligent, hard-working, and modest. When she won the Nobel Prize, she didn't even buy a new hat for the occasion. In 19th century Europe, which was unfavorable towards women, she achieved things that many other scientists could not achieve. She became a professor at the Sorbonne University, and she was awarded the Nobel Prize twice. Till the end of her life, she was a dedicated person who loved science.

Maria was born in Warsaw. She was one of five children of the Skłodowski family. Her family was happy, supportive and valued education highly. Maria's grandfather, Józef, was a teacher and her mother, Bronisława, worked as a headmistress of a private school for girls. Her father, Władysław, studied at the Technical University in St. Petersburg and worked at school. Unfortunately, her childhood was not always a bed of roses. As a result of the repressions towards the Poles during the partitions, her father lost his job. Just a few moments earlier, her mother fell ill. Lack of income and the illness that devoured most of the savings, led to the family's financial instability. To earn some money, the family decided to sub-rent their rooms to students. However, these were not the only problems. When Maria was nine years old, her oldest sister Zofia died of typhus fever. Three years later, her mom passed away. This was a tragic loss for Maria.

When years later, already as a famous woman, Maria recalled her childhood, she said that the love of knowledge and interest in science was instilled in her by her father. From early childhood, Skłodowska was fascinated by his technical interests. She had above-average intelligence and an excellent memory. She learned to read very quickly and could repeat a poem from memory, which she heard only once. At the age of four, she studied her father's books, which she found in his bookcase – these included technical works and various textbooks. She also became familiar with the teaching aids that her father used to teach his classes.


AT THE AGE OF 36, I WAS AWARDED THE NOBEL PRIZE IN PHYSICS FOR THE STUDY OF RADIOACTIVITY (1903).
I WON THE NOBEL PRIZE IN CHEMISTRY FOR THE DISCOVERY OF THE NEW ELEMENTS POLONIUM AND RADIUM (1911).
DURING WORLD WAR I, I DROVE A TRUCK WITH X-RAY EQUIPMENT AND HELPED WOUNDED SOLDIERS.

Great Plan

After learning at home and in a nearby school, Maria was enrolled in the Women's Gymnasium located at the heart of Warsaw. It was an excellent school and, in fact, the only educational opportunity for women at that time. At the age of 16, she graduated with the top grade. She was even honored with a gold medal. She wanted to further her education, but it was only possible abroad. Her dream was the Sorbonne University in Paris. Easy to say, but how to achieve it without money?

After graduating from middle school, she spent the following year with her extended family in the countryside. She could take some well-deserved rest – at school, she often had to study for several hours a day. When she was tired, she changed the subject or took a break to do some mathematical riddles. At the same time, she did not neglect her household duties. After a year's rest, she returned home and began studying at the "Flying University" with her sister. It was an underground institution educating women who could not attend universities at that time. Why such a strange name? The school did not have premises. For fear of the authorities, lecture locations were often changed, making it easier to avoid the invaders' control. For Maria, the lectures at the clandestine school were only an introduction, or rather a preparation for studying abroad. Money was scarce at home, and in addition, Maria's sister Bronia also dreamed of studying in Paris. So the sisters agreed on the following plan: Bronia would be the first to go abroad. In the meantime, Maria would work in the country and send money to support her sister living in Paris. As soon as she got on her feet and found a job there, she would take Maria to Paris. Then, Bronia would support her sister.

At the age of 16, she graduated with honors from the Female Junior High School in Krakowskie Przedmieście Street in Warsaw. She received a gold medal!

While fulfilling these plans, Maria earned money by tutoring, but it was not a well-paid job. Therefore, she gave it up and started a more profitable job as a governess. In Warsaw, Maria worked for a family of a wealthy lawyer. Later, she taught the children of the affluent Żórawski family in the village of Szczuki, a few hours' drive from her family home. In addition to performing her daily duties, she organized teaching for the local children. She used her earnings to buy them pencils, pens and notebooks.

Maria's employers valued her work. Yet, when she fell in love with their son Kazimierz, a student at the University of Warsaw, they objected to their marriage. The couple secretly met, but they knew that they could not be together, because Kazimierz's family would not bless their matrimony. To avoid embarrassment, Maria decided to leave her job. However, it was not easy, because the loss of income would impact Bronia's financial situation. Fortunately, as soon as her father found a better job, he took over Maria's obligation. Maria was finally able to give up her position as a governess.

She came from a large family. Both her parents and grandparents were very well educated. The Skłodowski family placed great emphasis on education.

A Dream Fulfilled

Although her sister invited her to Paris, Maria, once again, had to postpone her plans. She promised to take care of her two younger siblings. At that time, thanks to the support of her cousin Jerzy Boguski, later a professor at the University of Warsaw, she observed the real life of a scientist for the first time in her life. In the laboratory of the Museum of Industry and Agriculture, she studied chemistry and learned the basics of analytical work. It was not an easy experience. In the schools she graduated from, no one taught her this. She had no laboratory practice, did not know how to use the equipment, could not perform experiments or conduct measurements. Yet, thanks to the support of her cousin, she learned it all quickly. She probably had no idea how practical this knowledge will be in the future.

Maria was extremely persistent. Despite various obstacles, she earned a bachelor's degree in physics and mathematics with a very good result. She was awarded a scholarship.

After about two years of work, her dream came true – she was able to go to Paris. She packed clothes, food, a mattress, and a stool for the journey. She bought a fourth-class ticket, and after four days, she arrived at her destination. At first, she stayed with her sister, but soon she moved out and rented the cheapest possible rooms. She lived very poorly, but she preferred it to living with Bronia. To study, she needed peace. The noise and the presence of other people bothered her more than the cold, as she lived in rooms without heating. In the winter if she left water in a bowl or tea, it would freeze. Maria had to cover herself with clothes to survive the night. At that time, her standard meal consisted mainly of tea and buttered bread. Sometimes she allowed herself to buy fruit, chocolate, or meat. The difficult conditions took a toll on her health – she often fainted, and once she did it in front of her sister's friend. Under these circumstances, Bronia and her husband tried to persuade Maria to move back in with them to a heated and comfortable apartment. Maria agreed, but she only stayed with them for a week.

Despite various obstacles, Maria earned a bachelor's degree in physics and in mathematics. She passed a teacher's exam that qualified her to teach in women's high schools.

In order to be able to study in Paris, Maria worked for several years – first as a tutor and later as a governess. She used the money to support her sister, who was studying in Paris

Maria received a scholarship that allowed her to study the magnetic properties of metals. While working in the laboratory, she met her future husband, Peter Curie. At that time, he helped her to explore the secrets of new laboratory methods. It was then that the first scientific publications co-authored by Maria were written. While looking for a topic for her doctoral thesis, she became interested in Becquerel's discoveries. Henri Becquerel was a French chemist and physicist who discovered natural radioactivity. When Maria chose her dissertation topic: *Becquerel's Radiation*, the issue was fresh and fractious in the sciences. No wonder that describing radiation that originates in rocks (and simultaneously penetrates opaque materials) can be intriguing. Maria chose a new direction in her career, and her scientific life began to accelerate.

Greatest Achievements

In her research work, she was interested in the newly discovered natural radiation. It was her research on radioactivity and the discovery of two elements – polonium and radium, that allowed Maria to become the first woman to receive two Nobel Prizes.

At this point, Maria's experience and familiarity with laboratory work, gained during her chemistry internship in Warsaw, came in handy. Inspired by the study of natural radioactivity, she decided to delve deeper into this subject. Instead of the inaccurate methods of measurement used by the author, she used an instrument that her husband, Peter Curie, had developed together with his brother. An electrometer made it possible to accurately measure the activity of a preparation containing a radioactive element. Using it, she discovered a new element. By examining the samples, she knew which of the known elements were sources of radiation. She also knew the relationship between the amount of an element and the amount of radiation. Yet, something didn't add up in some of the samples. The instruments indicated that there was more radiation. Maria drew the following conclusion: a previously unknown radioactive element is present in some samples. Together with her husband, using chemical analysis, she discovered polonium. Shortly after that, she discovered another element, radium. It was a massive achievement for which, unfortunately, a very high price had to be paid.

Maria Skłodowska-Curie was the first woman to win the Nobel Prize for her research on radioactivity. Yet, she never even bought herself

a new hat from that money. Instead, she renovated the bathroom and put wallpaper in the rooms. The rest of the money she distributed among her sister and her friends. Some of it, she put on deposit.

Innovative research gave her fame and scientific standing. Her husband Peter received a new created Department of Physics at the Sorbonne University – Maria was to become an assistant professor and head of the laboratory. The couple had two daughters. Everything was going perfectly. Unfortunately, what was not yet known, was that the radiation that Maria and Peter were dealing with, was very harmful. Peter, who conducted many experiments on himself, often suffered from muscle pains, headaches, and general weakness. The poor working conditions in the laboratory set up in an unheated shed, caused Maria to develop tuberculosis. Constant radiation exposure slowly contributed to the development of leukemia. In addition, she worked under great stress. The unexpected death of her husband, who fell under a speeding carriage while deep in thought, added to her hard situation. Despite the personal tragedy, Maria did not intend to slow down the pace of her research. She took over as head of the department after her tragically deceased husband. She lectured, and after another two years, she became the first woman in France to become a full professor at the Sorbonne University. Unfortunately, the French Academy of Sciences refused to allow Marie to join its ranks. She was a woman, and such institutions were closed to women at the time. Two Nobel Prizes (in chemistry and physics), the title of a professor, and a substantial scientific output, were of no importance to the members of the Academy.

She became the first woman to earn the title of a professor at the Sorbonne University in Paris. Her research methods are among the fundamental in chemistry. She was one of the most outstanding and the most prominent scientists in the world.

Maria built the Radium Institute in Paris, where she worked until her death. During World War I, she organized ambulances that could take X-rays on battlefields. She obtained a license to drive a truck. She got behind the wheel herself to visit field hospitals and rescue wounded soldiers. She also supported the development of Polish science, getting involved in the construction of the Warsaw Radium Institute.

Maria Skłodowska-Curie's road to success was not easy. Firstly, she suffered from family tragedies, poverty, and health problems. Later, despite excellent scientific results and honorary doctorates, the male scientific community did not include her. Thanks to her hard work, she fulfilled her dreams of graduating from the Sorbonne University, taking up a professorship. She was the first woman in history to win two Nobel Prizes. The research methods she developed are still among the basic ones in radiochemistry. She was one of the most eminent scientists in the world. Still, despite her fame, she remained a modest woman for whom family and the country she came from were of highest importance.

Mikołaj Kopernik
Nicolaus Copernicus (1473–1543)

Although he is best known for his astronomical observations, today, we would say that he performed them "after business hours." His duty was to administer, manage, and attend to ill patients. He was great at it. He was extremely hard working and meticulous. Above all, he was perceptive. With his critical thinking about the prevailing order in the cosmos, he created and argued the theory that "stopped the Sun and moved the Earth."

Nicolaus Copernicus was born in 1473 in Toruń. His father, also called Nicolaus, was a merchant and a juror, i.e., a court official. His family came from a region called Silesia, from a town close to Nysa. Nicolaus Senior met his future wife, Barbara, in Krakow. She also had Silesian roots.

We do not know much about the future astronomer's childhood. Still, he probably finished school located at the parish of one of the city's churches. He probably studied with his brother Andrew, and later, which is not certain, he was tutored by his uncle – a Catholic canon from Wloclawek. When Nicolaus was only ten years old, his father died. At that time, such families would usually fall into poverty. This case was different, because his mother's brother, Lucas Watzenrode, later the bishop of Warmia, took care of them. He was a significant and influential person. Thanks to his uncle, or more precisely, thanks to his money and contacts, Nicolaus continued his education and went to university. He chose to study in Krakow. But this was only the beginning of his scientific journey, which led him throughout Europe.


I STOPPED THE SUN, MOVED THE EARTH, MEANING: I PROVED THAT THE EARTH REVOLVES AROUND THE SUN.
I WROTE: *ON THE VALUE OF COINS*, IN WHICH I JUSTIFIED WHY INFERIOR MONEY DISPLACES SUPERIOR MONEY.
THE 112TH ELEMENT, A CRATER ON THE MOON, A CRATER ON MARS, AND AN ASTEROID WERE NAMED AFTER ME.

Youth and Science

During this period, many knowledge-seeking Swedes, Germans, and Hungarians came to Krakow to attend the lectures delivered by Wojciech of Brudzew and many other members of the local school of astronomy and mathematics. At the famous Academy of Krakow, Nicolaus first encountered Ptolemy's theory called geocentrism. According to this theory, the Earth is fixed at the center of the Universe; whereas, the Sun and other planets revolve around it. The study of astronomy required the study of mathematics and physics. However, at that time, not all of the branches of physics, that we know today, existed. It was in Krakow that Nicolaus learned to construct tables and astronomical instruments. This knowledge proved to be very useful in the future.

It was in Krakow that Nicolaus learned to construct arrays and build astronomical instruments. This knowledge proved to be very useful in the future.

After studying in Krakow, Nicolas went to Italy, specifically to Bologna, where he studied law. He became acquainted with the works of astronomer Dominic Maria Novara, with whom he conducted observations of the Moon. After graduation, he came to Poland, but only for a while, because he quickly returned to Italy to begin medical studies at the University of Padua. Copernicus was already a Catholic canon at that time. Still, contrary to the often-repeated false opinion, he never became a priest. He could perform specific duties in the church, but he was not ordained as a priest.

During his apprenticeship in Rome, he conducted independent observations of the sky, including a lunar eclipse and the covering of the star Aldebaran by the Moon. He also gave open lectures in mathematics. He already thought that the generally accepted Solar System models, including Ptolemy's model (with a fixed Earth in the center), were incorrect. Soon, he returned to Poland. During his medical studies, he passed all the examinations necessary to obtain a license to practice medicine. Later, he defended his doctorate in law.

Renaissance Man

Upon his return to Poland, Nicolaus Copernicus was responsible for a great deal of administrative work. He served as his uncle's secretary for some time, living at the bishop's court. Thanks to his medical background, he also took care of his uncle's health. The work at the bishop's side was not a bed of roses. It involved many administrative duties, frequent trips, and participation in visits of diplomatic guests. During that time, he had the opportunity to visit Prussia, participate in the coronation ceremony of Sigismund I the Old, and even worked on creating the map of Warmia and Masuria. He also finished translating the letters of the Byzantine historian and writer Symokatta, from

When he was studying, the applicable model of the structure of the universe was Ptolemy's model, in which the Earth was at the center of the universe. Observations conducted by the young Nicolaus proved otherwise.

Greek into Latin, which he had begun working on while still in Italy. He dedicated them to his uncle as a token of gratitude for his help. Despite the shortage of time, he visited the well-equipped library in Lidzbark, where he deepened his knowledge and created an outline of his revolutionary theory about the place of the Earth in the universe.

He was a hard-working and meticulous young man. Therefore, his aging uncle Bishop Lucas Watzenrode saw him as his successor. Nicolaus, however, did not want to become a priest. As a result, their relations became increasingly tense. Eventually, Nicolaus decided to move out and settle in Frombork, where he took over the organizational responsibilities. He was a host of the cathedral – today, we would call him an administrator. He managed the lands that belonged to the chapter, took care of the settlement of unused lands, organized armed help for Olsztyn during the invasion of the Teutonic Knights, with whom he had negotiated earlier. He also wrote a scientific dissertation about... money. He entitled it: *On the Minting of a Coin*. He noticed that counterfeit money drives the real ones out of the market. He also wrote down his thoughts on inflation, i.e., rising prices in the economy. The principles that Nicolaus Copernicus described are still present in economics today as the Copernicus-Gresham law.

Nicolaus Copernicus passed the examinations allowing him to practice medicine. When he returned from Padua to Poland, he became a respected physician.

In addition to his administrative, managerial, and diplomatic duties, Nicolaus practiced as a qualified physician. He attended to the members of the chapter, the successive bishops of Warmia, and the regular people, even those living far beyond the borders of Warmia. Despite many duties, Copernicus found time to study astronomy and refine his hypothesis on the movement of planets in the Solar System. To make accurate observations, he bought a tower located within the walls of a fortress and hand-made the necessary instruments. The quadrant allowed him to measure the height of the Sun above the horizon, the triquetrum indicated the distance of the Moon from the Earth, while the armillary sphere determined the position of the Silver Globe and other planets. In Frombork, Copernicus conducted the majority of his 60 recorded astronomical observations.

A Subversive Theory

Copernicus was born when Poland was flourishing economically and culturally. The reign of King Sigismund I the Old was also exceptionally peaceful. It was a good time for scientists to write their works, including such a revolutionary concept, as the one proclaiming that the Sun is stationary, and the Earth and other planets revolve around it. It was not just a concept. Copernicus supported his ideas with mathematical calculations and observations. Of course, his work was not deprived of mistakes. In his calculations, Nicolaus assumed that the Earth and other planets revolved around the Sun in perfectly circular orbits. In reality, they orbit in ellipses. His error was corrected many years later by Johannes Kepler, a German mathematician and astronomer. Kepler was fascinated with astronomy since childhood. As a 6-year-old, he observed the passage of a comet, and a few years later – an eclipse of the Moon. These two phenomena made such a great impression on the boy, that he decided to devote his life to astronomy. Interestingly, Kepler had very poor eyesight due to diseases suffered during his childhood. Still, it did not stop him from making observations. To this day, he is one of the greatest astronomers of all time.

Copernicus was the author of the revolutionary concept, which shattered the established order. His theory stated that the Sun was in the center of the Universe, and the Earth as well as the other planets, revolved around it.

Let us return to Nicolaus Copernicus. His work was a genuine revolution and shattered the established order. Nicolaus was fully aware that many people would find it controversial. For this reason, the outline of the heliocentric theory written in the work *Commentariolus*, or *Little Commentary*, was intended only for trusted acquaintances. Copernicus worked on the final form of his theory for over 15 years. In addition to observing what was happening in the firmament and making calculations, he analyzed the existing works on natural philosophy, which played an essential role in shaping the groundbreaking masterpiece. Nicolaus studied nearly two hundred works of various authors – from antiquity to the Renaissance. Among the many Greek philosophers he esteemed, Aristotle held a special place. In the first chapter of his work, he collected all the theories about the Solar System's structure, then "juxtaposed" them with his calculations and results of observations. The astronomer's life work, which indeed can be called the work of an entire era, was published in 1543 when Copernicus was already very seriously ill, as a result of a stroke. He still had a chance to see it, when it reached him two months after its publication. Whether he was aware of what he saw is unknown, as it happened on the last day of his life.

Loud Reactions

Copernicus' theory received a thunderous reception, which is not surprising. It turned everything, that most famous thinkers and scientists had said about the planets and the Sun, upside down. Part of the scientific world agreed with Copernicus' concept. Among those who supported it, was a professor of mathematics, George Joachim Rheticus. This scientist, who worked in Wittenberg, took lessons in astronomy from Copernicus. Both men knew and liked each other very much. They often consulted each other scientifically. It was Joachim Rheticus who encouraged Nicolaus to publish the book. Copernicus' theory, in turn, was criticized by Martin Luther, the founder of the Reformation. Anyway, the work itself opened with a preface. It was clear that the following pages of the book present only a hypothesis. However, it was not Copernicus' text.

He worked for several decades on his work *On the Revolutions of the Celestial Spheres*. When the book was published, Copernicus was already very ill. He never saw a printed copy of the book.

The one written by him was removed and replaced by another, more gentle and diplomatic. Copernicus himself, and the scientists who supported him, feared the world's reaction to such a revolutionary concept. Among them were not only astronomers, but also mathematicians and theologists. Some believed that Copernicus' work "threw" the Earth from its deserved first and most important place in the cosmos. Moreover, they claimed that his work undermined the biblical order of the world. Some of them refused to accept it. The disputes surrounding Copernicus' theory lasted several decades. In the end, its supporters lost, and opponents decided that heliocentrism (the idea that the planets revolve around the Sun) is dangerous. In 1616, Copernicus' work was placed on the index of banned books and remained there for over 200 years.

In 1616, Copernicus' work was placed on the index of banned books and remained there for over 200 years.

Today, Copernicus' theory, perfected by many scientists, no longer raises any doubts. Nicolaus Copernicus himself joined the group of the most eminent and, if we may say so, the most famous scientists in history.

He was able to think critically and observe the sky in a manner independent from the well-grounded schemes. I wonder where astronomy would be today if not for him?

Jan Czochralski
(1885–1953)

There would be no computers or the Internet without him. There would be no Facebook and no devices that we love to use. It is impossible to imagine a world without electronics. Today, there would be no media without devices equipped with a processor. There would be no cars or airplanes. A modern city would not function, because microprocessors control the changing of lights and supply of electricity and water. There would be no hospitals or banks.

Wait a minute. What do you mean there would be no hospitals, cars, or airplanes? After all, all of those things worked before there were computers. That is true, but the technology used to build them was very different than today. Cars moved slower, and there were fewer of them. Hospitals didn't have complex research and life-saving equipment; airplanes did not carry millions of passengers. The same applies to banks. Can you imagine a bank without computers? A bank where all transactions, interest, loans, and deposits are recorded in paper books?

Jan Czochralski, a brilliant Polish chemist and engineer, made the development of electronics possible. Even though he is the most quoted Polish scientist globally, he is almost unknown in Poland. Meanwhile, considering his achievements, he should have a street or a park named after him in every city. Also, space probes should carry his name. If Jan Czochralski had lived in today's times and had an efficient manager, he would have built a giant similar to Google, Facebook, or Apple.


I DEVELOPED THE METHOD OF OBTAINING SILICON CRYSTALS THAT MADE THE DEVELOPMENT OF ELECTRONICS POSSIBLE.
I INVENTED THE METAL ALLOY THAT REVOLUTIONIZED THE RAILROAD.
I WAS A PHILANTHROPIST AND PATRON OF THE ARTS, I FINANCED THE RECONSTRUCTION OF CHOPIN'S MANSION AND EXCAVATIONS IN BISKUPIN.

Perceptive Scientist

At the age of 31, he accidentally made the discovery of his life. He verified and described a method of crystallizing metals by so-called "pulling." To this day it is called the Czochralski method.

Jan Czochralski was born on October 23, 1885 near Bydgoszcz. At that time, this part of Poland was ruled by Prussia. He was one of eight children born to a family of carpenters. Jan showed interest in chemistry since childhood. Mildly speaking, his parents did not like his experiments, which were not entirely safe. For this reason, as soon as he was 16 years old, they "convinced" him to move to Krotoszyn. Jan began working in a pharmacy. When he was 19 years old, he went to Berlin and started working in the German concern AEG's research center (as we would call it today). At the turn of the 19th and 20th centuries, the company produced electrical equipment, including light bulbs. Czochralski did not have a high position at work due to his lack of proper education. However, he was hardworking and liked to learn. Only six years after arriving in Berlin, Jan defended his engineering thesis at the chemical faculty of the local Polytechnic.

In 1916, at the age of 31, he made the most profound discovery of his life. Or rather, the discovery of the century. An anecdote says, that he was so absent-minded that he dipped this fountain pen nib in a crucible with melted tin, instead of an ink bottle, while taking notes. In those days, people did not write with pens we know today. The fountain pens had to be dipped in an ink bottle from time to time, in order to write. However, the bottle in which Jan inserted his nib contained molten metal. As soon as he realized this, he took out the nib along with a thin metal rod clinging onto it. That was it!

Probably many people would curse quietly under their breath after such a mistake; others would have laughed, or shown their friends the result of their error. However, Czochralski was delighted with what he saw. The genius of some discoverers is that they begin to think about what others would ignore. Probably Czochralski was not the first to notice that by dipping an object in molten metal and then taking it out: it would pull a "thread" of cooling metal behind it. What is interesting about this? For Czochralski, it was a crucial moment in his scientific career. Thanks to this discovery, he is probably the most quoted Polish scientist in the world today.

How does it happen that metal solidifies in such a strange way? Does it concern all metals? Since that memorable mistake, Czochralski began to measure the solidification (crystallization) rate of metals and their alloys. The method involving the formation of metal crystals by pulling (which is how Czochralski did it by his absentmindedness) was fascinating. The crystals formed in this way had a very ordered structure – the atoms were arranged in a strictly defined manner. Not

only was this manner determined, but it was also regular. What at the beginning was only a curiosity, which metallurgists were interested in, turned out to be the foundation of an entirely new field, which became electronics. Thin layers of crystalline silicon are essential in electronics. However, the atoms in this material must be very ordered. There is no better method to create perfect crystals of silicon than the one developed by Czochralski. Jan himself could not have known that when he dipped his nib in molten tin instead of ink. In fact, he considered his work on the crystallization of metals interesting, but not very practical. He made his real money from something else.

Return to Poland

The times when Jan Czochralski was gaining his scientific experience (the turn of the 19th and 20th centuries) were impressive for someone in love with science and technology. The industrial revolution was beginning to accelerate, and the need for fast and reliable transport was growing. In those days, the best way to get around was by rail. However, it had some drawbacks that stemmed from the poor quality and price of the metals used to build the trains' rails, wheels, and structural components.

Although Czochralski had no formal education, once he found a job at a research center, he earned a degree through great determination. He defended his engineering thesis and became a respected researcher.

At less than 40 years of age, Jan developed an alloy that was ideal for constructing railroad sliding bearings. Previously, the alloy that was used, wore out quickly and contained tin, which was very expensive. Czochralski's alloy was more durable and cheaper. German railroads immediately bought the patent, because it allowed them to increase the trains' speed. Jan Czochralski became a wealthy and respected man thanks to the so-called bahnmetal, or railroad metal (as his alloy was commonly called). He was respected not only in Germany but even overseas. At the personal invitation of Henry Ford, the owner of the world-famous automotive brand Ford, Czochralski sailed to the USA. There, he was offered the position of director of a metallurgical plant, which belonged to the magnate and car manufacturer. Czochralski, however, declined. Instead, he accepted another offer, which was related to his return to Poland.

He gained wealth and international fame by creating a metal alloy that could be used for the construction of railroad wheel components. Thanks to his invention, trains could move faster.

In 1918, Poland regained its independence. A few years later, thanks to the initiative and authority of President Ignacy Moscicki (who was himself a well-known and respected chemist), the scientists and engineers scattered all over the world by the winds of history, began to return to Poland. Jan Czochralski also returned to Warsaw, precisely to the Warsaw University of Technology. First, he took the position of a contract professor, and later, he accepted the title of full-time professor. Czochralski also renounced his German citizenship. The scientist found himself in the capital of the new country. He bought a palace located in Warsaw's Nabielaka Street, which became an essential point on the cultural and social map of the capital. Czochralski invited both recognized figures and promising scientists. The entire elite of interwar Poland visited him. He financed scholarships for talented young people, donated money for the restoration of Chopin's manor in Żelazowa Wola, and even funded archaeological work in Biskupin. Unfortunately, in 1939 the war broke out.

A Tragic End

Thanks to his contacts in Berlin, he saved the lives of many scientists. Czochralski knew the most important German scientists. After all, he worked in Germany for many years, and it was there that he gained world recognition for his patents. He stayed in Warsaw during the war and benefited from friendships established in his youth. Despite the warfare, he continued the research at the Warsaw University of Technology. The Germans were interested in it, because Czochralski's works were helpful in the war effort.

On the other hand, precisely because the research was so valuable to the German army, Czochralski managed to employ many people (thus saving their lives). Importantly, the Polish authorities in exile and the underground authorities, knew that Czochralski was saving people's lives and allowed him to continue his scientific work. The Czochralski family's money and contacts saved scientists, artists, and people outside the world of science or culture. The whole family of the scientist was involved in helping the repressed. However, this did not matter to the post-war communist authorities. In the first years of the People's Republic of Poland, the newly formed government accused the distinguished professor of collaboration with the occupying forces. After the war, Czochralski found himself in prison suspected of treason. His situation was even worse, as the procedure of renouncing German citizenship was not completed due to formalities. For the communists, Czochralski was a German agent. Although the investigators

asked for the names of the rescued, the scientist did not want to give them. He was afraid that they would also be punished. Czochralski defended people first against the German occupants and then against the communists. Although finally released from prison (there was no evidence of cooperation with the Germans), he was deprived of his job and academic titles. The Warsaw University of Technology authorities cut him off, stripped him of his position, and banned him from lecturing and conducting scientific research. Although he survived the war, he had to leave Warsaw, because he could not find a job there. He returned to his hometown Kcynia, near Bydgoszcz, and founded a small family company Bion. He produced shoe polish, hairdressing cosmetics, and salt used for curing meat. After all, he was a very gifted chemist. The communist authorities removed Czochralski's name from all encyclopedias, and the Warsaw University of Technology did not acknowledge its professor.

Czochralski's discoveries and his method of growing monocrystals began to be appreciated only after his death. Most likely, he would have been awarded the Nobel Prize, if his fate had turned out differently.

Meanwhile, Czochralski showed not only his scientific talent, but also his business flair. His company grew in strength and made very good money. Czochralski's enemies could not leave this without reaction. In 1953, during a fierce search of his home and company premises, the owner and world-famous scientist suffered a heart attack. Shortly after, he died on April 22, 1953.

As Czochralski was dying, the world was beginning to appreciate his method of growing monocrystals. It is almost certain that a few years later, when the potential of semiconductor electronics was recognized, Czochralski would be awarded the Nobel Prize. He left behind over 120 publications, making him the most cited Polish scientist in scientific papers. Meanwhile, in the People's Republic of Poland, the first encyclopedic reference to Czochralski did not appear until 1970 – 17 years after his death! The Senate of the Warsaw University of Technology rehabilitated Czochralski only in 2011 – 66 years after they deprived him of his degrees and disgracefully dismissed him!

Ignacy Łukasiewicz
(1822–1882)

Łukasiewicz was a pharmacist, an oil specialist, and a social activist. He was not talkative, but he was stubborn and hard-working. Maybe that is why, he did not break down when the business did not go his way and refineries burnt down. At the same time, he was a man of great heart, who was very family-oriented. His virtues were recognized by the Pope himself, who bestowed upon him the dignity of a chamberlain. His zeal for action became a driving force for many people. He was a pioneer of the oil industry. Many grateful people would call him "Father Łukasiewicz".

Ignacy Łukasiewicz was born into an impoverished noble family in Zaduszniki, currently in the Podkarpackie province. The family lived in a palace that was destroyed by fire twice. Despite these unpleasant experiences, Ignacy's childhood passed in a cordial atmosphere.

When he was eight, the Łukasiewicz family moved to Rzeszów. This decision was made, as a result of his father's illness and the need to see a doctor frequently. In the new place, young Łukasiewicz passed his primary school examinations, and together with his brother Franciszek, he attended high school in Rzeszów. He did very well at the Piarist Fathers' institution. However, only one of the brothers could continue his studies, due to the family's financial problems. Even before his father's death, it was decided that it would be Franciszek. Therefore, after four years at school, Ignacy was to dedicate himself to learning the pharmacist profession. Why was this profession chosen for him? It is not entirely known. Perhaps, because of family traditions, or perhaps because of the boy's interests.


I INVENTED THE KEROSENE LAMP.
I FOUNDED THE WORLD'S FIRST OIL MINE AND REFINERY.
I WAS AN EVOLUTIONIST AND A SOCIAL ACTIVIST. I FINANCED ROADS, HOSPITALS, AND SOCIAL WELFARE HOMES.

Pharmacist's Assistant in the Underground

He was a capable, hard-working student, but the family could only afford to pay for the studies of one child. It was decided that higher education would be acquired by his brother, Franciszek. Ignacy was to become a pharmastist's assistant.

After four years of practice, Ignacy passed the exam, after which he became an assistant pharmacist. To take it, he had to learn how to read prescriptions and formulas. He also had to master pharmaceutical chemistry and the analysis of simple chemical compounds. This knowledge and experience with laboratory equipment, came in handy in the following years of his life. It was while working in a pharmacy that young Ignacy began to dream about university. Without a degree, he could not become a pharmacist and run his own business. He could only be an assistant pharmacist. People who worked with young Łukasiewicz remembered him as reticent and secretive, but also very hard-working. He was also remembered as someone with a good heart, willing to help others, and dedicated to his family and friends.

Already when he was working as a pharmacist's assistant, Ignacy began to get involved in politics. Poland was then under the partition and young Łukasiewicz, like many others, wanted to change this state of affairs. Ignacy, therefore, began to act in the conspiracy. A pharmacy was an ideal place for this. Many drawers, shelves, nooks, and crannies could accommodate illegal content, and the out-of-the-way room did not have to serve merely as a resting place. This small room on the first floor, away from the eyes of onlookers, was a great contact point for the conspirators. He did not manage to hide his subversive activities for long, because he was arrested on a charge of organizing an uprising in the region of Rzeszów. He helped to lead it, relieving a recently released activist, who for some time had to avoid attracting the attention of the invaders. Ignacy was firstly imprisoned in Rzeszów and then transferred to Lviv. After two years, he was released, but lived under police supervision. He had to report for court summons. It was then that Ignacy decided to change his residence and moved to Lviv, where his brother Franciszek lived. He found a job with Piotr Mikolasch at a pharmacy known throughout the city as "Under the Gold Star." When it seemed that Ignacy Łukasiewicz, after the experience of conspiracy, arrest, and imprisonment, had settled down... the most incredible adventure of his life began.

Studies with a Factory in the Background

Before this could happen, however, Łukasiewicz began his studies. It was not easy to enroll at the university. Ignacy had a reputation of a troublemaker who used to be in prison. At first, the authorities did not want to permit the rebellious student to study, but eventually, with the help of the pharmacy owner whom he worked for, they agreed. After

Lviv, Łukasiewicz spent two years in Krakow at the Jagiellonian University. The pharmacy course included biology, chemistry, general physics, and the study of rocks – petrology. It was during these classes, that Ignacy Łukasiewicz first heard about the use of crude oil in pharmacy.

Lviv, Krakow, then Vienna. Ignacy Łukasiewicz was one of the best students in his year. After defending his master's thesis, he returned to Lviv, where he researched petroleum in the pharmacy he worked at.

His studies at the Jagiellonian University went very well. Ignacy was one of the best students, and he passed all the subjects in his freshman year. Despite fulfilling the formal requirements, he did not manage to take the master's exam earlier. It did not help either, that Ignacy argued his request with financial problems, which indeed bothered him. One of his professors saved him from this difficult situation by helping him find a job. For his final semester, Ignacy transferred to the University of Vienna and wrote his master's thesis there. Having passed his exams, Łukasiewicz returned to Lviv, to the pharmacy where he used to work – an important task was waiting for him there. His boss bought several barrels of crude oil and assigned the newly graduated pharmacist a mission to check how to use it in the pharmacy. Despite appearances, the pharmacy laboratory was an excellent place for such an analysis. The pharmacists were knowledgeable, and the room itself was suitable for chemical analysis.

Refining oil, Łukasiewicz obtained a light yellow substance that resembled an expensive foreign substance – *Oleum petrae album*, which was used mainly for skin diseases. Hoping to earn a lot of money, Ignacy founded a three-person company with his friends. The company bought quite a large amount of oil, which was then purified. The finished product was offered at a lower price to many pharmacies, both at home and abroad. However, there was little interest in the cheaper substitute, and Ignacy Łukasiewicz's first business initiative failed.

The Beginning of the Oil Industry

However, Łukasiewicz was stubborn and decided to use oil for purposes other than medicine. He continued his experiments by heating the raw material in boilers at 200°C, without air. After several different reactions, he managed to separate kerosene, the properties of which astonished him. It burned with a bright flame, but what was equally important, it produced no pungent or black smoke. Besides, it was cheaper than the oil or camphine previously used for lighting. It was not without its problems, however. Kerosene could not be used in available lamps. They exploded in contact with a new liquid with different physical and chemical properties. Therefore, Łukasiewicz created the first cylindrical kerosene lamp, and the first examples of it lit up the pharmacy's interior, where he worked.

The beginning of the world oil industry is considered to be July 31, 1853. That evening, a nurse named Bronisz, rushed into the pharmacy. He came from the General Hospital, where an urgent surgical operation had to take place. The patient's condition was very grave, and he probably would not live to see the morning. The problem was that in those days, surgical rooms had no artificial lighting. However, everyone in Lviv knew about Lukasiewicz's invention, hence the idea to operate by the light of kerosene lamps for the first time in history. The night operation went well. The management of the hospital, convinced of the excellent quality of the product, replacted the lighting with kerosene lamps and ordered a supply of 500 kg of kerosene. It saved a lot of money. After all, the new substance was very economical. Nobody else, but Łukasiewicz was able to offer such a low price for his product.

During one of his experiments, he obtained kerosene – a liquid that did not smoke and burned with a bright flame. He also designed a suitable lamp for the new type of fuel.

Seeing the potential in oil, Łukasiewicz moved to the place where its deposits were located, i.e. Gorlice. There, in the backroom of a pharmacy that he leased, he conducted his distillation experiments further. They were not the safest. One of the experiments almost ended in a tragedy. A fire broke out and consumed nearly the entire room. There was a need for a distillery, a separate room for purifying oil. The demand for kerosene was so high, that the backroom of the pharmacy was no longer sufficient.

His fame and money came at night,
when Łukasiewicz's kerosene lamps illuminated
the room where a surgery was taking place.
In those days, lack of good lighting
made performing surgeries at night impossible.

Łukasiewicz invested the money he earned in oil extraction. He built wells and other refineries. His fame, as well as his fortune, grew. He received prestigious orders, i.e. to provide large quantities of kerosene to light the entire Vienna railway station.

A Man with a Good Heart

Łukasiewicz experienced fires and accidents, but also the rapid development of an entirely new industry. Refineries and mines brought profit from oil exploitation and processing. They were also a place of practical learning for new Polish specialists. Łukasiewicz himself became an internationally recognized authority in the field of crude oil

processing. He obtained substances for lighting and lubricants to protect wood against decay, as well as asphalts for floors, among others. However, running an oil business was not only about profit. Łukasiewicz had a social spirit. It was already visible during his studies, when he selflessly helped those who did not learn as quickly. Łukasiewicz was involved in political matters and undertook independent initiatives to make the lives of those around him easier. He introduced a modern system of workers' insurance. Everyone received free treatment and medicines, and even an allowance paid out in case of illness. He gave out low-interest loans and supported rural youth who wanted to study. He used his own money to build roads, the quality of which – as it seems – was better than that of other roads in the Austrian partition. He financed the establishment of orchards. He also planted roadsides with fruit trees. He built many schools in various towns and initiated the establishment of an institution preparing future miners for work. His house was open to many guests – he received emigrants and participants of the January Uprising. His wife Honorata's mother and sister lived there, as well as Valentina – Ignacy's teacher's daughter from his youth, whom the Łukasiewiczs took care of after their own daughter's death.

He was a visionary and created a new industry. To the end, however, he remained a man sensitive to the injustice of others. He built roads and schools. He financed scholarships and supported patriotic organizations.

Łukasiewicz's adventure began with a simple experiment in the backroom of a pharmacy, where he managed to isolate kerosene. Thanks to his perseverance and persistence, he did not stop there. With outstanding commitment, he built the world's first oil mines. He created refineries and founded a company in the shape of later oil companies. Despite many problems, he became the father of a new industry. At first, its aim was to power new lighthouses. It grew to become a significant part of many economies in modern times. Oil is the primary raw material in the creation of gasoline, oils, and many synthetic substances. Launching an era is not the only contribution of Łukasiewicz. He also helped many of his contemporaries through his social activities. Thanks to his attitude towards others, he was called "Father Łukasiewicz" – always a good-natured, modest man who felt humbled when receiving an award or a distinction.

Rudolf Weigl
(1883–1957)

This man's life story could make for a good thriller. It would show war, emotions, millions of lives saved, betrayal, an international scandal, and unfortunately, no happy ending. Rudolf Weigl developed a vaccine against spotted fever in 1920. He achieved spectacular professional success and was a man known in the whole medical world. But history dealt with him cruelly.

Rudolf Weigl was born in 1883 in Prerov, which is now in the Czech Republic. His mother was Czech, and his father was Austrian. He did not learn Polish until he was a few years old. He lost his father as a child, and his mother remarried to a Pole. Rudolf was raised in the Polish tradition and identified with it so much, that he publicly claimed to be Polish.

Success

He studied natural sciences in Lviv. At the age of 30, he received his habilitation in zoology and anatomy. When World War I broke out, Weigl was drafted into the Austro-Hungarian army. He began research on spotted fever. In those days, more soldiers died on battlefields from diseases than from battle wounds. Typhus was particularly deadly. It spread in places where hygiene and good nutrition were almost non-existent, so it took its toll among the prisoners of war and soldiers in the trenches. The disease killed three million people during World War I. The typhus epidemic of 1915 wreaked havoc on the ranks of the Austro-Hungarian army. In some areas, there were no soldiers who would fight, so the hostilities were halted for several months.

After World War I, Rudolf Weigl, already a professor, founded the Institute of Typhus and Virus Research in Lviv. It was a city that lay within the territory of independent Poland. After two years of intensive research, his vaccine against typhus was ready. It was the first in


I CREATED THE WORLD'S FIRST VACCINE AGAINST TYPHOID FEVER, WHICH SAVED MILLIONS OF PEOPLE.
I PIONEERED MANY NEW METHODS USED IN VIROLOGY AND BACTERIOLOGY.
I WAS TO RECEIVE THE NOBEL PRIZE TWICE – THE FIRST VETO WAS PUT BY THE GERMANS, THE SECOND (IN 1948) BY POLISH COMMUNISTS.

In those days on the battlefields, more soldiers died from diseases than from injuries sustained in battle. Typhus took a deadly toll, as it was hazardous in places where hygiene and good nutrition were hard to come by.

the world! To develop it, he used lice, which he fed with... his blood. Lice are insects that feed on human blood. To provide them with food, Weigl attached a box full of lice to his forearm. After some time, he infected them with bacteria carrying typhus. Then, he would use a microscope to derive the biological material from each louse and use it to make a vaccine. The process was very tedious. Records show that in 1933 approximately five thousand lice were hatched each day at the Weigl Institute, and another five thousand were infected with typhus. 120 lice were needed to produce one vaccine.

During World War I, he was a military doctor and it was on the battlefield that he became interested in the disease that killed as effectively as rifle bullets.

Rudolf Weigl developed the vaccine as early as 1920. Still, to be sure that it worked properly, he tested it for the next ten years. He was pressured to publish the research results by the scientific community and by politicians. In Poland, reborn after World War I, poverty was devastating, and the typhus epidemic killed both the sick and the doctors. If Weigl had published the results of his research earlier, he would undoubtedly have been awarded the Nobel Prize. The Nobel Committee rewarded scientists from other fields for the next few years, perhaps assuming that Rudolf Weigl could be recognized later. There was no doubt that the creator of the typhus vaccine deserved the highest award in the world of science. In ruined by World War I Europe, his vaccine had already saved hundreds of thousands of people.

War

Unfortunately, in 1939 World War II broke out. When the Germans entered Lviv, where Rudolf Weigl conducted his research, they offered him honors and a new institute in Berlin. He refused, because he considered himself a Pole. Although the Germans killed Polish professors and their families in those days, they did not harm Weigl – they needed his vaccine at the front. Among other things, the professor fought for total freedom for hired personnel in his institute. As a result, he saved the lives of several thousand people, including the poet Zbigniew Herbert and the brilliant mathematician Stefan Banach. The

entire intelligentsia of Lviv, people of culture, science, and almost the whole command of the Lviv Home Army passed through Weigl's institute. They were all the so-called "lice feeders." They attached boxes of lice to their bodies and fed them with their blood. Weigl himself and his wife were among the lice feeders, as well. The position of a lice feeder guaranteed inviolability and safety in German-occupied Lviv. Weigl's vaccines were also illegally smuggled to Auschwitz-Birkenau concentration camp, the ghettos of Lviv, Warsaw, and distributed among the underground army.

During World War II, he saved many people by employing them at his institute. He also allowed the smuggling of vaccines into the ghettos of Lviv and Warsaw and the concentration camp Auschwitz-Birkenau.

When the Red Army captured Lviv, the Soviets offered Rudolf Weigl an independent Institute in Moscow. Weigl refused again, because he felt Polish. After the war, however, Lviv no longer belonged to the Polish state, and Rudolf and his family had to leave the city. First, he settled in Krakow, where he could conduct his research at the Jagiellonian University. However, he was suspected of collaborating with the Germans during the war. The communist authorities, despite his international fame, fought him. The scientific community also isolated him. When in 1948 the Swedish Academy of Sciences nominated Professor Weigl for the Nobel Prize, the Communist authorities blocked his nomination. Rudolf Weigl was close twice to receiving the most excellent award in the world of science. Once the Germans stopped it, because he did not want to work for them, and the other time the Poles, because they believed he worked for the Germans. The professor quickly moved from the hostile Krakow to Poznań. He died suddenly in 1957.

When in 1948 the Royal Swedish Academy of Sciences nominated prof. Weigl for the Nobel Prize, the communist authorities blocked this nomination.

If the story of Professor Rudolf Weigl had happened, for example, in the USA, it would undoubtedly have been filmed many times and presented in a comic book. Rudolf was very hard-working, intelligent, and wise. His life is very similar to the life of another Polish scientist, Jan Czochralski. Rudolf Weigl was posthumously awarded the Righteous Among the Nations medal for saving Jews during the war. In Europe, the last case of spotted fever was reported in the 1960s.

Mieczysław Bekker
(1905–1989)

Without people like Professor Bekker, the world of motorization and the conquest of the Moon, would look different for sure. It was a Polish engineer who built rovers, which were very successful on the Silver Globe. Although he was a world-class designer of off-road vehicles, his interest in science began with a book he found in the attic.

He was an outstanding designer of off-road vehicles. The armies of Canada and the USA wanted to cooperate with him. However, Mieczysław Bekker is best known for what he did to conquer the Moon. He was born near Hrubieszów, but his school was located in Konin. The love for technology and space was instilled in him by his father. Together with his younger brother, Mieczysław loved admiring the disk of the Moon and listening to their father talking about the stars and planets. Three Bekkers – a father and his two sons – built a platform, a small observatory, in a tree. Using binocular lenses, they also constructed a simple telescope. Many years later, Professor Bekker said that while observing the disk of the Moon, he felt as if he could touch it with his hand. At that time, he probably did not even dream that the vehicles he built would drive people around the Moon's surface.

The telescope and observatory were not the only structures the Bekker brothers built. One summer, they created a replica of Lilienthal's biplane glider. The design, covered with glued newspapers, was never tested, because the brothers lacked the courage to get into it. Maybe that was a good thing.

Technology, physics, and mathematics – these were subjects that Mieczysław did not have to learn. The knowledge smoothly slid into his brain. One of the hobbies of the future inventor, was transforming formulas and solving mathematical problems. He is said to have covered the wooden gate, leading to the backyard of the Bekker house, with mathematical patterns.


MY BROTHER AND I BUILT A TELESCOPE, A SMALL ASTRONOMICAL OBSERVATORY, AND EVEN A GLIDER.
THE UNIVERSE STARTED TO FASCINATE ME COMPLETELY BY CHANCE. I WAS CLEANING AN OLD ATTIC WHEN I CAME ACROSS A BOOK ON ASTRONOMY.
I BUILT A VEHICLE THAT DROVE PEOPLE AROUND THE SURFACE OF THE MOON. IT WAS SO GOOD THAT IT WAS TAKEN TO THE OUTER SPACE SEVERAL TIMES.

War

When Mieczysław Bekker was still in middle school, by some coincidence, he found a box with old books in the attic of his school. One of them was a book with the basics of astronomy published in 1880. As he recalled, he could not stop thinking about the planets, the moons and the stars from that time on.

After graduation, he took up designing off-road vehicles for the Polish army. After the outbreak of war, he ended up in France and worked in the Tank Division of the Ministry of Armaments. Then he found himself in Canada at the Office of Armored Weapons Research of Ottawa.

From Konin, he went to Warsaw to study, specifically at the Warsaw University of Technology. He chose the specialization in automobiles. He defended his diploma with the constructors of the famous Polish RWD airplanes. After graduation, he started to design off-road vehicles for the Polish army. Unfortunately, not much came out of it, because the war broke out. He escaped to France via Romania, where the Ministry of Armament in Paris immediately employed him as a specialist in the Tanks Department. When France capitulated, the Canadians evacuated him and immediately hired him at Ottawa's Armoured Weapons Research Office.

It was there that he eventually began to conduct work on off-road vehicles. He researched various types of drives, suspensions, and steering systems. In the mid-1950s, the US Army persuaded him to accept their job offer. When he retired to civilian life, the best American universities and technical colleges offered him jobs. Although he lectured at many of them, he was an industry employee. He became the director of the research institute of the global automotive giant, General Motors. It was there that he took up the task of building a lunar rover. The challenge was extremely difficult. He had to build a vehicle capable of transporting heavy loads, comfortable and safe for people dressed in restrictive suits, lightweight, that would not bury in the lunar soil, and foldable, so that it could be conveniently transported. An additional difficulty was the inability to use an internal

> The challenge was to design a human-safe vehicle that could transport heavy loads, yet was lightweight, compact and did not require the use of an internal combustion engine.

combustion engine, because there is no atmosphere on the Moon and no oxygen, necessary for burning gasoline in the engine. If that wasn't enough, the wheels of the car couldn't be made of rubber, because this material would not withstand the large temperature fluctuations that occur on the surface of the Moon (from +110 to −80 degrees Celsius).

Eighty-five companies entered the competition announced by NASA with their designs. Professor Mieczysław Bekker's design won. What is interesting, there were also several Poles in other teams.

The Moon

Bekker's lunar vehicle was nearly 3.5 meters long and 1.8 meters wide. Weighing only 200 kg, it could take a 500 kg payload to the Moon. Bekker applied a solution that was later applied not only in electric cars, but also in super-fast trains. It consisted of separate electric motors in each wheel. The vehicle worked so well, that it was used in three subsequent Apollo missions without any improvements. It flew to the Moon with the Apollo 15, 16, and 17 missions.

When the Americans announced a program to fly to the Moon, he decided to propose his design of a lunar rover. Although 85 companies entered the competition, his concept won.

Although he is unknown in Poland, in the US, his name is listed in the avenue of merit for conquering space. Most of the astronauts of the Apollo program were his acquaintances.

Bekker himself said that the biggest challenge was to design wheels that would not bury themselves in the lunar soil. It was pretty complicated, because, without gravity, the loose surface behaves differently than on Earth. The constructors of Mars rovers learned about it as soon as their designs worked on the Red Planet differently than predicted. Bekker's vehicle did not bury itself even once and quickly climbed slopes. The astronauts themselves repeatedly mentioned that driving was comfortable and provided great fun. Bekker constructed the rover's wheels from piano strings twisted like springs and reinforced them with titanium plates.

A replica of a book about space, that he had read as a middle school student, hung on the wall of Bekker's office for all these years. Bekker died in the USA in 1989.

In Poland, he is unknown. In the USA, his name is inscribed in the alley of merit for conquering space. Most of Apollo's astronauts were his friends. Every four-wheel drive off-road vehicle has a technological solution invented by the Pole. His book *The Theory of Terrestrial Locomotion* is a must-read for any car builder. The unit used to determine the looseness of the ground is named after him. After the war, he visited Poland several times. Each time he emphasized how important a role his parents and teachers played in developing his passion.

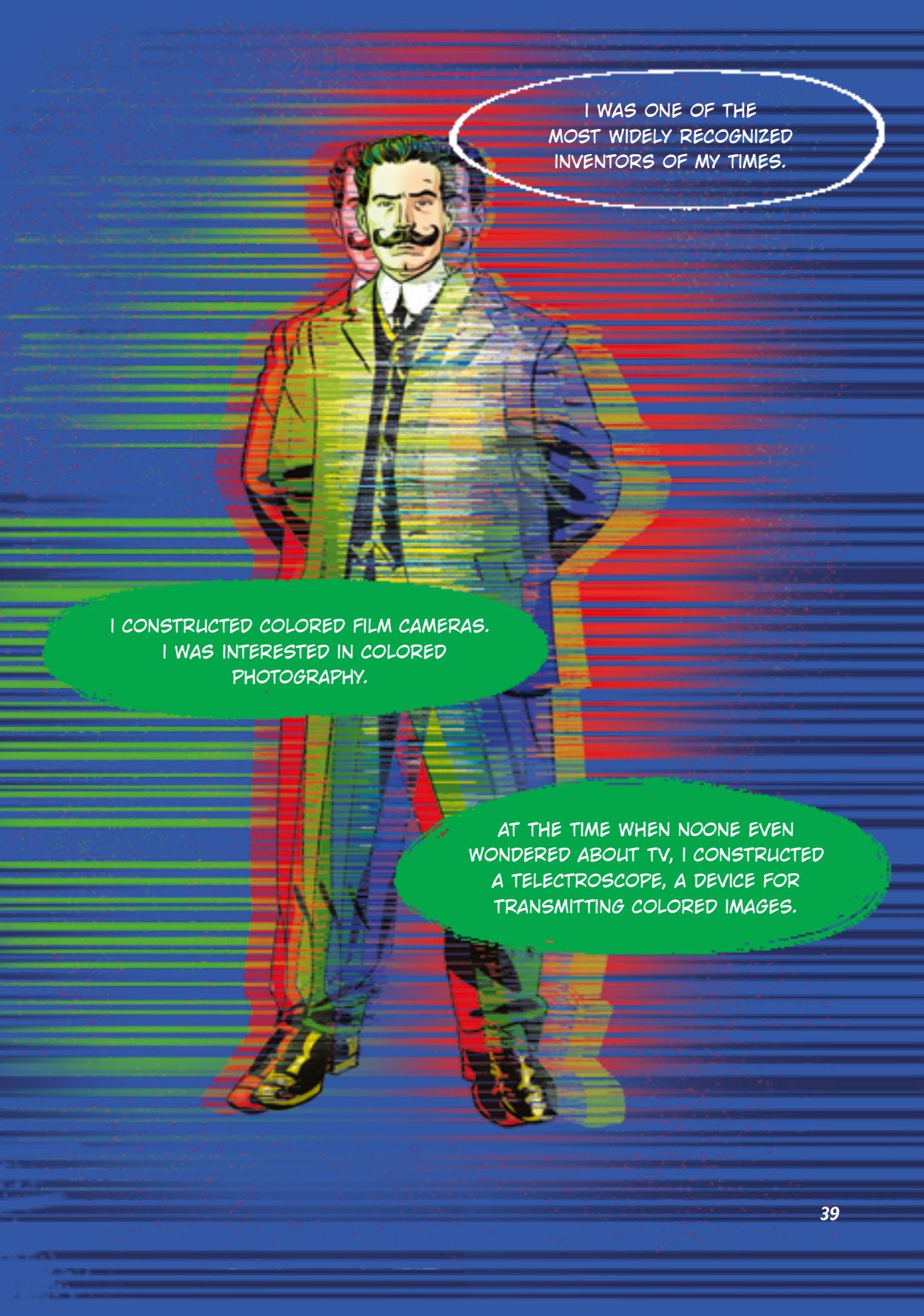
Jan Szczepanik
(1872–1926)

He was a brilliant and versatile constructor. He is sometimes compared to the most eminent inventors, such as Edison, and even called the Leonardo da Vinci from Galicia. He invented and built devices that the world did not appreciate until many years later. Interestingly, he did not focus on one field. However, all of Szczepanik's inventions had one thing in common. They were colorful. This man was fascinated by colors.

He was born in 1872 in the village of Rudniki, which belonged to the Austrian partition, now part of Ukraine. As a child, he visited the workshop of Ignacy Łukasiewicz, another brilliant Polish discoverer, about whom you can read on our website and in this book. Technology and science fascinated him so much, that he decided to become a teacher. Many sources claim that his lessons were very unconventional. He did a lot of experiments, which even today are not standart, but in those days, they were a real rarity. He always carried a notebook to write down his ideas. And he had a lot of them. His first significant invention, actually an improvement, was an automatic weaving system. As a teacher, he had seen looms in many rural homes of his students, but what he invented and constructed took weaving to another level. Szczepanik improved the weaving machine so much that, thanks to perforated cards, it was possible to weave a tapestry with a colored pattern in just a few hours. Before the invention of this system, it took several days and sometimes even several weeks.

Beginnings

The automatic weaving machine brought Szczepanik fame and big money. The technology was so good, that the Emperor of Austria-Hungary himself admired his tapestries. He released Jan from military service, as a reward for his achievements.


I WAS ONE OF THE MOST WIDELY RECOGNIZED INVENTORS OF MY TIMES.
I CONSTRUCTED COLORED FILM CAMERAS. I WAS INTERESTED IN COLORED PHOTOGRAPHY.
AT THE TIME WHEN NOONE EVEN WONDERED ABOUT TV, I CONSTRUCTED A TELECTROSCOPE, A DEVICE FOR TRANSMITTING COLORED IMAGES.

He was fascinated by technology
and wanted to inspire others, so he became a teacher.
His lessons were said to be very original.

At the age of 25, Jan Szczepanik, first in Great Britain and then in the USA, patented the *telectroscope*, the prototype of the color television. This device transmitted color images and sound over a distance. At that time, at the very end of the 19th century, no one had yet thought of television. When the telectroscope's possibilities were presented in Vienna, they caused a worldwide sensation. It turned Jan into a celebrity not only in Europe, but also overseas. When the famous American writer Mark Twain, the author of *The Adventures of Tom Sawyer*, came to Europe, he went to Vienna to meet Jan Szczepanik.

He patented a telectroscope – a device that transmitted color images and sound. Demonstrations of the telectroscope caused a sensation, and made Jan a celebrity.

The photosculptor, a device for sculpting or copying a three-dimensional model of some object, was a masterpiece. A combination of mirrors projected the contours of the original object onto the material on which the artist worked. As a result, it was enough to have a model and pattern to make its three-dimensional copy.

Szczepanik's weaving workshop produced the material used to make the first bulletproof vests, although it was Kazimierz Żegleń (you can read about him in this book) who invented the vest itself. The men had a dispute about it. Although it was Żegleń living in the USA who invented the bulletproof vest, it was Szczepanik who claimed its authorship in Europe. Jan received a royal medal after the walls of a Spanish king's carriage covered with bulletproof material saved the monarch's life during a bombing. The Tsar of Russia wanted to award Szczepanik his medal for the same invention – a bulletproof vest. Yet, the inventor refused to accept it for political reasons. At that time, part of Poland was under Russian annexation. Szczepanik considered the Tsar's recognition a blunder. Therefore, the Tsar sent him a gold watch with a diamond-studded case.

Obsession

The "Vest business" developed quite well. Thanks to this, Szczepanik earned money to create the world's first electric machine gun. However, the real revelation came the following year – the wireless telegraph. At that time, at least several people built a device that used electromagnetic waves for communication. Among the most entre-

preneurial ones was Guglielmo Marconi, who received the Nobel Prize in Physics for developing wireless telegraphy.

Szczepanik's most significant achievements were in the field of color photography, as well as sound and color film. He constructed three models of film cameras and projectors for color photography. He also found a way to record sound on film. On the one hand, tapers lost their jobs. On the one hand, viewers were able to experience a whole new sensation when a character in the movie spoke to them, and they heard his voice. His cinematic experiments caused a sensation and sometimes even shock. Literally. In 1925, Szczepanik made a film of a surgical operation. It was a color film, and the accurate rendering of the colors made the image so realistic, that some in the audience reportedly fainted. At other times, they delighted in watching a film shot on alpine passes. The press said that the colors in these films were so realistic, that the viewing experience was incredible.

His greatest achievements were cameras and projectors for color photography.

Everything he did had to be perfect. He did not compromise in this regard. However, color films and special cameras were quite complicated and therefore expensive. They lost the race with the color system entering from across the ocean – Technicolor. Today, we know that Szczepanik's rendering or reproducing colors systems, were more accurate and gave much better results. However, Technicolor was cheaper. Other inventions remained mere curiosities and were not successful, because they were too far ahead of their time. Kodak and Agfa used the method of small-image color film invented by Szczepanik, only 30 years after its invention. Szczepanik, especially towards the end of his life, did not have the money to register patent rights. As a result, his inventions were used in Great Britain, France, or the USA utterly free of charge. In total, he registered as many as 92 patents in 5 countries of the world. He died in 1926. The notes found after his death indicated that he was also interested in submarines, airships, and airplanes with movable wings. Unfortunately, the Germans destroyed all the equipment and many of his technical notes during the occupation. What remained, burnt during the Warsaw Uprising.

Szczepanik's method of creating small-image color film was adopted by Kodak and Agfa only 30 years after it was invented. Szczepanik, especially towards the end of his life, had no money to claim patent rights. As a result, his inventions were used completely free of charge in the UK, France and the USA.

Jacek Karpiński
(1927–2010)

This man was called the Polish Bill Gates or Steve Jobs. Only that our inventor was born in the wrong time and place. In communist Poland, he could not develop his passions and count on access to the latest technologies. He built, among other things, the world's first transistor computer, a learning machine – the so-called perceptron and a voice-controlled robot. Without a doubt, he was a visionary. Simply put: he was a computer man.

Computers

During World War II, he was a soldier of the "Zośka" battalion. During the occupation, he belonged to the Grey Regiments. He participated in the scout conspiracy, took part in sabotage actions, and was a member of Assault Groups. After the war, such people were treated with tremendous distrust and usually were not allowed to spread their wings. His entrance into adulthood was ferocious. When he was 17, he was seriously shot in the spine, on the second day of the Warsaw Uprising. He recovered in the Tatra Mountains. In Zakopane, he learned to walk again.

Immediately after the war, he started his studies, first in Lodz, then in Warsaw. One of his first inventions was the AKAT-1, the world's first transistor computer. Jacek won the first prize at the UNESCO world competition for the youth. The design was so innovative that Karpiński received an invitation from MIT (Massachusetts Institute of Technology), one of the best technical universities in the world. He had many job offers from international companies, but he wanted to return to Poland. Together with a colleague, in 1962, he constructed a perceptron – the first machine in the world that could learn and recognize the environment. A perceptron is a simple neural network. The one created by Karpiński was the second of its kind in the world. Today, algorithms of many applications


I CREATED THE WORLD'S FIRST TRANSISTOR-BASED COMPUTER (AKAT-1).
I CONSTRUCTED THE K-202 PERSONAL COMPUTER, THE PARAMETERS OF WHICH WERE BETTER THAN THE DEVICES OF A SIMILAR CLASS IN THE WEST.
I CONSTRUCTED THE PERCEPTRON, A LEARNING MACHINE THAT RECOGNIZED OBJECTS AND A VOICE-CONTROLLED ROBOT.

possess learning capabilities, for example, in our smartphones. The appropriate software can recognize elements of the environment using a built-in camera. Of course, it arouses interest and emotions even today. Karpinski built his network 60 years ago! However, it was still not the end of his discoveries. In 1971, he showed the world the K-202 personal computer. Unfortunately, its production never started. It was undoubtedly a breakthrough design made in cooperation with British companies, which wanted to put the K-202 into production. Polish communists also had such an intention, but nothing came out of it. The computer had better parameters than devices of a similar class in the West.

Politics

No new invention was created for the next few years, and previous ones were not developed. The Polish economy was in a terrible state. The world was moving forward, and Poland was standing still. The inventions that were admired all over the world years ago, are no longer remembered. The potential was wasted. In 1978, Karpiński gave up electronics and computers to start raising pigs. After a few more years, he went to Switzerland and worked at a tape recorder factory. He returned to Poland after another 10 years, in the early 1990s, and became an IT advisor to two finance ministers.

After the international presentation of the AKAT-1 computer, he was offered a job at renowned universities abroad. Jacek did internships there, but he wanted to work in Poland.

Many people claim that the inventions he bragged about were not his work, but the work of the whole team. This information can be looked at in different ways. Many famous people described in encyclopedias attributed the results of a large group of employees to themselves. Some stole ideas and then, with money, filed patents under their own name. It is not entirely clear what the case of Jacek Karpiński was. Many documents are missing. His former colleagues give contradictory information. One should also remember that Karpiński lived in a communist country, where visionaries were often suppressed, and mediocrities were elevated to pedestals.

After the war, the Communists brutally cracked down on people who, like Karpiński, had belonged to the Home Army. Many young people could not count on being admitted to universities. To fulfill their hunger for knowledge and deepen their passions, many had to cooperate with the secret services or intelligence. What compromises did Jacek Karpiński have to make? Did he cooperate to build computers? Did he have an easier career path, because he collaborated? We will never know...

Human

Discouraged by the lack of progress in his work, in 1978 Karpiński quit electronics and computers, to take up breeding of pigs.

Jacek Karpiński was not easy to work with. He had a huge ego and was reluctant to share his computer design plans with his clients and the Polish committees, that were to evaluate the results of his work. He notoriously exceeded his budget; yet, he constantly complained about the lack of sufficient funds and people to work with. None of his inventions could be put into production, despite constantly increasing financial outlays. Finally, the approval to purchase foreign components with American dollars was withheld. After Karpiński's team had worked for two years and spent millions of zlotys, there was still no single fully functioning K-202 computer on the market. As a result of various disputes, conflicts of interest, and technical problems, the production of the computer was discontinued. Some people said that its parameters were greatly exaggerated.

He took part in the Warsaw Uprising and during the fighting, at the age of 17, was shot in the spine. Doctors claimed that he would never walk again. However, the opposite happened. After a long convalescence in the Tatra Mountains, Jacek got back on his feet.

In contrast, others said that human envy and the country's economic collapse, wasted a great talent. After the political system changed, Karpiński continued to advise finance ministers and tried to produce cash registers and even intelligent pens, which he called Pen-Readers. However, these designs turned out to be either impractical or obsolete. Later Jacek made a living by designing websites. He was awarded Commander Cross of the Order of Polonia Restituta and the Officer Cross of the Order of Polonia Restituta. He died in 2010 in Wrocław.

He was a genius with a problematic character. Someone who had a vision but, for various reasons, suffered business failures. Today it is difficult to understand his choices mainly because the reality of a country behind the Iron Curtain in the 1960s and 70s, was different than now. One can only regret that Karpiński was not born in other times. Who knows, maybe the Silicon Valley would have been located in Poland?

Napoleon Cybulski
(1854–1919)

Some people don't like to follow the beaten path. Some people love to wander. And this does not only apply to travelers or explorers of new lands, but also to scientists. One of them was Napoleon Cybulski. He believed that his place was somewhere between physics and medicine. He was fascinated by the speed of the blood flow, the brain's electrical activity, the impulses that make the heart contract in the proper sequence, as well as hormones.

He was said to be an extremely humble and hard-working man. His co-workers claimed that he would throw on the floor the devices he built which did not work. He vented his anger on objects, yet he was helpful and friendly towards people. To cooperate with the best, he also demanded a lot from himself. He was the author of nearly 80 scientific papers, many of them ground-breaking. Suprisingly, the topics he researched were interesting neither for physicians nor for physicists. He used his vast knowledge of physics and mechanics to study living organisms, including humans. For example, when Cybulski built devices to measure the speed of blood flowing in the arteries, people were surprised, because they thought it was of little use. From today's perspective, we would definitely consider it essential. How can you help people and cure them if you don't understand how human bodies work – like the brain and the endocrine system?

He was born in 1854 in the village of Krzywonosy in the Vilnius region, now the territory of Belarus. He received the name Napoleon in honor of Napoleon Bonaparte, whom his father adored. In childhood, he was interested in reptiles and amphibians. He is said to have brought them home, which caused quite a commotion among his family members. After graduating from high school, he began studying at the Military and Medical Academy in St. Petersburg. He met an outstanding Russian physiologist, Ivan Pavlov, a Nobel Prize winner responsible

I DISCOVERED ADRENALINE, ONE OF THE STRESS HORMONES.
I DEVELOPED A METHOD TO MEASURE BLOOD FLOW IN THE MAJOR ARTERIES OF THE BODY.
I PIONEERED THE STUDY OF BRAIN WAVES AND CONSCIOUSNESS.

for the "Pavlov's reflex." He wrote his first scientific paper at the age of 24. It addressed the issue of blood pressure and velocity in animals. Today, we know that the so-called pulse wave produced by the heart can move in the carotid artery at speeds exceeding 50 km/h. At that time, however, it was not known how to measure such quantities. Cybulski designed and built a photochemotachometer, a device measuring the speed of blood flow in blood vessels.

Brain

He measured the currents flowing through the heart. He wondered how it was possible that it works with such precision. He was a pioneer of electrocardiography.

As a Pole living in the Russian partition, after the fall of the January Uprising, he could not count on a good job and the possibility to continue his scientific passions. Therefore, after defending his doctoral dissertation, he moved to Krakow and took up a job at the Jagiellonian University. It is said that it was there, that he heard a scientific lecture in Polish for the first time in his life. Napoleon Cybulski created the Department of Physiology, Histology, and Embryology in Krakow. The building where he worked was reportedly in such poor condition, that when a car drove along the nearby street, the floor trembled so much that researching with a microscope became impossible. Therefore, the scientist conducted part of his research at night, when the traffic stopped. All these inconveniences did not discourage Cybulski. He earned money for his research and renovations by organizing, among other things, paid popular science lectures.

Cybulski was a very sociable, open, and friendly person. He trusted his students and allowed his co-workers a great deal of independence. He willingly cooperated with other scientists and shared his scientific ideas with them. He only occasionally threw research equipment on the floor, but only when something didn't work out for him.

Cybulski was doing electrocardiography to understand how the heart works and how its muscles contract in such perfect order. He also initiated research into the physiological basis of hypnotism. These were the times when the world of science and culture was fascinated by this subject. Hypnotists were very popular, and people believed that hypnosis could cure many diseases. Napoleon Cybulski, however, took a scientific approach to the matter. A few years after moving to Krakow, he and one of his students began groundbreaking research on the brain's electrical activity, specifically on electrical phenomena in the cerebral cortex and spinal cord. In 1890, he became the first person in the world to measure the brain's electrical activity. With the help of his colleagues, Cybulski located the sensory areas of the cerebral cortex by measuring the currents.

Stress

Cybulski was also interested in taste – specifically, why we experience certain sensations. He then studied or measured the amount of heat produced by skeletal muscles. To do this, he had to construct a unique device, a microcalorimeter. This device was first presented at an international congress of physicians in Rome, and created a sensation. Although he authored nearly 80 scientific papers, many of which were ground-breaking, his most significant scientific achievement was the discovery of the stress hormone – adrenaline.

During one routine examination, Cybulski noticed two lumps located above the kidneys. Experimentally, he showed that cutting out these lumps affected the function of the entire body. He proved that the adrenal glands – as he called these lumps – secrete into the blood a substance that alters the action of the nervous and muscular systems. He called this substance suprarenin. It produces adrenaline, a hormone that plays a vital role in the mechanism of stress. Its release into the blood causes a faster heartbeat, higher blood pressure, and dilated pupils. Adrenaline also regulates blood sugar levels; in short, it prepares the body to fight or flee quickly. For its discovery, Cybulski, already then a professor and rector of the Jagiellonian University, was nominated three times for the Nobel Prize. Interestingly, when Poland regained its independence, Professor Cybulski was awarded the Academy of Arts and Sciences prize called the "Polish Nobel." The material value of this award was equivalent to 12 kilograms of gold. Considering today's exchange rate, it would be more than 2 million PLN or about half the value of the Nobel Prize. Either way, a fortune.

He was the author of nearly 80 scientific papers, but his most important achievement is considered to be the discovery of the stress hormone, i.e., adrenaline.

He was a social activist, loudly calling for the improvement level of eduction, fought for equal access to universities for boys and girls.

Cybulski was not only a scientist, but also a social activist. Today we would say that he lobbied for the improvement of education and health awareness. He fought for women to be able to study. Together with his friend, bacteriologist Kazimierz Bujwid, he opened the first female gymnasium in Krakow. Napoleon Cybulski died in 1919, in his office at the university, as a result of a stroke.

Zofia Kielan-Jaworowska
(1925–2015)

Zofia Kielan-Jaworowska was the discoverer of many mysteries of long-extinct species, including those that were our distant ancestors. In recognition of her merits, many scientists named newly discovered fossils using either her name or her surname. Her most tremendous scientific success was a paleontological expedition to Mongolia. Zofia Kielan-Jaworowska had excellent knowledge and scientific intuition.

The Clandestine School

She was born in 1925 in the central region of Poland called Mazowsze. Her family moved to Warsaw when she was 10. World War II broke out when Zofia Kielan (after marriage known as Kielan-Jaworowska) was supposed to enter grammar school. The occupiers closed the schools, but many children, including Zofia, enrolled in clandestine classes. In 1943, Zofia passed her final exams in one of the schools located in Żoliborz. She immediately began studying zoology at the secret lectures at the Warsaw University. During the Warsaw Uprising, she belonged to the Gray Ranks, the underground paramilitary Polish Scouting Association. She helped in the fight for independence as a nurse, keeping a zoology book in her backpack. After the fall of the uprising, she managed to get out of the capital. When she returned home after the liberation, her parents' apartment was completely destroyed and uninhabitable. The Museum of Zoology, where she served her apprenticeship during the war, became her home. With unlimited access to exhibits and books, she decided to dedicate her life to paleontology, specifically to extinct vertebrates.


I ATTENDED A SECRET MIDDLE SCHOOL. AFTER THE WAR, INSTEAD OF LIVING AT HOME, I LIVED IN A ZOOLOGY MUSEUM. IT WAS THERE THAT I DECIDED TO BECOME A PALEONTOLOGIST.
MY COLLEAGUES APPRECIATED NOT ONLY MY KNOWLEDGE AND INTUITION, BUT ALSO ORGANIZATIONAL SKILLS. THEREFORE, THE EXPEDITION TO THE GOBI DESERT WAS SUCH A SUCCESS.
MY NAME AND LAST NAME WERE USED TO NAME DOZENS OF EXTINCT ANIMALS, E.G., CIELANODON OR SOPHIAGALEA.

The Largest Expedition

When the university reopened, Kielan-Jaworowska came under the influence of an outstanding scientist, Professor Roman Kozłowski. However, instead of fossil vertebrates, which were scarce in the Polish lands, she focused on trilobites – extinct marine arthropods. She conducted her research first in the Świętokrzyskie Mountains, then in Scandinavia and Czechoslovakia. A few years later, she devoted herself to studying scolecodonts, i.e., the jaw of a polychaete annelid. Using innovative methods, she described their evolution from the Ordovician period (which began about 480 million years ago) to the present day.

During the Warsaw Uprising, she was a nurse in the Gray Ranks. Years later, she recalled that in her backpack she always carried a book on zoology. After the fall of the uprising, she managed to to get out of the capital. When she returned, her parents' apartment was destroyed.

Her dream of studying fossil mammals came true thanks to the excavation expeditions into the Mongolian Gobi Desert in 1963–1971. Kielan-Jaworowska was a great organizer – she took care of the equipment, bought provisions for several dozen people, and rented three trucks from the Starachowice factory for free. What was the most important, she gathered the right members of the expedition – about 30 people in total.

The discoveries made during the expeditions echoed around the world. The researchers gathered a great collection of reptiles and mammals, as well as found numerous animals from distant times – turtles, birds, and crocodiles hidden in the rocks. They also found fossils of dinosaurs – among them was the world's only fossil of two "fighting dinosaurs" – a herbivore (Protoceratops) with a predator (Velociraptor). Since Mesozoic mammals were rarely found (and thus least known), the expedition mostly searched for them. At the end of the excavation expedition in 1971, the researchers had 180 skull specimens of Mesozoic mammals and many elements of other skeletal structures. That was the most extensive collection of Mesozoic mammal skulls in the world, and multituberculates, i.e., early herbivorous rodent-like forms, were abundant and well represented. Their discovery and study brought Kielan-Jaworowska international fame. The compiled findings were published under her editorship at an express pace for those times. Together with her fellow scholars, she wrote ten volumes of the English-language series *Results of the Polish-Mongolian Paleontological Expeditions*. Many international journals, including such prestigious ones as "Nature", also published their articles.

Zofia Kielan-Jaworowska was very diligent. She did most of the research herself, and if necessary, invited the best specialists in the field to cooperate. Over time, her house in Konstancin became a command center for various international projects.

Books, Exhibitions, and Awards

She created a model of the brain of primitive mammals – the polygynous mammals that became extinct 35 million years ago. The model was so accurate, that the mouths of nerves and blood vessels could be seen in it, as well as the large lobe of the olfactory lobe.

Zofia Kielan-Jaworowska's first breakthrough was identifying epipublic bones in multituberculates, similar to those of present-day marsupials. Moreover, by examining the fused bones of fossil mammals, as well as the width of the opening through which the young animal was born, she concluded that they must have been viviparous. She concluded that they were born very early. The result of her unapologetically exacting work, to which she dedicated three months and 10 hours a day, was a brain model of these primitive mammals. The nerves, blood vessels, and olfactory lobe were clearly visible. The model used to calculate intelligence indicated that the fossil mammals were clever. In addition, Kielan-Jaworowska found that one bone of multituberculates is similar to those of platypus. Since it is associated with venom-producing glands in contemporary mammals, she concluded that early mammals must have also been venomous.

Kielan-Jaworowska summarized her research and published it in two editions of compendia on Mesozoic mammals. The second version of the 630-page book *Mammals From the Age Of Dinosaurs* was awarded the so-called Polish Nobel Prize, presented by the Foundation for Polish Science. The researcher was able to explain the mysteries of the world she studied, to scientists and non-specialists, interested in the subject. She published several popular science books and organized exhibitions. While working at the University of Oslo, she developed a new scenario and redesigned the neglected paleontological display in the museum. She also designed many exhibitions in Poland, e.g., *Dinosaurs from the Gobi Desert* and *Evolution on Land*. You can still visit the latter in the Palace of Culture and Science in Warsaw.

Professor Zofia Kielan-Jaworowska studied mammals living in the distant Mesozoic Era. Once asked why she picked them, she replied that they were the beginning of our history. She dedicated her entire life to putting this puzzle together. Her organizational skills translated into groundbreaking research, well-chosen collaborators, exciting exhibitions, and substantial contribution to the world of science. Expeditions to Mongolia were the most significant scientific success of her life, and they set in motion a new age of exploration. The specimens she had found, were analyzed by various scholars and continue to be studied by the young generations of paleontologists. In recognition of her contributions, researchers worldwide have named dozens of fossil animal specimens after her. Thanks to Zofia Kielan-Jaworowska, we can now learn about Kielanodonta, Sophiabaatara, or Sophiagalea.

Kazimierz Siemienowicz
(ca. 1600 – after 1651)

Already in the 17th century, our compatriot laid the foundations for rocket missions to the Moon. How is this possible when a trip outside the continent was already a cosmos for the average European inhabitant? Maybe because Kazimierz Siemienowicz was not average at all.

We do not know much about his youth. It is assumed that he was born in 1600 as a poor nobleman. He held a position as an artilleryman in the army of King's Wladyslaw IV Vasa. His interest in explosives pushed him to conduct experiments to improve the design of cannons and guns. To fully understand artillery knowledge, he independently undertook to study many fields such as mathematics, physics, and chemistry. Times were troubled and full of wars. The Polish-Lithuanian Commonwealth had to fight to maintain its borders with Turks, Tatars, Russians, and even Swedes. The king wanted to create specialized troops armed with a new kind of weapon. Therefore, he sent Siemienowicz to study in the Netherlands. After his return, he was given the position of the crown artillery engineer and started creating his great work *Artis Magnae Artilleriae pars prima*, or *The Great Art of Artillery Part One*, which he wrote in Latin.


I WROTE THE ARTILLERY MANUAL, WHICH WAS USED IN EUROPE FOR OVER 200 YEARS.
I WAS A ROCKETRY ENGINEER AND THE COMMANDER OF KING'S WŁADYSLAW IV VASA MOUNTED ARTILLERY.

The book presented all artillery knowledge in a scientific, not a craft, manner. Theoretical basis referenced almost two hundred researches in mathematics, physics, and chemistry – it was a real scientific work! In addition to theory, Siemienowicz included the results of his experiments. His work became a complete textbook opening the way to the secrets of artillery for the layman. Literally, everything was there – a whole chapter on the production of materials used in pyrotechnics in the form of rockets, bullets, fireworks, as well as tips for the construction of powder depots. If someone was burned due to explosive experiments, he could use ways to treat burns (tested on his skin by the Author).

The most revolutionary idea that Siemienowicz presented in his book was the idea of a three-stage rocket. He invented a rocket made of three parts. Each part would burn its pyrotechnic material and cause the next piece to ignite and fall off. With this design, rockets flew faster and much farther than conventional rockets. Doesn't this idea sound familiar? Of course, it does – today, space rockets, including the Saturn V, used in the Apollo manned moon missions, are built the same way! What else has been improved? Kazimierz's contemporaries used to attach long poles to rockets to stabilize their flight – just like the ones used in New Year's Eve fireworks. Siemienowicz invented delta stabilizers in the shape of triangular wings. Such stabilizers are in use today.

Siemienowicz's work became, as we would say today, a bestseller. The Author himself probably did not enjoy his work long. The last trace of his existence is an inscription in a French translation of his book of 1651.

What happened to him later? We do not know.

Marian Rejewski
(1905–1980)

He was a brilliant mathematician. Although he did not use a weapon, he saved millions of people during the war. Thanks to his work, World War II lasted a few years shorter. He certainly could have been a hero had it not been for the fact that... his occupation was secret! It also didn't help that others took credit for his work.

Between World War I and World War II, the Polish intelligence had a lot of work to do. Germany, breaking the Treaty of Versailles, secretly expanded its army. The number of German orders and reports grew exponentially. At the same time, Germans started to encode them in a new, previously unknown way. Modern cryptology was based on advanced mathematics: calculus of probability and operations on permutations. A team of talented mathematicians was needed to find out what was going on behind the western border.

The Impossible Does Not Exist

In 1929, the General Staff of the Polish Army officers admitted over twenty students of the Institute of Mathematics of the Poznań University to a secret military cryptology course. Why exactly from this particular university? The students coming from Prussian partitioned Poland, knew the German language, as they had to learn it at school. The ability to speak it was crucial. Marian Rejewski, Jerzy Różycki, and Henryk Zygalski stood out among the students. Rejewski, born in 1905 in Bydgoszcz, was a senior student. All three excelled in passing the tests, while fulfilling their duties at the university. After graduation, Rejewski started working at the Cipher Bureau of the General Staff of the Polish Army. Everyone treated him and his colleagues as ordinary university employees. Little they knew, that they went to the basement of the City Headquarters to the so-called "black office," where they could work on ciphers at any time, of day or night.


I LIKED MATH AND IT HELPED ME DECIPHER CODES.
I CONSTRUCTED A BOMB, IT DID NOT EXPLODE, BUT MADE CALCULATIONS.
AFTER THE WAR, I WAS STILL BOUND BY SECRECY, SO FOR ALMOST 30 YEARS NOONE KNEW ABOUT MY SECRET JOB.

This unit ceased its activity two years later, and the most talented ones, including Marian, were sent to work in the Warsaw Cipher Bureau. Here they had to face their greatest adversary. The Enigma (Greek: riddle) was manufactured for the civilian market to encrypt business correspondence. However, it was quickly adapted and improved by the German army. There were many of these machines. If all of them used the same settings, each one could decode a message from another. An operator who wanted to encrypt a message, would press the keys with the appropriate letters one by one. Through a combination of electrical wiring and mechanical rotors, the letters replacing the original ones were illuminated. At first glance, the cipher looked utterly random and breaking it seemed impossible to Western intelligence.

Race Against Time

Rejewski understood the general mechanics of the machine. He knew that it consisted of mechanical elements, many gears, and electric elements. The first rotor had the alphabet letters written around the dial face, with metal elements allowing electricity to flow. Pressing keys caused the rotors to turn and illuminate specific letters. An average person would see only a coincidence in this game; Polish mathematicians thought differently. As if that was not enough, the Germans protected themselves even more, and every day they changed the so-called: daily code. In the morning, all the units received information about the rotors' initial positions. As a result, all machines spoke the same language. In practice, it meant that the code was partially changed every day and had to be broken anew!

A few years before the start of World War II, the Polish military organized, for students of mathematics, a secret cryptology course. Marian Rejewski stood out thanks to his great knowledge and intelligence.

When breaking new ciphers, they started looking for something characteristic in the messages – some repetitions or a stable structure. It turned out that each Enigma operator had to repeat any three letters twice at the beginning of a message. Knowing this, the Poles looked for a connection between the encoding of the characters. Having many messages, they could decode all the letters, but they had to hurry. The next day the daily codes were different. An actual race against time. The ciphers themselves were helpful, because out of laziness, they chose combinations of consecutive letters or the initials or names of their beloved ones. Thanks to that, the Enigma's cipher was broken for the first time on New Year's Eve 1932.

Lazy ciphers were punished as their superiors knew well that taking shortcuts was a simple way to break ciphers. It was a real test of strength in remote intelligence centers. Mathematicians in Warsaw

decided to act "lavishly." Rejewski invented the cyclometer, a device that searched all possible rotors' settings. As a result, in the morning, the daily code was deciphered in less than 20 minutes. In response, the Germans improved the entire communication system by changing the message format, the initial coding, and the frequency of rotor changes. It was then that Rejewski decided to construct a bomb. Yet, not the one with explosive material! The bomb was a system of six copies of Enigma looking for dependencies in encrypted messages and finding the correct keys. Cryptologists in this period did titanic work, invented many methods of breaking ciphers, and developed several new mathematical theories.

When the work of constantly breaking ciphers consumed more and more money, it was decided to transfer invaluable decryption methods to English and French intelligence. Rejewski was not allowed to pursue his work.

Unused Talent

Unfortunately, at some point, the Polish intelligence service could not afford further work. The invaluable decryption methods and the complete documentation were to be handed to the English and French intelligence.

After the outbreak of World War II, the entire Cipher Bureau had to evacuate to Romania. Rejewski and his friends made their way to France, where they worked on decrypting ciphers of machines other than the Enigma.

After World War II broke out, the whole Cipher Bureau had to evacuate to Romania. Rejewski and his friends made their way to France, where they worked on the decryption of cipher machines other than the Enigma. After their station was compromised, the friends decided to evacuate in groups of several people. Rejewski and Zygalski wandered all over Europe until they reached Great Britain, where they surrendered under the orders of the Polish army. The third of their friends, Jerzy Różycki, died in the turmoil of war. In England, the work on the Enigma was in full swing, but it had the strictest secrecy clause. Poles were not allowed to work on it. After the war, the English took all the credit for breaking German ciphers. Rejewski was released from service and could return to Poland where his wife and children were waiting for him. He worked as a physical worker, and nobody knew about his role in solving the greatest secret of World War II. In 1973, the British declassified the information of breaking the Enigma code by the Poles. Only then could Rejewski start writing articles and memoirs on this subject.

Henryk Arctowski
(1871–1958)

Henryk Artcowski was a polar explorer who studied the mysteries of unexplored Antarctica. He was also a pioneer of climatology. His name can be found in scientific works and in several places on the world map. In addition, he was a Renaissance man, an expert in many fields, who showed incredible fortitude. Above all, he was an extremely hard-working and resourceful person. When he saw some obstacles in front of him, he did not slow down, but started to run to jump over them.

Henryk Arctowski was born in Warsaw in 1871. As a child, he was called Artzt, because his ancestors had moved to Poland from Württemberg two centuries earlier. The future Antarctic explorer was initially educated at home, where he mastered the German and French languages. When he was ten years old, his parents enrolled him in the gymnasium in Inowrocław. The town where the school was situated was then under Prussian rule, so young Henryk could speak the first of the foreign languages he had learned. Perhaps the trip from Warsaw to Inowrocław awakened the passion for travel. Unfortunately, his teachers in the junior high school in Inowrocław did not like Henryk's patriotic views. He spent only three years in school, because due to the harassment he was subjected to, his parents transferred him to a school in Belgium.

Henryk Arctowski (although his surname was still Artzt) graduated from high school in Belgium and began his first studies. For his following studies, he went to France. In Belgium, he studied astronomy, but his relatives urged him to change the field. They thought that astronomy was impractical. Henryk began to study chemistry with geochemistry, petrography, and mineralogy. He also studied geology. He explored all these subjects at the Sorbonne University in Paris, the Natural History Museum, the College de France, and the School of Mines.


I WAS A GEOGRAPHER, METEOROLOGIST, GEOPHYSICIST, GLACIOLOGIST, AND THE AUTHOR OF SEVERAL HUNDRED PUBLICATIONS CONCERNING POLAR REGIONS.
THE POLISH RESEARCH STATION IN ANTARCTICA, THREE MOUNTAINS, A GLACIER, A PENINSULA, AND A BAY, BEAR MY NAME.
I WAS THE AUTHOR OF REPORTS ON POLAND FOR THE AMERICAN DELEGATION AT THE VERSAILLES CONFERENCE.

A Smart Tough Guy

From France, he returned to Liège and was hired at the university at the age of 22. In those days, it was an outstanding achievement (which has not changed to this day). He began to use the name Arctowski, because he wanted to sign his scientific papers "in Polish." Within two years, he published about 20 of them. Despite excellent results at the university, he resigned from his stable job. He was persuaded to take part in the famous Belgian Antarctic Expedition, of which he also became the scientific director. Adrien de Gerlache de Gomery, a naval officer, convinced him to join the expedition. Before Arctowski set off into the unknown, he visited outstanding specialists in England, Belgium, and Switzerland. He expanded his knowledge of geology, oceanology, meteorology, and glaciology. Rich in new knowledge and skills, he finally set sail with his crew – literally – into the unknown. Those parts of the world were practically unexplored. Among several scientists on board, there was also another Pole – Antoni Bolesław Dobrowolski. His task was to deal with precise meteorological observations of clouds and snow crystals.

Due to anti-Polish repressions, parents of the future scientist sent him to school in Belgium. There he finished high school and went to university.

The ship they sailed on was called "Belgica." It was a small sailing ship and, due to limited funds, had already been used before. Despite this inconvenience, it had everything they needed: plenty of space to work and a little place to rest. After all, they sailed there not as tourists, but to explore the most extensive unexplored area of the world. The crew members shared the workload. Arctowski became the ship's meteorologist, glaciologist, and oceanographer.

The journey was not an easy one. By the time they reached their destination, one crew member had died. They had also survived a storm and encountered underwater rocks. Unfortunately, the worst was still ahead of them – the ship was trapped in a field of ice for a long 13 months! At first, the expedition members tried to free themselves, but eventually gave up. This does not mean that they did not move – the ship, along with the krill, drifted and traveled quite a distance. Another member of the team died, but scientific research and observations were not interrupted even for a moment. It was a tremendous effort. The ship's crew functioned in conditions of perpetual darkness during the polar nights and at significant risk to their health from scurvy. Outside, the temperature was –45°C. Before the Belgica, no ship had ever wintered in the Antarctic ice. As the temperature rose, there was a chance to get the ship out of the ice. For the entire five weeks, in addition to conducting scientific research, the crew worked physically to carve

As a very young man, he was employed at the university, but quite quickly he gave it up to take part in the amazing Belgian Antarctic Expedition.

a channel in the ice, for the ship to get out of the field of ice wheels. The expedition was groundbreaking, but not just because of the stories that happened there. Most importantly, the crew made many observations and collected data that served as a prelude to further research.

Off the coast of the ice continent, they had to face nature. Their ship was trapped in a field of orifice for 13 months!

What We Owe Him

After returning from the expedition, Arctowski gave up geological research. He got a position at the Royal Meteorological Observatory in Uccle. Although it was a modest post of an assistant, Henryk had good conditions there to examine the results of the expedition, especially concerning the weather phenomena. The findings were published in 10 volumes under the common title *Expedition Antarctique Belge*.

Even then, the Polish researcher devoted most of his time to studying the climate of the planet. He even became the head of the meteorological station. The climate was his great interest until the end of his life. Eager for scientific adventures, he planned another expedition to the Arctic regions, but could not find the money for it. He sailed on a shorter trip to Spitsbergen and Lofoten. After returning, he moved to America. He worked in the New York Public Library, where he served as the natural history department director. Later, he returned to Poland to work at the Jan Kazimierz University in Lviv. He thought that he had returned to a free Poland permanently. However, in August 1939, he and his wife left for a congress in the United States. While he was overseas, World War II broke out in Europe, which kept the Arctowskis in America for the rest of their lives. They left everything in Poland. They had to start a new life with what they took with them on their short trip. Henryk, an internationally respected scientist, took a job at the Smithsonian Institution, where he worked until his retirement. Even then, he pursued his passion and was scientifically active.

For more than 2 years Arctowski and a group of scientists sailed the South Seas. It was a time full of dangers, but also scientific discoveries.

Although it is difficult to count the fields in which Henryk Arctowski was scientifically engaged, he is best known for his discoveries of the Belgian Antarctic Expedition, which lasted more than two years. Three out of ten volumes of the great work published after the expedition, mainly presented our compatriot's discoveries. The

remaining seven volumes presented the research and observations of other crew members. The volumes written by Arctowski included year-round meteorological observations, including hourly cloud observations. He also described his conclusions about the temperature of Antarctica. He found that it was lower than previously thought. Arctowski also found out why part of the continent, that flooded by shallow waters, lay about 400 m deeper than assumed. He saw the reason in the pressure of vast amounts of ice. In addition, he described the theory of the movement of cyclones. These, depending on the hemisphere, move clockwise or counterclockwise. He also made a map that showed the depth of selected Antarctic seas.

In the scientific career of Arctowski, climate research occupied the most important place. As one of the first people, he observed the influence of solar activity on the Earth's climate and weather.

Today, climate research is conducted in hundreds of scientific institutes and at almost every university in the world. When Henry Arctowski conducted it, the climate was studied by only a few. Yet his team analyzed climate change for nearly every area in the world. Arctowski was able to create a kind of a jigsaw puzzle of interconnected facts. He knew that there was a connection between climatic phenomena happening in both hemispheres. In addition, he was one of the first to see the effect of what was happening on the Sun, on weather and climate change. He also wrote several papers on the geophysics of the Sun. These included studies linking the location of sunspots to magnetic storms. He was also interested in the effects of observed changes on agriculture. His research also contributed to the development of weather forecasting. He held important positions in the International Commission on Climate Change, eventually becoming its chairman.

While working in Poland, he compiled a collection of articles on climate change. He put them in a historical aspect. The first volume published in Lviv had 4150 items. He worked on subsequent volumes in the United States.

Scientist and Patriot

Arctowski was a great scientist, an excellent manager and organizer, able to plan and carry out extensive research programs, also internationally. He introduced innovative solutions and plans, and presented them at congresses in Washington or Brussels. That is where he suggested the first international exploration of Antarctica. Moreover, he sketched a plan of an expedition across the South Pole. He even developed a plan of meteorological stations which could be built there. He was the first to propose the construction of a Polish research station on Spitsbergen.

He lived abroad, but Polish affairs were always on his mind. During World War I, he volunteered to work in the Commission for Peace, which was just established.

Within its structures, he was active in the Commission for Polish Affairs. There he co-wrote a 2,500-page report on such things as demography, geology, and Poland's natural resources. This document was used when establishing the borders of our country. As a member of the commission, he was invited to the Versailles Peace Conference in 1919–1920, where he cooperated actively with the Polish delegation debating the fate of Europe. When he returned to independent Poland, he was offered the post of the Minister of Education. Henryk Arctowski chose scientific work at the Jan Kazimierz University in Lviv. The department was quickly transformed into the Institute of Geophysics and Meteorology. When the war surprised him in the United States, together with his wife, a well-known singer Arian Jeany Addy, he ran charitable campaigns to help Poland. After the war ended, he helped domestic explorers educate themselves and buy necessary literature.

During World War I, Arctowski worked in the United States, compiling data on the demography and geology of Poland, among other thigns. These reports were the basis for the development of the American position for the Peace Conference in Versailles.

After Poland regained its independence, Arctowski was offered the position of the Minister of Education. He, however, preferred scientific work at the Jan Kazimierz University in Lviv.

Henryk Arctowski published over 400 scientific papers. Many of them gave rise to new fields of science. In recognition of his contributions, the Polish Antarctic Station, which is located on Admiralty Bay on King George Island in Antarctica, was named after him. The station was commissioned in 1977, is year-round, and consists of several buildings. In addition, many places in the polar regions that he tamed for world science, hold Arctowski's name. In Antarctica, we can find Arctowski's peninsula, peak, or nunataks. On the other side of the globe, in Spitsbergen, we have a mountain and glacier dedicated to our discoverer. It can be said, that the names of all these places are the fulfillment of the dream of our polar explorer, who, by changing his name, hoped that Poland would be present in world science.

Hilary Koprowski
(1916–2013)

It's interesting that according to the stereotype, scientists are dull and spend their lives almost entirely in the laboratory. In reality, their life stories are complex and full of surprising twists and turns. A prime example is Hilary Koprowski, the man who created the vaccine against polio.

Hilary Koprowski was born in 1916 in Warsaw. Although he graduated from the Warsaw Medical University, he wanted to dedicate himself to music. He also graduated from the music conservatory, and just before the war, he went to Rome for further music studies. Next, he sailed to Brazil, where he made a living by giving piano lessons and concerts. His life changed after a conicidental meeting on a beach in Rio De Janeiro. He saw a friend with whom he had studied medicine in Poland. He convinced him to take up science. His arguments must have been strong because soon, Koprowski moved to the USA and started working in a laboratory. At first, he researched rats. These animals infected with the poliovirus, did not show any symptoms of poliomyelitis. Koprowski took sections of brain tissue from infected animals and then, after appropriate processing, injected them into other rats. He repeated this procedure many times to finally isolate a relatively weakened poliovirus.

An effective vaccine against the poliovirus was developed in 1950. The first large-scale vaccination occurred a few years later in the Congo. More than 200,000 children were vaccinated within a few weeks. The vaccine was convenient, because it was administered orally.

Damaging Gossip

In 1992, "Roling Stone" magazine published an article whose author claimed that Hilary Koprowski, a world-class virologist and immunologist, was responsible for the development of the AIDS epidemic in Africa. The production of vaccines against the poliovirus was supposedly based


I WAS A DOCTOR AND A VIROLOGIST, BUT I WAS ALSO A GOOD PIANIST. BEFORE I IMMERSED MYSELF IN SCIENCE, I COMPOSED AND GAVE CONCERTS.
I DEVELOPED A VACCINE AGAINST THE POLIO VIRUS, BUT I ALSO PARTICIPATED IN THE DEVELOPMENT OF VACCINES AGAINST RABIES THE YELLOW FEVER.
WHILE WORKING IN THE USA, I OBTAINED 9 MILLION DOSES OF THE POLIO VACCINE AND SENT IT TO THE EPIDEMIC-STRICKEN POLAND.

He was destined to become a musician and began his professional life by touring. It was not until a coincidental meeting that occurred on a beach in Rio de Janeiro, Brazil, that he started his research.

on the biological material of chimpanzees that carried HIV. By administering the vaccine to humans, the virus was supposed to enter the human body. The "Rolling Stone" is not a science magazine, but a music magazine. Yet, the information quickly spread around the world. It was quickly proven to be false, but it didn't matter much. There was even a documentary film made in France called *Has the world gone mad? Where did AIDS come from?* By then, it was clear that Koprowski's vaccine had nothing to do with AIDS. "In Nature and Science", three independent teams of scientists published papers that confirmed this. Nevertheless, to this day, you can still find claims that vaccines caused AIDS.

Disease and Vaccination

The poliovirus causes inflammation of the so-called anterior horns of the spinal cord. The disease was described independently by two researchers, Jakob Heine and Karl Medin. Hence the name Heine-Medin disease. The virus usually enters the body through food. Usually when a child drinks dirty water, for example, while swimming in a lake or pool. Receptors for the virus are present in many different cells. Still, the virus is particularly keen to attack cells in the nervous system, specifically cells in the spinal cord. That causes nerve paralysis and muscle flaccidity. People struck by the virus moved around on crutches or in wheelchairs. When the virus attacked the brain, it usually ended in the child's death. But it could also attack the respiratory muscles. The person in whom this occurred, would suffocate, because of the impossibility to catch a breath. The chest would stop working and the lungs would follow. In fact, the only way to prevent this from happening was to use the so-called "iron lungs" (chambers in which a child would stay and only the head would stuck out). When the pressure inside the sealed chamber decreased, the air was sucked into the lungs through the minor patient's mouth and nose. Usually, the child spent several weeks in the iron lungs, but the cases of permanent paralysis still happened.

By studying rats, he developed the world's first vaccine against the polio virus, which caused poliomyelitis. Its victims, mainly children, fell as the virus caused paralysis.

When mass vaccinations were taking place in Congo, an epidemic of this disease broke out in Poland. Since the beginning of the 1950s, more and more children had fallen ill with polio. At the end of the 1950s, the scale of annual infections amounted to six thousand cases. Koprowski, already a big name in the virology and immunology world, obtained nine million doses of the vaccine from the company producing it and sent them to Poland for free. In the first year after the vaccine was administered,

the number of new polio cases dropped from 6,000 to 1,000, and two years later to a few dozen cases. At the same time, child fatalities dropped from several hundred cases, to just two.

Before the invention of the vaccine, several hundred thousand children contracted polio each year. In rich countries, vaccinations began to be introduced in the late 1950s. Their effects, i.e., a rapid decrease in reported cases, appeared almost immediately.

In African and Asian countries, regular vaccination began only in the early 1980s. The entire 1980s and early 1990s saw a rapid decline in the number of infections. However, it was not Koprowski's vaccine that was used, but an improved vaccine by Albert Sabin, a Pole born in Białystok and, like Koprowski, working in the USA.

He was professionally active until the end of his life. He wrote more than 850 scientific papers and co-developed vaccines for rabies and the yellow fever. He also conducted research on cancer and multiple sclerosis.

The vaccine had proven to be extremely effective. In the first year after the vaccine was administered, the number of new cases of polio dropped from 6,000 to 1,000, and 2 years later to a few dozen cases. At the same time, the number of child fatalities dropped from several hundred cases, to just two.

Human

Today, individual cases of the disease are recorded worldwide. Officially, Europe has been free of the poliovirus since 2001. Thanks to the vaccine sent by Hilary Koprowski, Poland was one of the first countries in Europe, where polio was not present.

Hilary Koprowski directed the Institute of Biotechnology and Advanced Molecular Medicine and the Center for Neurovirology at the Thomas Jefferson University in Philadelphia, almost until his death. He also established a foundation that helped young Polish scientists. Koprowski authored more than 850 scientific papers and contributed to the development of vaccines for rabies and the yellow fever. He conducted research on cancer, multiple sclerosis, and the impact of GMOs on living organisms. He continued to compose until his old age. He was an excellent pianist and reportedly more likely to employ scientists who could play some instruments. When he was asked about the recipe for a long life in his nineties, he replied that the key things were swimming and moderation in eating. Hilary Koprowski died in 2013 in the USA.

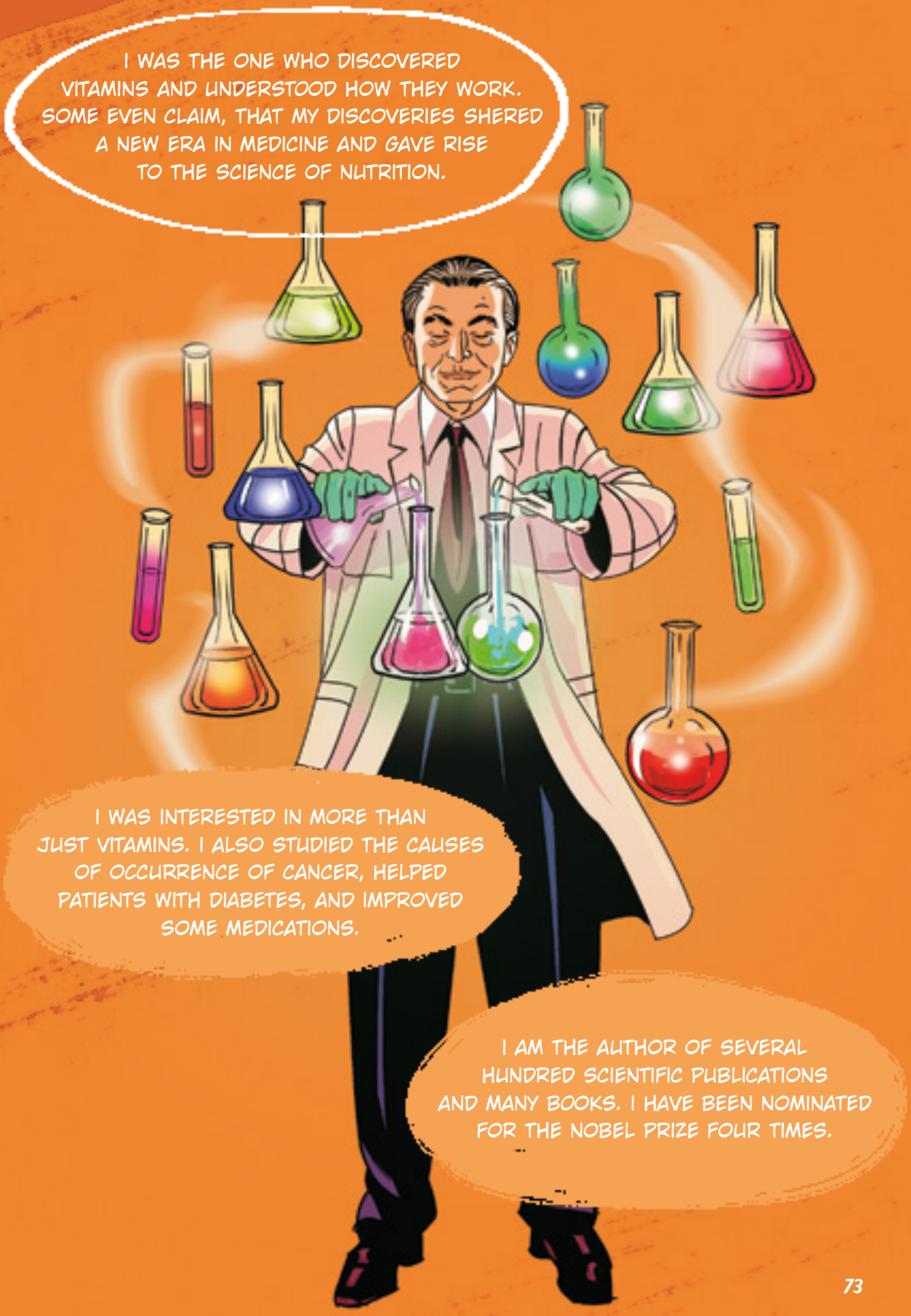
Kazimierz Funk
(1884–1967)

If not for him, we might not have known some of the fundamental substances for our health. Even if we did, we would most likely know them under other names: nutramine, dietary hormone, or auxiliary food factor. Kazimierz Funk is the discoverer of vitamins. He also coined the term, which is used today by the whole world. Thanks to the discoverer's determination, a new era of medicine began, giving rise to the science of nutrition.

Scholarly Traveler

Kazimierz was born in Warsaw, on February 23, 1884, into a medical family. His father, Jakub, a dermatologist, practiced medicine and conducted clinical research. His mother, Gustawa, also a doctor by training, gave up her professional career to care for the home. However, his parents did not instill in him a passion for science. He caught it in a hospital near Augsburg, Germany. It happened during treatment of his congenital hip defect – hip dysplasia. Upon returning home, he spoke excellent German.

The trip was a sign of what his future life might look like. The language skills he had acquired earlier, came to be helpful. At the age of 16, after graduating from high school in Warsaw, he went to Geneva to study biology. Then he moved to Brno, where he studied chemistry. He defended his doctorate at the age of 20. Obtaining the diploma was not the end, but the beginning of a scientific journey – fascinating but not always easy.


I WAS THE ONE WHO DISCOVERED VITAMINS AND UNDERSTOOD HOW THEY WORK. SOME EVEN CLAIM, THAT MY DISCOVERIES SHERED A NEW ERA IN MEDICINE AND GAVE RISE TO THE SCIENCE OF NUTRITION.
I WAS INTERESTED IN MORE THAN JUST VITAMINS. I ALSO STUDIED THE CAUSES OF OCCURRENCE OF CANCER, HELPED PATIENTS WITH DIABETES, AND IMPROVED SOME MEDICATIONS.
I AM THE AUTHOR OF SEVERAL HUNDRED SCIENTIFIC PUBLICATIONS AND MANY BOOKS. I HAVE BEEN NOMINATED FOR THE NOBEL PRIZE FOUR TIMES.

Detail and Determination

He changed his place of residence 8 times, moving to New York, Berlin, London and Warsaw. He was constantly looking for better conditions to develop his passion – biochemistry.

Even his first research works showed that Kazimierz looked at the objects of study differently from others. His insight meant that, unlike chemists, he did not see trace elements as contaminants, but as vital components. When he focused on cancer, he came up with a theory of how it occurs. He saw food as the cause. He said that food contains two types of chemical compounds – one promoting cancer development; the other inhibiting it. If the latter is lacking, the disease develops. Unfortunately, he did not develop his concept. Today, we already know that many factors affect cancer development, including those that have nothing to do with food. Well, even great scientists make mistakes. Despite his various scientific interests, his primary focus was nutrition. In his research on the diet of dogs, he noticed that in addition to fats, proteins, sugars, and minerals, there were other substances necessary for the proper development of the body. Unfortunately, he could not continue his research due to a conflict with one scientist, who continually challenged his findings and research methods. He discovered the missing puzzle – vitamins – while working in London. In addition to being focused on details, he was also a determined scientist. Thanks to his determination, with little financial resources and at the expense of his own health, he developed Polish diabetology, dealing with the production of insulin. He modernized the formulation of several medicines already in use, but above all, he laid the foundations for a new science of vitamins.

Vitamin, Not a Bacterium

In 1910, while staying in London, he began his groundbreaking research related to beriberi – a disease that causes, among other things, muscle atrophy and memory disorders. In those days, contracting the disease was often fatal and posed a significant problem in tropical regions — the disease affected many people, mainly in large port cities where white rice was the primary source of nutrition. Brown rice could not be stored in high humidity. Besides, it was considered not very tasty.

Encouraged by Charles J. Martin, director of the Institute of Preventive Medicine, Funk set about researching rejected rice bran. The director was probably familiar with the results of Christian Eijkman's research, who noted that there was an anti-beriberi substance in the discarded husk. According to Martin, it was a type of amino acid. Since Funk had already worked with such molecules while in Paris, he was competent to begin the research. The preliminary results showed that his boss was wrong. According to Funk, the missing

substance isolated from rice bran contained nitrogen, but it was not an amino acid. Looking at its chemical properties, he concluded that it belonged to a group of compounds called amines. Because he was aware of its essential role in life (Latin: *vita*), he called it a vitamin. This idea, however, did not attract the authorities of the institute. They disregarded the name and gave a completely different emphasis to the works written by Kazimierz.

Prior to the discovery of the first vitamin, Funk studied the causes of cancer. In his opinion the reason was supposed to be – improper nutrition. Today we know that factors influencing the development of cancer are many, including some that have nothing to do with food.

The word vitamin entered Funk's scientific work only in 1912. It was made possible by another prominent Pole – Ludwik Rajchman – head of the Bacteriology Department at the Royal Institute of Public Health in London. He was, among other things, the publisher of one of the scientific journals. Since the published work was not experimental, but a review, he did not have to ask his superiors for their opinion on its content. As a result, he was able to describe everything in the paper in a way he wanted. He included the story of discovering and isolating a new substance curing beriberi and other known compounds of vitamin nature. Most important, in retrospect, was the hypothesis that a proper diet is essential in preventing many diseases such as rickets, pellagra, and scurvy.

Convincing the scientific community to the new view, was not easy. The idea that deficiencies of these "new" compounds in the diet could cause disease, was difficult to accept. In the scientific world at the time, there was a "fashion for bacteria," and many scientists, inspired by the groundbreaking discoveries of Robert Koch or Ludwig Pasteur, looked everywhere for the role of microorganisms. The fact that Funk had not isolated a pure form of the vitamin, was also a problem. However, as time went on, publications on vitamins became more numerous. It was also possible to learn the structure of the compound that was called vitamin B1, or thiamine. The progress of work in the field of vitamins is clear from the bibliography of books published by Funk. The first contained 385 papers. The next one, published eight years later, was already based on 1595 publications.

Healthy Future

Kazimierz Funk did not want to close the achievements of science in the drawers of his office. When opening the door to a new, large field of research on vitamins and their role in maintaining human health, he understood that this knowledge had to be implemented in practice. He was aware that a proper diet supported by exercise and new scientific discoveries, would protect people from many diseases. Kazimierz Funk's scientific achievements are of great value also in our times. Can we imagine modern life without vitamins and a healthy lifestyle?

Maria Czaplicka
(1886–1921)

Her life was as turbulent and unusual, as the subjects she was interested in. She studied ghosts and shamans. She traveled, took pictures, wrote books, learned customs and languages. She brought to life a world that remained abstract and magical for the "Western man."

She was born in Warsaw, but she went to Great Britain to study thanks to a scholarship. First in London and then at Oxford, she studied geography and anthropology. There, she won a scholarship that enabled her to finance her first expedition to Siberia. It certainly helped that she spoke Russian fluently. After this expedition, she wrote her first book. It became very popular, because of her simple language and its subject. The Siberian people had not been in the scope of interest before, certainly not by someone who could understand them. She decided to organize a second expedition to Siberia. Some members of the second expedition returned ahead of schedule, unable to withstand the extreme weather conditions and the journey's hardships. Maria Czaplicka, however, continued her efforts. She brought back many notes and hundreds of photos from her travels. She studied the customs, but also the people themselves. After compiling the materials she collected during the second Siberian expedition, she was offered to chair the Department of Anthropology at Oxford University as the first woman ever. She studied Eastern Europe and Siberia, but was mainly interested in shamanism and the cult of spirits. She explored the subject from all perspectives: customs, legends, psychology, and sociology.


I WAS THE FIRST RESEARCHER OF THE CULT OF SPIRITS AND SHAMANISM IN SIBERIA.
I RESEARCHED CUSTOMS. I WAS THE AUTHOR OF BOOKS AND HUNDREDS OF PHOTOGRAPHS OF SIBERIAN PEOPLE.
I WAS THE SECOND EUROPEAN TO RECEIVE A DOCTORATE IN ANTHROPOLOGY AND TAUGHT AT MANY OF THE WORLD'S UNIVERSITIES.

She conducted scientific work and supported organizations that fought for Polish independence. She was one of the female members of the British Royal Geographical Society and the Royal Anthropological Society. She received offers to lecture at various world universities and received several scholarships and awards. However, it was difficult for her to find a permanent job. It was not because of her incompetency, but gender and eccentric behavior. As a result of a nervous breakdown, she committed suicide at the age of 35. In her will, she wished that all her notes and souvenirs go to Henry Hall – her friend, colleague, and traveling companion.

After her first trip to Siberia, Maria Czaplicka published a book that became very popular. It focused on the people of Siberia.

Restless Spirit

She was a restless spirit, constantly searching and feeling nowhere at home. She fought for equal rights for women and supported Poland's quest for independen100ce. Later, she actually became an ambassador for Poland. As a well-known person, she wrote articles and gave interviews about her country of origin. When the western press made negative comments about Poland, she often spoke out strongly in its defense.

Her excursions to Siberia featured extremely difficult conditions. It was so difficult for the participants of the expeditions, that some of them had to return home before completing the research.

She was hungry for knowledge, first – while still living in Warsaw – at illegal schools, then at foreign universities. She was bored with working in the study room and library. Maria wanted to gain knowledge in practice, hence her long expeditions to the east, to places that no one visited then. She conducted interviews, took notes on her observations, photographed, and collected exhibits, she later presented during her lectures in Great Britain or the USA. In those days, what Czaplicka described and showed, seemed like sharing experiences from another world. She wrote a lot and her books were very popular. Yes, they were well written, but most of all, they were authentic and unapologetic.

Maria Czaplicka was the first woman ever to be offered the chair of the Department of Anthropology at the University of Oxford.

Stefan Drzewiecki
(1844–1938)

When in 1870 Juliusz Verne wrote *Twenty Thousand Leagues Under the Sea*, he didn't expect that the Polish Captain Nemo would start his first underwater voyage just a few years later. That man was Stefan Drzewiecki, constructor and scientist, inventor, and a man who did not understand the notion of "impossible."

Taximeter

He was quite a rascal. Rumor has it that he loved to play tricks on his teachers. And although he passed his high school exams very well, he did not receive his diploma. That, unfortunately, closed his path to university. But Stefan was not discouraged. He began studying at a prestigious technical school. His schoolmate was Gustave Eiffel, later the famous engineer and constructor of the Eiffel Tower. It was during this period that Stefan experienced a very turbulent episode. When the January Uprising broke out in Poland, as a patriot, he came to the country to join the fight. He arrived too late and could only see the tragic end of the uprising. Upon returning to France, he took part in the Paris Commune, a revolutionary uprising by the people of Paris. After its defeat, he moved to Vienna. The Universal Exhibition was coming up, and it would host scientific and technical achievements.

By this time, he had already made several constructions. He patented his first invention in 1867, when he was 23 years old. It was a taximeter. Before his invention, a carriage driver could demand any payment from a passenger. Drzewiecki invented a "counter" showing kilometers traveled. Today, every cab is equipped with such a device. The following inventions were related to railroads. He developed an instrument to measure the speed of a steam locomotive and a machine for connecting wagons. These inventions were awarded at the Vienna Exhibition.


MY FIRST INVENTION WAS A DEVICE THAT CALCULATED THE DISTANCE A HORSE CARRIAGE WOULD DRIVE. TODAY, EVERY TAXI IN THE WORLD IS EQUIPPED WITH THAT DEVICE.
I BUILT THE FIRST SUBMARINE WITH ELECTRIC ATTERY-POWERED PROPULSION. IT WAS SO EFFECTIVE, THAT IT BECAME A PERMANENT ITEM OF THE NAVY'S EQUIPMENT.
MY CALCULATIONS ALLOWED FOR THE CONSTRUCTION OF THE FIRST PLANES.

Neptune's Gift

He constructed a device that automatically drew a map of the path of a sailing ship. In those days it was a true innovation, which was immediately purchased by the Russian navy.

The railroad was not the only thing that interested Drzewiecki. Back then, nobody dreamt about the GPS (the Global Positioning System) The ship's position and its route on the map had to be marked manually, by the officer on watch. It required skill and attention, so mistakes were quite common. Drzewiecki constructed a device that automatically drew the ship's route using a compass, which he called a dromograph.

When Stefan was presenting his invention at the world exhibition, Prince Constantine, brother of Alexander II, Tsar of Russia, noticed it. The prince was so impressed with the work of the young engineer, that he offered him a well-paid scholarship. The improved dromographs were soon used on warships participating in the war with Turkey.

Drzewiecki's greatest fame was as a pioneer of submarine navigation. He was the first to build a submarine with electric battery-powered propulsion. It was far from today's submarines, but you had to start somewhere. The ship had room for one crewman, who pedaled the propeller. Practicality was added by a pair of rubber gloves sticking out of the hull, which could be used to mount mines under enemy ships. Subsequent versions were more extensive and could already serve four people. They also used a periscope. The periscope was constructed in the 17th century by an astronomer called Jan Hevelius (you can read about him in this book). It was Drzewiecki who came up with the idea of using it in submarine navigation. Drzewiecki personally demonstrated his improved design in 1881, on a lake near Gatchina. Tsar Alexander III and his wife watched the maneuvers. It is said, that after launching his boat, Drzewiecki went out and presented a bouquet of Tsarina's favorite orchids, saying: "here is a gift from Neptune for Your Highness."

When he moved to France in 1892, Russia already had an entire submarine fleet of about 50 vessels, which testified to its power in those days. Indeed, the Pole could already be considered an expert in submarines. In a competition of the French Ministry of the Navy, he received an award for designing a submarine with built-in torpedo launchers powered by compressed air. The ship had a hybrid propulsion system – when afloat, it operated on steam propulsion, while underwater, it used electric propulsion. The largest submarine designed and built by Drzewiecki, had a displacement of 350 tons.

Propellers, Screws and... Birds

Once he fulfilled his dream of swimming like a fish, he decided to learn to fly like a bird. Despite appearances, these are very similar subjects from the perspective of physics. Drzewiecki became interested in

aviation, studying bird flight and developing a theory of gliding flight. No wonder, at the end of the 19th century, it was a very catchy topic, literally and figuratively. He published several interesting papers in which he described birds as living aircrafts and explained their ability to glide against the wind. Unlike some scholars, he came to the correct conclusion, that the ideas prevalent at the time about flapping winged machines, were not valid. His research focused on the operation of propellers in water and turbines in the air. He created the basis for the propeller theory, which was used by the Wright brothers, among others, when constructing the first airplanes.

He showed how to calculate the optimal shape and size of propellers. When he published a book on the theory of propeller drives, it became a must-read for all aeronautical engineers of the time.

Moreover, Drzewiecki prepared a manual on correctly calculating the optimal shape and size of propellers for a particular craft. It was an immense gift for engineers from all over the world, which they gladly used. All his research in this field was summarized in a book on the theory of propeller propulsion published in 1920, for which he received an award from the Academy of Sciences.

However, he did not limit himself to paperwork. He built an airframe called Canard, which means duck in French, with an innovative automatic stabilization during flight. In this way, he solved the problem of changing the machine's center of gravity by fuel consumption. Another of his inventions came in handy during the war. Aircraft-mounted generators made it possible to mount radio stations on board and transmit enemy positions to artillery units.

He wrote his last research paper at the age of 90. While living in Paris, he was eager to help Polish engineers. In his last will, he bequeathed the rights to his books and inventions to the Polish state.

Drzewiecki never rested on his laurels. Until the end of his life, he worked on new aviation ideas. Still, he was also interested in new inventions and technical innovations. He developed over 150 technical solutions. At the age of 90, he published a book on water turbine mills. He lived to be ninety-four years old. He was eager to help young enthusiasts of technology and science in implementing their ideas. He generously supported future Polish engineers. At the end of his life, he bequeathed all his works, books, and his laboratory to the Polish state.

Stanislaw Ulam
(1909–1984)

It is no exaggeration to say that the work of Stanisław Ulam, a brilliant Polish mathematician, made the technological developments, we now see, possible. But most often, his name is mentioned in the context of weapons, which were expected to end all military conflicts forever. For it was Stanisław Ulam, one of the greatest minds of the 20th century, who supported the American nuclear weapons program.

Discussions Instead of Exams

Stanisław's family was of Jewish descent. When he was five years old, World War I broke out. He survived it with his parents in Vienna. Upon his return to Lviv, he started school. Several coincidences caused him to become interested in mathematics. In his home library, he found the book *Elements of Algebra* by Eurler. He was intrigued by the unfamiliar signs and symbols. He tried hard to understand them, just as he tried to understand Einstein's *Special Theory of Relativity*, then widely described. At the age of fifteen, he began reading books by Wacław Sierpinski on differential calculus, group theory, and number theory. In 1927, he enrolled at the Lviv Technical University, wanting to become an engineer or a mechanic.

His talent was quickly recognized. He was invited to join the elite group of mathematicians forming at the so-called Lviv School of Mathematics. It was a breeding ground for talent. Ulam had the opportunity to discuss and exchange ideas with the most brilliant mathematicians of his time. He spent many hours in the famous Scottish Cafe talking to Stefan Banach, Stanisław Mazur, Kazimierz Kuratowski, and Hugo Steinhaus. One of these discussions, with snack breaks, extended to 17 hours!


WHEN I WAS A KID, I FOUND A MATH BOOK. I DECIDED TO DECIPHER ALL THESE MYSTERIOUS SYMBOLS.
I WROTE MY MA THESIS IN SIX HOURS! IT TOOK ONLY ONE YEAR TO FINISH MY PH.D. DISSERTATION.
I WANTED TO HELP END WORLD WAR II. TOGETHER WITH OTHER SCIENTIST I CONSTRUCTED THE ATOMIC BOMB.

He wrote his master's thesis, using his scientific papers, in just six hours! A year later, he had already defended his doctoral degree. He then traveled throughout Europe, listening to lectures and giving them himself at Austrian, French, and English universities.

His mathematical genius was used in the Manhattan Project, i.e. a project to build the American nuclear bomb which determined the outcome of the war.

After Hitler came to power in 1933, the situation for Jewish people in Europe became complicated. Ulam, therefore, accepted an invitation to Princeton in the USA, and after a year, he moved to Harvard. Just before the beginning of World War II, Stanisław managed to visit his family in Poland and take his teenage brother overseas with him. The trip saved the brothers' lives. Shortly after arriving in the United States, Stanisław learned about the bombing of Warsaw. Almost all of his family members were killed.

Mysterious Offer

Due to a family tragedy, Stanisław desperately wanted to get involved in the fight against Nazi Germany. He even volunteered for the army, but was not accepted due to his poor eyesight. He did not give up and kept asking his fellow scientists how he could help to defeat the aggressor. He received a letter from his older colleague, asking if he would like to get involved in a mysterious strategic scientific project that had something to do with the interior of stars. Stanislaw was instructed to come by train to the small station of Lamy, near Santa Fe, in the desert in the state of New Mexico. That's how he and his family found themselves in the secret laboratory at Los Alamos – the center of the American nuclear bomb program. It was a veritable hotbed of scientists. The Americans

He left Poland just before the outbreak of World War II. After arriving in the U.S. he learned of the bombing of Warsaw in which almost everyone in his family died.

brought here the most brilliant mathematicians and physicists, including a dozen Nobel Prize winners. They solved the theoretical and practical problems related to the bomb's construction, which was to determine the outcome of the bloody war. For Stanislaw, who had not been involved in physics until then, it was a new, but fascinating experience. It was there that Ulam entered the top elite of world science. His great talent for making valuable acquaintances with scientists in other fields of knowledge

was quickly recognized. It turned out that through lively discussions and unconventional approach to subjects – as he once did in the Lviv Scottish café – the entire team would come up with a solution to a problem. In 1945 two nuclear bombs fell on Japanese cities: Hiroshima and Nagasaki. Japan was brought to its knees and signed the surrender. Nevertheless, many scientists could not forgive themselves for having played a part in the tragedy of thousands of people. Others said that had the war continued, the number of casualties would be dramatically higher.

Eternal Thinker

After the war, he was one of the founders of the Orion Program, the development of nuclear propulsion technology for space rockets. He was also a key figure in the team building an even more powerful bomb than the nuclear – the hydrogen bomb. Its test explosions caused shock even among the military. The enormity of the destruction was so great, that large-scale deployment was abandoned.

He was the creator of the Orion, which is the construction of nuclear propulsion for space rockets, and one of the developers of the hydrogen bomb, which was never used in combat.

Ulam's career gained momentum. He became a professor at Harvard, was an advisor to President John Kennedy and served as a consultant to various committees and corporations, such as NASA and IBM. Despite his great success in the United States, he felt a great attachment to Poland. He tried to popularize the knowledge of the great Polish mathematicians Stefan Banach and Stanislaw Mazur.

On May 13, 1984, he suddenly fainted and died of a heart attack, just after returning from another trip. Until the last day of his life, he traveled around scientific centers in America and Europe, giving lectures, seminars, and colloquia. He was buried in Paris.

Once Klara Ulam, Stanisław's daughter, who was a few years old at that time, was asked if her father played football with her. She answered without hesitation, that he did not and "that her daddy would only think, think, and nothing but think". Ulam's contributions to science are unique and span into many fields. He wrote more than 150 publications on the probability theory, group theory, multiplicity theory, real number theory, and mathematical physics during his career. On the one hand, he was successful in Lviv in extremely abstract problems. On the other hand, he was the author of countless ideas and concepts that solved technical issues. He was one of those people, who introduced computer calculations into research. Among other things, he created the Monte Carlo method, which is still used today in many fields of science. There is absolutely no exaggeration in saying that the work of Stanislaw Ulam, a brilliant Polish mathematician, made the technological development that we see now possible.

Ignacy Mościcki
(1867–1946)

Mościcki was a scientist by passion, a president by accident, a patriot dedicated to Poland, who was passionate about the practical side of science. Thanks to his inventions and patents used all over the world, he gained international fame and recognition. His engineering sense was practical in organizing laboratories, companies, institutes and educating new specialists. He used it to raise the economy in post-war Poland.

Ignacy was born in Mierzanów in 1867. His grandfather, father, and two uncles, fought for their homeland. Since childhood, he had a flair for mathematics and science, but apparently, he did not like chemistry. Nevertheless, he chose to study it for practical reasons. Supposedly, he found a leaflet about dry wood distillation – a technological process that produces, among other things, charcoal and wood gas. He thought that since there were many trees on his family estate, this knowledge could prove helpful in the future.

He graduated from the Chemisty department in Riga, but did not defend his engineering thesis. As a wanted conspirator, he had to flee from the tsarist police. Together with his wife Michalina, he escaped to London through Berlin and Rotterdam. Unable to find a contract as a chemist, he took up many jobs: he produced kefir, worked as a carpenter, and decorated furniture. He also worked in a print shop, and only this job improved the family budget a little. However, Mościcki wanted to pursue his passions. Therefore, he visited the library and profounded his knowledge of chemistry. He also continued his patriotic activities.


I DID NOT MANAGE TO DEFEND MY ENGINEERING THESIS, BECAUSE I HAD TO FLEE ABROAD FROM THE TSARIST POLICE. THEY WERE LOOKING FOR ME, AS I WAS A KNOWN CONSPIRATOR.
IN THE LECTURES I GAVE AT THE UNIVERSITY, I PERFORMED SO MANY EXPERIMENTS, THAT EVEN STUDENTS FROM THE DEPARTMENT OF HUMANITIES JOINED.
I CAME UP WITH THE IDEA TO EXTRACT NITROGEN FROM THE AIR. IN DOING SO, I SAVED THE INDUSTRY FERTILIZERS AND CONTRIBUTED TO THE DEVELOPMENT OF MANY BRANCHES OF INDUSTRY.

Scientist

Thanks to the efforts of the Polish community in London, he was employed at the University of Freiburg. One of his tasks at work was to prepare demonstrations. His engineering sense came in very handy at this time, as he designed most of the teaching aids with his own hands. Impressive illustrations of physics lectures were so spectacular, that both his students and people studying humanities attended. He quickly developed as a scientist, and thanks to his inventions and patents, he gained wealth and scientific authority.

In 1926, Moscicki became the president of Poland. Józef Piłsudski had previously been elected to this position, but he was not interested in the presidency and did not accept the nomination. Looking for an alternative candidate, Mościcki was pointed out. Surprisingly, he agreed to run for office.

While he was working in Switzerland, the scientific world was electrified by the writing of a very famous chemist, William Crookes. He predicted that the deposits of saltpeter in Chile, an essential mineral fertilizer, would soon be exhausted. This genuinely frightened not only the food producers (who feared much smaller yields), but also the governments of many countries, who feared famine. Besides, nitric acid, an essential compound for many industries, was produced from saltpeter. Large quantities of vital nitrogen are present in the air we breathe. Unfortunately, nobody knew how to turn atmospheric nitrogen into nitric acid. Mościcki solved this problem – it brought him real fame and money.

Discoverer

His idea worked well on a small scale in a laboratory. Yet, when Mościcki began constructing installations on a large, industrial scale, he encountered several problems. The heart of the nitric acid installation was a colossal capacitor, but in Mościcki's days, there were no devices of such size. Many scientists would have given up at this point, but Mościcki decided to design and then build the missing elements of the installation. The capacitor that he created was unrivaled for the next 25 years. Thanks to the original design of the whole device, Mościcki was treated as a scientific genius. Mościcki's capacitors were part of chemical installations, protected power lines, and comprised radiotelegraph stations, such as the one installed on the Eiffel Tower. His research results were published in over 60 scientific papers and described in 40 patents used on a large scale. Although the most famous (and the most profitable) patents concerned capacitors and furnaces, Mościcki also created the non-steamable double glazing windows.

Even though Moscicki had no formal education, in recognition of his merits, the Imperial and Royal Polytechnic School in Lviv awarded him an honorary doctorate. Thanks to him, the future Polish president

could teach there as a professor. He created the Department of Electrochemistry and Physical Chemistry in Lviv, which he equipped with equipment from Switzerland. He lectured, educating future engineers. He also made his dream of a research institute, come true. While working in Lviv, he became interested in gas and oil extraction. He was the author of several fundamental technical solutions. He also managed the government-owned fertilizer factory in Chorzów, which he modernized and saved from bankruptcy. As a result, production increased, and in the following years, the factory reported the best financial results in all of Europe.

Although he did not like Chemistry, he decided to study it when he read about the so-called dry distillation of wood, thanks to which you can produce gas. He decided that since there are a lot of trees on his parents' property, obtaining gas from them was a practical solution.

Politician

Even when Mościcki became president, he looked at the country's needs through the lens of engineering and technical expertise. He attended meetings of research institutes. He initiated the construction of strategic companies, such as the Synthetic Rubber Factory in Dębica and the Hydroelectric Power Plant in Rożnów. He also supervised the creation of Nitrogen Works in Tarnów-Mościce. They reported an even higher production volume, than the previously mentioned factory in Chorzów. Thanks to his many different activities and logistic abilities, he was the father of the economic leap in Poland, a country reborn after the partitions.

Before he gained worldwide fame, to had to make a living. He produced kefir, he engaged in carpentry, decorated furniture and worked in a print shop. When he started work at the university, his job was building scientific instruments.

Throughout his life, Ignacy Mościcki was a practitioner who, with his engineering sense, constructed innovative equipment and built the Polish economy. From his choice of studies to his presidency, he did everything to ensure that his actions had a measurable purpose. His pursuits were so crucial that earning a college degree seemed secondary. Even though he did not formally graduate from any university, he accomplished a great deal. Honorary degrees, of which he had several, were bestowed upon him, as recognition for his work and accomplishments. If you love something, you can do it under any circumstances and still benefit others.

Hanna Hirszfeldowa
(1884–1964)

One night, when a powerful explosion woke up the Hirszfeld family, they thought a bomb had fallen on the hospital they ran. Instead of running for her life, Hanna rushed to save a notebook with her research results.


DURING WORLD WAR I,
I VOLUNTEERED IN FIELD HOSPITALS.

Hanna Kasman was born near Warsaw. As a very talented person, she passed her high school diploma exam at the age of 16. First, she studied medicine in France and then in Berlin. She married Ludwik Hirszfeld, who was also a doctor and a bacteriologist. Both of them focused on blood research in their scientific work. Hanna and Ludwik married young and were inseparable, also in scientific work.

Together with her husband, Hanna Hirszfeldowa worked as a military doctor in the Serbian army, in the treatment of typhus spotted fever.

When World War I broke out, the Hirszfelds lived in Switzerland, which established neutrality and did not participate in the war. Ludwik, however, decided to serve with his medical expertise and volunteered to work in the Serbian army to treat an epidemic of spotted fever. Hanna could not focus on her quiet work, knowing that people needed help. A few months later, she found herself in Valjevo, Serbia, where she fought the epidemic with great sacrifice as an army doctor. When the front was broken and the foreign missions evacuated, the Hirszfelds went to Thessaloniki, Greece. They treated infectious diseases, especially typhoid fever, dysentery, and malaria. Hanna headed one of the hospital's wards at the time. Together with her husband, she researched blood groups. It was the determination of blood groups, that proved to be their most important achievement.

During World War I, Europe was decimated by an epidemic of spotted fever. Hirszfeldowa and her husband Ludwik, gave up their comfortable life in independent Switzerland, to bring aid to the sick at the front in Serbia.

After World War I, the Hirszfelds returned to independent Poland, but initially, their situation was complicated. The money they had earned in Switzerland lost its value due to inflation. Ludwik began working as a researcher at an epidemiological institute and Hanna as a volunteer at a university pediatrics clinic. After some time, she became its head. Children's diseases became her specialty. In the interwar period, she wrote about 40 scientific papers and a book on this subject, which she translated into French herself. She also translated her husband's works.

The Hirszfelds' lives changed entirely at the beginning of World War II. As doctors, they both helped to defend Warsaw. Hanna had to combine many functions: she managed the sanitary and rescue center at the clinic, she took care of the nursery, and when the wounded

started arriving in the city, she needed only one day to open a hospital in a school building in Saska Kępa district. She risked her life every day to get to the hospital. At one point, the front was a hundred meters from the Hirszfelds' house, and bullets and artillery shells whistled through the air.

She was the author of about 40 scientific papers on pediatric diseases, which were her specialty. She translated them into French.

Two years after the capitulation of Warsaw, in 1941, the couple was resettled into the ghetto. Even there, they continued to study and work. At the time, Hanna was the head of the infant ward in the Wola hospital. Even though she and her daughter could have escaped, she refused to leave without her husband.

After the war, the Hirszfelds settled in Wrocław. Hanna started to organize medical care with her usual energy and co-founded the Medical Academy (today, the Medical University). She also headed the establishment of the Pediatric Clinic. In 1946, Hanna traveled to the United States, where she encouraged people to donate several tons of food for needy Polish children. She worked in Wroclaw until her death in 1964.

Józef Hofmann
(1876–1957)

Józef Hofmann was born in Krakow, which was then part of the Austro-Hungarian Empire. He was an extremely talented pianist and composer, but he was also an inventor with incredible potential. Both of his passions – music and innovation – often intersected. Józef constantly improved vehicles and instruments. He single-handedly built a car and made changes to the design of the piano.

Music

As an 8-year-old, he gave piano concerts in front of large audiences in concert halls in Warsaw. At the age of 10, he was giving concerts all over Europe. He loved music more than anything. At the age of 11, he went on a tour of the USA. After one of the concerts at Carnegie Hall, one of the most prestigious concert halls in the world, The New York Times newspaper published a review that included the words: "his playing was not extraordinary for a child, it was extraordinary for a man." Interest in Hofmann in the United States was enormous. Yet, the tour was canceled. One of the American associations fighting for children's rights, stated that the adults were using the 11-year-old Józef, who was giving concerts. The boy denied it and asked for the possibility of continuing the tour, but it was to no avail. The scandal was hanging by a thread, and the matter had to be pursued by the court. The court ruled, that the tour was too demanding and had to be canceled. The young Hofmann returned to Europe and, at the age of 12, began his musical studies in Berlin. He completed them at the age of 18, winning a prestigious scholarship for young pianists.


WHEN I WAS 10 YEARS OLD, I GAVE CONCERTS IN EUROPE. WHEN I TURNED 11, I HAD A TOURNEE AROUND THE USA.
I WANTED TO OWN A BOAT THAT WOULD NOT RESPOND TO WIND AND WAVES, SO I CONSTRUCTED THE FIRST TOURING MOTORBOAT IN THE WORLD.
I WAS THE FIRST MUSICIAN TO RECORD HIS MUSIC ON A PHONOGRAPH.

He worked until the end of his days to invent technology, that would make it possible to record and then reproduce music, in such excellent quality, as the one heard in concert halls.

Parallel to his world music career, Józef Hofmann was passionately constructing. Who can argue that music and innovation are two different tales, and that the scientific and humanistic minds lie at opposite poles? If anyone thinks so, they are wrong. No research supports the fact that we have minds capable of either math or art. Everyone is born a potential genius at everything. More often than not, adults narrow down a child's imagination. Well, Józef Hofmann's parents: his mom a singer and dad a conductor, most likely did not narrow it down.

Józef Hofmann was the first pianist and professional musician to record his works on a medium. When he was 11 years old, he read about Thomas Edison's invention of the phonograph. Perhaps it was the first device that allowed sound to be recorded and played back from a portable medium. Rollers covered with zinc foil carried the sound. A special diamond-tipped stylus carved a groove on it, the depth and width of which depended on the recorded sound. The principle of the device's operation was analogous to that of the later gramophone record. This invention from across the ocean intrigued Józef so much, that he wrote a letter to Edison. Thomas Edison was already a world-famous inventor, and little Józef Hofmann was only 11 years old. It turned out that it did not matter. Józef managed to persuade Edison, and they recorded the first music piece. Unfortunately, the phonograph rollers were lost. Or maybe Hofmann destroyed them himself? He let himself be recorded only that one time, because he believed that mechanical recordings do not convey the beauty and complexity of the music. Until the end of his days, he worked on inventing a technology, that would record music as he heard it. That was his true obsession.

When he was 11 years old, he read about the invention of the phonograph – a device that records sound. This invention from overseas intrigued him so much, that he simply wrote a letter to its inventor, the worldwide famous – Thomas Edison.

Inventions

He is the author of more than 70 patents. He has redesigned his piano many times. His work on a system that would transfer force from the key to the hammer striking the string, inspired him to create a new kind of car shock absorber.

Józef Hofmann is the author of over 70 patents. Yet, he did not patent many inventions; he simply created them. For example, Hofmann redesigned his piano. As a man of small stature, he found it better to play on narrower keys. It is to Hofmann that pianists owe their height-adjustable stools. During one rehearsal, the young Hofmann gazed at the metronome – a device that measures the tempo of a piece of music. This pendulum movement inspired him to develop the world's first windshield wipers. He sold the patent to Ford.

Cars and music were two of Hofmann's greatest passions. As a 25-year-old, he built a car himself, which he drove around Europe. A few years later, at the age of 32, he constructed a prototype of a car location system. He registered the invention in the US Patent Office under the number 909 798. The idea was to place a map on a film wrapped around special disks. Depending on the speed of driving, the discs would scroll at different rates. Additionally, the map and its scale would become more detailed, as the car entered the city.

Another music-car invention was shock absorbers. Hofmann came up with the idea while modifying his piano. The idea was to make the power transmission system between the key and the striking hammer, as precise as possible. The hammer strikes the string, just as a pianist strikes the key with his finger. The suspension, or rather cushioning system, was first tested in New York police cars. When it proved its worth, the car industry took it over.

During one of his rehearsals, while looking at a metronome, he came up with the idea of making car windshield wipers. He sold the patent to Ford.

An electric clock, a spiral water heater, several patents still used in aircrafts today, an oil furnace, and technology for regenerating electrodes in batteries – it would take a long time to list all of Józef Hofmann's inventions. It was he who constructed the first tourist motorboat. "I would like to have a boat that does not listen to the wind and waves. It goes where I want it to go. I don't want to force it with oars to change direction. I will steer it," he wrote in his diary.

Hofmann was considered the best pianist of his time. Famous pianist, Artur Rubinstein and a famous Russian composer Sergei Rachmaninoff, said that about him. Hofmann, the pianist, was also an acquaintance of the most significant people of his era. Addressing young people, he wrote: "Work always with perseverance, striving to give all that lies within your strength. Find a reliable teacher and rely on his advice as to your career. Do not give in to the temptation of the deceptive belief that success depends on fate. The most important factor is your toil, your work, and the wise guidance over you." Wise words.

Kazimierz Prószyński
(1875–1945)

His inventions certainly deserved Oscars in their category. Nevertheless, years later, other stars came to the fore. A child who knew about the latest innovations from the realm of photography, became a man who designed devices used by the entire film world. The development of cinematography would have been much slower without him.

Lights, Camera, Action!

Kazimierz Prószyński's grandfather had a photography workshop in Warsaw, where his grandson performed various experiments with childish curiosity. He used to show his family the pictures he had taken and even demonstrated magic tricks using lamps and mirrors. One day, as a child, Prószyński noticed an advertisement for live photography on the street. For a fee of 20 kopecks, a darkened room showed 24 images placed on a spinning wheel, creating the illusion of movement. This seemingly simple image of a horse jumping over an obstacle, sank into his memory and inspired him to take up cinematography.

During his secondary school education, he began to show excellent technical skills, so in 1894 his parents decided to send him to study at a polytechnic in Belgium. They did not have to wait long for the first results of his work. In the first year of his studies, he constructed a universal expeditor, a device for folding magazines, applying bands, and addressing them. He thought of his father's needs and made it much easier for him to send subscribers the copies of "Gazeta Świąteczna" and "Promyk" he published.


AS A CHILD, I LOVED SETTING UP SHOWS AND MAGIC TRICKS AT MY GRANDPARENT'S PHOTO ATELIER.
I CONSTRUCTED A CINEMA PROJECTOR, WHICH ALLOWED THE IMAGE TO REMAIN STILL INSTEAD OF FLICKERING.
I CONSTRUCTED A SMALL PORTABLE CAMERA EQUIPPED WITH AN IMAGE STABILIZATION.

His fascination with film began when, as a child he saw a zoetrope – a large cylinder which allowed to watch moving pictures through a set of slits. The device used a stroboscopic effect.

However, Kazimierz was most fascinated by film. The existing cameras for projecting moving images had a fundamental flaw. The resulting image was not continuous and even. It was difficult to watch the projections of the jittery and flickering image. The screenings were often interrupted by equipment malfunctions. That had to be changed! He created a pleograph that did not have a faulty projector and was better than those used before. But this was only the beginning of a long series of Prószyński's inventions. Prószyński presented the first feature film with directed action using his improved device, the biopleograph. This improvement involved using two lenses and two tapes. The image was projected alternately during projection to eliminate gaps in the display caused by a moving tape. The first films that were viewed in very high quality, for the turn of the 19th and 20th century, were: *The Return of the Birbant* – a movie about the adventures of a young man returning home after a drunken party, and *The Adventure of the Horse-Drawn Carriage Driver*, whose horses were buckled during a nap. And all this thanks to Kazimierz's inventions.

Columbus in Paris

In 1908, Prószyński graduated from a polytechnic in Belgium. He had previously interrupted his studies to work on his inventions and moved to Paris. There, work on developing cinematography was in full swing, because Paris – as a city full of theaters, cabarets, and artists – aspired to be "the city of film." Kazimierz continued to work on eliminating two of the most significant problems that still bothered him, namely, the flickering of light and image vibration during film projections. His new solution involved using an obturator, i.e., an aperture with three slits, so that the resultant flicker would be imperceptible.

The second problem was eliminated by improving the device that moved the film stock. The mechanism was difficult to invent, but very simple to construct. Prószyński's improved pleograph was received with great enthusiasm by the film community. Its mass production began immediately, and it was gradually introduced to cinemas. This was a breakthrough for the entire cinematographic industry. Previously films had lasted no more than a dozen, or so, minutes due to eye strain. It was now possible to start developing plots into movies that could last up to several hours. Prószyński was called the Columbus of cinematography, and his work was recognized by Louis Lumiere, who gave him a priority in technical mastery. Today it may seem difficult to understand, but Prószyński's inventions caused a real revolution and were the driving force behind the nascent film industry.

"Eye" on the World

Prószyński made the second breakthrough in cinematography by constructing an aeroscope, which is the first portable camera without a tripod, which stabilized the image with the help of a gyroscope placed in it. Kazimierz demonstrated his solution sitting in a saddle. He wanted to show that it was possible to get a satisfactory image even while riding a horse. Earlier cameras were huge, heavy and sensitive to shocks. This severely limited the producers' possibilities and directors' imagination. Thanks to Prószynski, live filming became possible, and the reporter's work took on a new meaning. The inventor himself recorded a report on the coronation of King George V, in London in 1911. Cherry Kearton, an English traveler and wildlife explorer, became a huge advocate of the aeroscope, after making many nature films in the African jungle. During World War I, the camera helped reporters document the war effort. Kazimierz's breakthrough invention was the cinephone, which couples the cinematograph with the phonograph, i.e., combines picture and soundtrack. Prószyński was ahead of even Thomas Alva Edison, who was working on the same device. Since his construction, films no longer had to be silent.

The aeroscope, a small portable camera with a stabilizer, made it possible to film reporters' footage. In 1911, Prószyński used it to record the coronation of King George V.

After Poland regained its independence, Prószynski returned to the country and worked in Warsaw. He did not survive World War II and died in the Mauthausen-Gusen concentration camp. During the deportation, he took sketches of his latest inventions. Unfortunately, everything was lost.

In 1914 Prószyński married Dorothy from England, with whom he had two children. The family settled in Warsaw. Over the following years, even after the war began in 1939, Prószyński worked on improving the design of the "Oko" (eng. "Eye") and other inventions, projectors, new cameras, and lamps. Prószyński enjoyed worldwide recognition and fame, as an inventor, but his dream was to work for Poland. He wanted the cinematographic industry to flourish in our country. Lack of capital and the economic and political situation, made it impossible to put these plans into practice. He never had a chance to realize them. Unfortunately, he was the only member of his family who did not survive the war and was sent to the Mauthausen-Gusen concentration camp, from which he never returned. As an avid inventor dedicated to his work, he took the "Oko" camera and sketches of his latest designs when deported. Unfortunately, it was all lost.

Michał Boym
(1612–1659)

He earned the nickname of the Polish Marco Polo, but this is definitely an unfavorable comparison. Unfavorable for Michał Boym. He was a Jesuit priest, traveler, cartographer, naturalist, and one of the first European orientalists. He gained such trust from the Chinese emperor, that he sent him as his envoy and ambassador to the Vatican.

Michał Boym came from a very respectable family. His grandfather was probably the secretary to King Stefan Batory, and his father served as the court physician to Sigismund III Vasa. When Michał was 14 years old, he fell seriously ill and promised God that if he recovered, he would enter a monastery. When he regained health, he joined the Jesuit order. He completed his studies in theology and philosophy. After being ordained a priest, he managed to get permission from the Pope, to go on a mission trip to China. It was not so easy. The young priest had to apply for approval for a long time – it was rejected nine times. However, with his persistence, he convinced his superiors, and in 1641 he set off on his journey. He sailed from Lisbon, circumnavigated Africa (the Suez Canal was constructed several hundred years later), and stopped in Mozambique, which was a Portuguese colony. In those days, the Portuguese dominated the great waters, and they had exclusive rights to trade with China. In 1644, three years after sailing from Europe, Michał arrived in Macau. Today it is part of China, but then it was a city, that was an important and autonomous trade center.

Nature and Geography

In Macau, Michał Boym began working in a school. He had to learn the language and the customs of the place where he was to live. Later he was sent to work on the island of Hainan in southern China. There he discovered a true passion for learning about China, a completely unknown country in Europe at that time. He became passionate about observing and describing nature. He had a strong urge to explore during his trip to China.


I HAVE ALWAYS BEEN STUBBORN. I WANTED TO SEE CHINA. DESPITE NINE REFUSALS, THE POPE FINALLY GAVE ME PERMISSION TO GO THERE.
WHEN IT TURNED OUT THAT I COULD NOT SAIL FROM CHINA TO EUROPE, I DECIDED TO WALK.
I WAS ALWAYS CURIOUS ABOUT THE WORLD AROUND ME. EVERYTHING THAT I FOUND INTERESTING, I DREW OR NOTED DOWN.

He came from a very well-known and respected Lviv family. His ancestors held important positions at the Polish royal court.

For example, he saw hippos in the countries he visited, which he called sea horses. While on the island of Hainan, he described the Chinese flora and depicted it in his drawings. He spent a lot of time exploring the secrets of Chinese medicine. He presented the properties of ginseng, a root that restored strength and vitality. He told the world about lychee for the first time. He described fruits already known, but still unexamined, such as mangoes, bananas, and pepper seeds. In his book, Boym tried to explain the taste and smell of pineapple, papaya, cinnamon, and ginger. The articles he published, became the first complete descriptions of Chinese nature in Europe. At that time, China was an unknown world of wonders for many Europeans, as they knew almost nothing about it. Travelers who came back from China did not bring knowledge about the country itself, and their pieces of information were often contradictory. Different names were assigned to the same settlements. At the initial stage of the trade cooperation, in-depth knowledge of customs, plant vegetation, animals of such a distant part of the world, was not needed. It was not even known whether the country which Marco Polo reached from the land side (and which he called Cathay) was the same country which the Portuguese had reached by sea. Michał Boym put this knowledge in order by creating the first atlas of China. It consisted of 18 hand-painted sheets on which mountains, rivers, and the most important cities of China were marked, not only those on the coast. He also carefully marked the Korean Peninsula on his maps, even though the previous European travelers held Korea to be an island. He also marked the location of the Gobi Desert and even the Great Wall of China. Everything was accompanied by illustrations of plants, animals, and the scenes of the everyday life of the inhabitants.

Michał Boym was the author of the first scientific paper on China. He described not only the location of mountain ranges, rivers or cities, but also the vegetation and customs.

A Dangerous Mission

Unfortunately, just a few years after Michał began his work in China, there was a Manchurian invasion of the island of Hainan, where Boym was staying. China had been in the throes of civil war for years,

and the Manchus had seized their opportunity – the Chinese emperor Yongli had to flee the capital. A vast crisis hung over the dynasty, which had been in power for 300 years. The emperor came up with an idea to ask for help from European countries, including the Vatican. The head of the envoy to Europe was Michał Boym. The mission was hazardous and delicate. The European courts were at odds with each other, and the Portuguese did not care at all about keeping the Yongli emperor in power, because they were already making deals with the Manchus behind his back. Boym agreed to move to Europe. He encountered the first great difficulties in India. He was arrested there by the Portuguese viceroy. The Portuguese feared that Boym would eventually succeed in convincing the European courts to help the Chinese. Fortunately, Michał managed to escape. He couldn't board a ship, or he would fall into Portuguese hands again, so he set off for Europe by land.... on foot. This way, he walked over six thousand kilometers. After reaching the Black Sea, he boarded a ship. When he sailed into Venice in 1652, he thought things could not get worse. However, diplomacy proved to be a complicated task.

The road to China led through the Vatican and Lisbon, and then along the African shores and through India. Several years passed from setting out on a journey, to reaching his destination.

Venice tried to remain neutral in the conflicts, so the high lord did not want to grant an audience to the envoy. After some time, Michał gained the favor of the French ambassador. However, that deprived him of the opportunity to meet with the Pope, who supported the parties opposing France. Finally, Boym managed to meet with the Pope, but it was already a new head of the Catholic Church. He waited for the meeting for three years. Instead of the desired military help, he received a letter from the emperor with words of encouragement and support. However, the Pope interceded with the Portuguese king John IV, who granted military help.

The 17th century China was almost a magical land even for an educated European. The information that was coming from China, was so incredible, that it was hard to believe it all.

Michał Boym set out on his return journey in 1656 and, as before, got stuck in India. The Portuguese still wanted to stop him on his way, but he managed to escape again. He died in 1659 in Kuangsi province, exhausted from his journey to the imperial court.

He was already very close to his destination. Unfortunately, he would not have been able to help the emperor, who was finally defeated.

It was not until after Michał Boym's death, that most of his works appeared in print, including a translation of the *Canon of the Yellow Emperor*, the oldest Chinese medical book. Other manuscripts were never published.

Paweł Edmund Strzelecki
(1797–1873)

He was the first Pole to circumnavigate the globe alone. The discoverer of Australian gold and the author of the first thoroughly scientific study describing Australia. British Queen Victoria made him a Knight of the Order of St. Michael and St. George, for this book, and Oxford University awarded him an honorary doctorate. When famine broke out in Ireland in the mid-19th century, Strzelecki saved many children from starvation with his innovative ideas.

Europe and America

Born near Poznań, he studied first in Warsaw and then in Krakow. Due to heartbreak, he decided to go abroad. First, he visited Switzerland, then Italy, France, and England. At the age of 37, he set off from Liverpool on a scientific journey around the world. He was the first Pole to do so. As he set foot in New York, he began a year-long scientific expedition around North America. He conducted meteorological, geological, and geographical research. He was interested in the methods of growing crops and even the customs and culture of the Native Americans. It was he who discovered the deposits of metal ores, which are still exploited in Canada today. From North America, he got to Brazil via Mexico and Cuba. Then there was Argentina, Chile, Uruguay, Peru, Ecuador, and El Salvador. He explored volcanoes, mountain ranges, and searched for natural deposits, often with positive results.

On his way to Australia, he visited many previously unexplored islands. For example, he visited the island of Kealakekua, where only 60 years earlier, the famous British sailor and astronomer James Cook had been killed. Strzelecki wrote the first scientific descriptions of many Hawaiian islands, their volcanoes, mineral deposits, and wildlife. The same was true of many islands in Oceania. On the North Island of New Zealand, Strzelecki conducted the first-ever geological research. On the South Island, he described and identified deposits of lead, iron, and copper. These deposits provided money for the country for years. However, he gained his greatest fame by exploring Australia.


I WAS THE FIRST POLE WHO TRAVELLED AROUND THE WORLD ALONE. DURING THIS TRIP, I VISITED 6 CONTINENTS.
I WAS THE AUTHOR OF THE FIRST SCIENTIFIC STUDIES ABOUT AUSTRALIA.
THANKS TO MY ORIGINAL IDEAS, I SAVED MANY CHILDREN IN IRELAND FROM STARVATION.

Australia

He had many interests. He researched meteorology, geology, geography. He was interested in plant cultivation, customs, and the culture of indigenous people.

He arrived at Botany Bay, on which Sydney lies, when he was 42 years old. He was surprised to find the city so peaceful and friendly, as he had heard it was the most demoralized colony globally. Australia was a penal colony. Strzelecki conducted the first geological surveys in the vast area of Australia. It was he who gave the highest peak of the Great Dividing Mountains, the name of Mount Kosciuszko. He discovered coal, oil, and metal ore deposits, in many places. He corrected the geographical position of islands on maps, plotted rivers, mapped mountains, and drew accurate maps of coasts.

The conclusion of his many years of research was the creation of a geologic map. The map was very accurate, as it was created on a large scale. When expanded, it was 7 meters long. However, the most interesting part of Strzelecki's Australian adventure, was his discovery of gold deposits in New South Wales. The governor of Australia asked the scientist to keep the discovery a secret, because he feared riots and violence. Most white people on the continent had a criminal past. The governor argued that going to Australia was a punishment, and if it came to light that gold had been discovered there, it would be treated as a reward. Strzelecki obeyed and did not describe the gold deposits he had discovered. It was a wrong choice. He lost a lot of money, and the discovery of gold would have been a ticket to the world's scientific elite for him as a geologist. Several years later, the deposits discovered by Strzelecki were "discovered" by Edward Hargraves, who made a fortune. By the way, if Strzelecki had announced the discovery of gold in Australia, he could have changed the history of the Antipodes and America. His discovery took place in 1839. In California, on the other hand, gold was discovered almost ten years later. When crowds of entrepreneurial and industrious people from all over the world (and technology and commerce) were heading to California, no one knew about Australian gold yet, because Strzelecki was keeping his promise to the governor.

From Sydney, Strzelecki sailed through the Philippines, Indonesia, and Hong Kong, until he reached China. Then there was Singapore, India, Egypt, Algeria under French occupation, and then France, and England.

Help

Upon his return to London, Strzelecki published a scientific monograph on Australia's eastern and southern parts. That was the first scientific study of that continent. The book brought him great fame and, for almost 50 years, was the primary work focusing on Australia. The book was 500 pages long. Charles Darwin wrote to Strzelecki after

reading it "I wish with all my heart, that at least a fourth part of our English authors could think and write in a language, at least half so vivid, and yet so simple."

This book was a real revolution. Strzelecki received an honorary doctorate from Oxford University. Queen Victoria made him a Knight of the Order of St. Michael and St. George.

When famine struck Ireland in 1846, Strzelecki was in charge of the relief organization. He presented visionary ideas, such as feeding hungry children at school, distributing clothes to children rather than their parents, and educating them about hygiene. At its peak, there were approximately 200,000 children under the care of the organization that Strzelecki led.

He discovered gold deposits in Australia. He yielded to the request of the governator and did not publish the results of this findings. He lost his fortune, and the fame of the discoverer of Australian gold, went to someone else.

In his will, Strzelecki requested that all of his correspondence and unpublished notes be burned after his death. The executor of the will fulfilled this wish. As a result, many descriptions of cultures and customs of peoples from all over the world, disappeared forever.

He abhorred violence and was known for his respect towards Indigenous people. In letters and diaries, he wrote about the need to protect nature in Australia, pointing out, among other things, the harmfulness of logging.

He visited six continents and crossed the equator six times. His name was used in naming several species of animals and a mountain range, a desert, a nature reserve and a river in Australia, as well as two mountains on the islands of Oceania. In his diaries, he described the hard life of the Indigenous peoples of North and South America. He could not come to terms with the slave trade he witnessed in Brazil. Strzelecki abhorred violence and was known for not using firearms in discussions with the Indigenous peoples, which was unusual behavior among white explorers. In Australia, to the surprise of the British, he drew attention to the mistreatment of Aboriginal people. What may seem incredible today, in his letters and diaries, he wrote about the need to protect nature in Australia, pointing out, among other things, the harmfulness of logging.

Wilhelmina Iwanowska
(1905–1999)

Throughout her life, and especially during her scientific career, she fought not only for her own development, but also for the growth of her colleagues and students. It was Wilhelmina Iwanowska who succeeded in making the universe twice as large. How did she do it? By studying her beloved stars.

The future professor was born in Vilnius. She studied mathematics at the Stefan Batory University. The fact that she devoted herself exclusively to astronomy was a coincidence. When she was in her third year of studies, the lecturer of astronomy, Professor Władysław Dziewulski, stopped her after one of the classes. He suggested that she, together with two colleagues, takes up an assistantship. It was a great ennoblement.


MY RESEARCH SHOWED THAT THE UNIVERSE IS TWICE AS EXTENSIVE AS PEOPLE THOUGHT.
I ACCIDENTALLY BECAME AN ASTRONOMER AND I REMINDED ONE FOR THE REST OF MY LIFE.
I PIONEERED RADIOASTRONOMY IN POLAND AND I FOUNDED THE ASTRONOMY INSTITUTE IN TORUŃ.

After the war, Iwanowska collaborated with scientists. Thanks to her contacts, the Toruń University received an astrograph and a lens, which were used to make the first telescope at the local observatory.

The employees of the Vilnius Observatory studied celestial mechanics, i.e., the movement of celestial bodies in the gravitational field, the study of the movements of stars and the determination of their distances, as well as the study of the brightness of the stars. Unfortunately, her scientific work was interrupted by the war. The Red Army occupied Vilnius, and the university was closed. Many scientists died during the turmoil of war at the front, in ghettos, or the Katyń massacre. The remaining staff members conducted secret teaching in Vilnius. After the war ended, repatriation began – Wilhelmina ended up in Toruń. The university in Toruń took the name of Nicolaus Copernicus. The ambition of the three astronomers, who founded the astronomy and astrophysics department, was to build a solid scientific research group in his hometown. The task was not easy. The scientists possessed nothing, but their knowledge – they had no books, no tools, no equipment.

Moreover, because of the war, they had no access to scientific literature. Nevertheless, they quickly began lecturing. Iwanowska began to cooperate with scientists from other cities, with whom she exchanged books and publications. As a result, for example, she received a lens donated by scientists from Poznań. It allowed the first telescope, for the future observatory in Toruń, to be created. Another valuable piece of equipment, an astrograph, was obtained thanks to her acquaintances in Sweden.

Despite numerous job offers from prominent scientists in the US, Iwanowska decided to return to Poland. At the Toruń Observatory, together with a team of young scientists, she devoted herself to the research of the stars.

Iwanowska's findings as an astronomer, were quickly recognized. In 1948, she was awarded a fellowship in the USA. She worked at a total of six leading observatories. She met many eminent personalities and received several job offers. Nevertheless, Iwanowska decided to return to Poland. She always believed that life in her home country was more exciting and richer in experiences, than in wealthy Western countries.

After returning to Poland, Iwanowska and her young colleagues, started research in a newly built and modestly equipped observatory

in Piwnice. She studied various types of stars, but was particularly interested in cepheids, i.e., stars that periodically decrease their size and brightness at the same time. The scale of distances between galaxies, which turned out to be twice too small, was based on her observations. She corrected it simultaneously with another scientist, Walter Baad. Astronomers respected her accomplishments, and they willingly invited Wilhelmina to international meetings. Unfortunately, the communist authorities did not allow her to leave the country for many years. The situation improved somewhat only in the 1960s. Iwanowska was eager to travel to foreign research centers. These visits allowed her to learn about the latest research results in astronomy and work on modern scientific instruments, which the university could not afford to buy.

Wilhelmina Ivanowska was an acclaimed scholarship recipient in the U.S, where she worked at six major observatories.

When she retired, she did not slow down her pace of life. The next day, she accepted the invitation and traveled to the Caucasus to give several lectures there. She died in 1999. She devoted her entire life to her work.

Benedykt Dybowski
(1833–1930)

Benedykt Dybowski dedicated his love to many. Apart from his loved ones, he loved his homeland and science. He dedicated his time to the latter, even under challenging conditions, in exile. It was in distant Siberia, where he made the most significant discoveries of his life. Exploring the then-unknown nature, he became known as a man with a great heart.

Benedykt was born in what is now Belarus on April 30, 1833. He grew up on his grandfather's estate in a prominent noble family. Initially, he received homeschooling, and his first teachers were his parents, tutors, and older siblings. It was then, that he became interested in nature, establishing his first herbariums and aquariums. This youthful love lasted until he studied medicine at the Tartu (earlier Dorpat) University, where he also took zoology courses. After three years of study, he wrote a book: *On the Freshwater Fishes of Livonia*, for which his professors awarded him a gold medal. Despite this success, he was expelled from the university because... he agreed to be a second in a duel. He moved to Breslau and then to Berlin. Only after obtaining his doctorate did he return to Tartu (earlier Dorpat).

Exile

The patriotism he learned at home, encouraged him to undertake social activities. During his studies, he was an activist in the Patriotic Society and later in the Lithuanian National Organization. He also believed that the nation's strength depended on sobriety. Together with seven friends, he founded a group of abstainers called the "Milk Brothers." They strongly opposed the alcoholism spreading in Poland. His participation in one of the demonstrations, later prevented him from taking the position of the chair of the Zoology Department at the Jagiellonian University. Eventually, a recently opened


I HAVE WRITTEN MORE THAN 350 SCIENTIFIC PAPERS. I DEALT WITH ZOOLOGY, PHYSIOLOGY, ANATOMY, AND SYSTEMATICS OF ANIMALS. LIKE FEW OTHERS, I HAVE DESCRIBED LIFE IN AND AROUND LAKE BAIKAL. I HAVE ALSO STUDIED THE CUSTOMS OF SIBERIAN PEOPLE.
I DESCRIBED HUNDREDS OF NEW SPECIES OF FISH, MAMMALS, AMPHIBIANS, AND REPTILES. I SHOWED THAT THE BAIKAL CONSISTS OF TWO BASINS SEPARATED BY A DIKE, LOCATED NO DEEPER THAN 60 METERS FROM THE SURFACE.

Warsaw High School offered him an assistant professor position. Soon, he was arrested, because he participated in the organization of the January Uprising. After spending several months in prison, he was sentenced to 12 years of hard labor in faraway Siberia. When he boarded the train with other deportees, his friends gave him a microscope, a first aid kit, and a set of surgical instruments. But foremostly, they gave him books. Dybowski dreamt about traveling. He wanted to go to Madagascar – there, while working as a doctor, he would be able to study the island's nature, which was not well know. It turned out differently, but it did not bring him down. He decided to fulfill his dreams in deep Russia. At that time, these areas were not explored either.

Obsession

Dybowski always tried to organize his day to find some time to collect specimens for his research. It was not easy during his forced labor, as everyone who failed to complete a task, would receive a severe punishment. Dybowski found time for everything, even running a free medical practice. He gained the respect of the locals and authorities. With time, they began to appreciate both his Berlin diploma and the value of his scientific work. That, in turn, gave Benedykt more freedom to move around and collect more specimens for research (which became his obsession). He was so devoted to the matters of science, that he ignored his health. He often spent nights on the bare ground and the muddy banks of rivers. He sailed in a boat constructed with his own hands and faced many dangerous adventures. He also drove a wagon. Once, he left it standing in the water for 12 hours. As a result, it got so wet, that the researcher lost some of his valuable notes, clothes, and books. He even slept on the surface of the frozen Lake Baikal – he constructed a portable, stove-heated house, which was once blown over by a gust of wind.

Despite his very good academic record, Dybowski was expelled from the medical school when it became known, that he was a secondee in a duel. He first moved to Wroclaw and then to Berlin. It was only there that he obtained a doctorate in medical science.

After several years, Dybowski was allowed to come back to his homeland. However, he did not find any employment. He returned to Siberia for the next five years. As he said, he was going "outside his Homeland," but "only for the sake of his Homeland." His primary motivation was to work for a country that did not even exist at that time. During his second stay in Siberia, he worked as a doctor in Kamchatka. He researched and collected animal and plant specimens, set up hospitals for the leprous, administered smallpox vaccinations, and taught the local people about animal husbandry and plant cultivation.

Recognition

In Dybowski's time, Russian scholars believed that Baikal's fauna consisted mainly of fish. Benedykt believed this to be an inaccuracy. What do fish eat, then? Using self-constructed equipment, he caught many mollusks, crustaceans, sponges, and other animals, then still unknown to science. He also discovered new species and subspecies of fish, some of which were endemic, i.e., lived only in Lake Baikal. The collected material was so vast that Dybowski was not able to process it on his own. Having prepared it beforehand, he sent it to Poland. His brother Wojciech, a biologist and an assistant professor at the Dorpat University, helped him with his work. Dybowski described several hundred new species and, using the deep-sea measurements, also proved that

Scientific research was his obsession. He spent the night on the bare ground by the muddy banks of the river many times. He sailed in a self-constructed boat and even slept on the surface of the frozen Lake Baikal in a wooden house of his own construction.

During his studies, he was active in patriotic societies, organized manifestations and joined the preparations for the January Uprising.

Baikal is composed of two basins: eastern and western. These are, in turn, separated by a dike, located no deeper than 60 meters from the surface. Although he also studied marine animals and terrestrial flora and fauna (mainly birds), he received a gold medal from the Geographical Society for his study of Lake Baikal. It was also suggested that his nickname "Baikalski" be added to his name – just as they would call the generals who conquered new territories. Dybowski strongly objected, because he did not want a Russian nickname next to his Polish name. Nonetheless, his last name has been used to name the new species of animals he discovered, e.g., one species of a deer is named Cervus Dybowski. During his second expedition to Siberia as a free man, he also conducted anthropological and ethnographic research. He collected elements of clothing and objects of everyday use of Siberian peoples.

Dybowski published over 350 works. Among them, you can find scientific treatises on zoology, animal systematics, comparative anatomy, and travel memoirs. Although he went into exile to a territory from which many did not return, Siberia turned out to be the fulfillment of his dreams and ideas, which he preached all his life. Through his hard work and dedication to research, he deepened his knowledge of nature and gained respect in the world as a Pole. He did this when Poland was not even an independent country, that one could find on the world map.

Kazimierz Żegleń
(1869–1910)

Not everyone has as much confidence in their inventions, as he did. To convince people that his vest stops bullets, he had people shoot at him. His demonstrations were impressive.

He was born in the Austrian partition, but we know little about his youth. The first certain information is that at the age of 18, he entered an order. However, when he was 21, he was sent to Chicago to work with the American Polonia.

The event that shocked him and shaped him was, an assassination on the mayor of the city, which Kazimierz Żegleń witnessed. The mayor died, and Kazimierz decided to construct a garment, that would protect people from bullets. He worked on it for several years, but finally succeeded. Żegleń was not the first to try it, but his competitors used steel plates to protect their bodies. These were heavy and uncomfortable, while our compatriot's idea was completely different. He created a bulletproof vest consisting of several or more layers of silk, the most durable fiber at the time.


I INVENTED THE BULLETPROOF VEST...
AND TUBELESS NON-PUNCTURE TIRES.

Contrary to appearances, the successively stretched layers of material, better absorbed the bullet energy, distributing it over a large area. To further strengthen the effect of the vest, the fibers were soaked in a special substance, the composition of which Żegleń did not reveal to anyone. He made his vests by hand, sewing the material together layer by layer. This was a serious problem, because not all of the pieces were equally strong due to the hand-made work. There were weaker pieces of fabric, that let bullets through. Only machine weaving could ensure equal durability. However, despite his search, Kazimierz could not find a suitable manufacturer in the United States. He did not give up and set out for Europe. At the beginning of 1898, he met with another Pole. Jan Szczepanik (you can read about him in this book) was already a world-class inventor, known for his revolutionary weaving devices. The gentlemen came to an agreement, and Szczepanik adapted his machines to serial vest weaving following Żegleń's idea. The effect was more than satisfactory. The fabric stopped rifle and pistol bullets. Both men were eager to advertise the product, Żegleń in America and Szczepanik in Europe. To demonstrate the properties of the vest, Żegleń would put his invention on himself and give people the order to shoot him. There are many accounts of demonstrations that he held. To the delight of the audience, the bullets did not pierce the vest, but fell to the ground.

Kazimierz Żegleń improved his design several more times. He parted ways with Szczepanik, set up his own company, and began selling vests in earnest. Interestingly, he used his bulletproof fabric to produce car tires and armor plates, which were much better received than the vests. Eventually, however, weapons development outpaced body armor technology. During World Wars I and II, the steel plate idea was reintroduced. The plates were used until the Kevlar's invention of highly flexible synthetic fibers. Kazimierz did not live to see the outbreak of war and probably died in 1910, living and working in Chicago for the rest of his life.

Ernest Malinowski
(1818–1899)

Building a railroad at an altitude of almost five thousand meters is not an easy task today, let alone in the 19th century. Back then, it was the most outstanding engineering achievement in the world. Its author was a Polish engineer, Ernest Malinowski.

He was born in a noble family. Since he was very talented, he attended reputable schools. However, when another uprising against the countries that invaded Poland broke out, he dropped out of school and went off to fight. People who took part in the November Uprising experienced repercussions, so after the fall of the Uprising, Ernest and part of his family had to flee to Paris.

In Paris, Malinowski and his brother received a comprehensive education. Soon after, they got a job in the French Corps of Engineers for Roads and Bridges. At first, they were sent to Algeria, that was conquered by France, at the time. Ernest thought that his supervisors sent him to the French colony, because they lacked trust towards a political expatriate. After a few months, he returned to France and was hired to build canals – it was then that he gained profound experience. A few years later, Ernest's father died, but his brother was still in Algeria. Malinowski decided to take advantage of the opportunity and accepted a few years contract in Peru, then a very young country in South America. The fight for independence from Spain had ruined the country, which was poor and underdeveloped even before the war. It needed new infrastructure and complete reconstruction. Malinowski was already highly respected in the community, so he was entrusted with marking new roads, building bridges, making maps, and supervising various construction works.


I DESIGNED AND CONSTRUCTED SEVERAL HUNDRED BRIDGES AND TUNNELS.
I BECAME A NATIONAL HERO IN PERU, WHEN I SET UP A PLAN FOR DEFENDING THE PORT OF CALLAO AGAINST SPAIN.
I DESIGNED THE CENTRAL TRANSANDINE RAILWAY AND MANAGED ITS CONSTRUCTION. UNTIL 2025, IT WAS THE HIGHEST RAILROAD IN THE WORLD.

Engineer-Defender

Unfortunately, the young country did not enjoy freedom for long — the western coast of Peru was rich in natural resources, including saltpeter. The Spanish did not want to let this treasure out of their hands. Since they had already lost the battles on the land, they decided to attack from the sea. When the Spanish ships arrived at Callao, Peru's main port, the cause seemed lost. Capturing the city meant easy access to the capital, Lima. The situation was even worse, as the chief engineer for the defense of the port was a foreigner. It was none other than Malinowski. Most inhabitants did not trust the "newcomer." Not everyone believed that someone would have the courage and dedication to risk his life for another country. Malinowski, however, well remembered his homeland and the struggle for independence, so it was easy for him to empathize with the people defending their recently regained freedom. Ernest used an innovative idea of placing the cannons on mobile platforms, which allowed for a very long range of fire and directed the enemy's primary attack to the less strategic defense points. When the Spaniards began firing seven days after surrounding the city, the engineer himself, with guns in hand, stood on the defensive walls. Despite many casualties and great destruction, the port defended itself, and the Spanish army sailed away from the South American shores for good.

Due to political repression, he escaped to Paris together with his brother and father. He finished his studies and began working as an engineer and builder of roads and bridges.

For many engineers, the idea of building a railroad high in the mountains was an impossible folly. Nevertheless, the government financed the project designed by Malinowski.

Malinowski became a national hero and an honorary citizen of Peru. He was famous and respected by the people. His house was always open, and his cooking was supposedly delicious. He welcomed many guests from different scientific and political backgrounds. The 19th century was very turbulent for Peru politically, but Malinowski was always there to give advice and help, no matter who ruled the country. He loved the Peruvian Republic and treated it as a second homeland. Thinking about the country's future, he urged those in power to expand the country's infrastructure.

Building Over the Precipice

Shortly after gaining independence, Peru was attacked by the Spanish. Malinowski commanded the defense of a key port. Despite the overwhelming strength of the invaders, the port was defended.

In the nineteenth century, it was not the construction of highways, but railroads that enabled countries to develop. The lack of transportation, especially for countries with large areas and difficult terrain, meant they were divided into the main center, the capital, and "all the rest." In Peru, this problem intensified as the Andes lay between the coast and the eastern part of the country. The Andes are one of the highest mountain ranges in the world. Could a railroad even be built in such high mountains? Many engineers considered it to be completely impossible. Ernest Malinowski, however, was of a different opinion. Before creating the project, the engineer traveled the entire route in order to make the necessary measurements. All this took eight months, because Malinowski had to climb with the measuring equipment into the inaccessible Andes at over four thousand meters. There were no roads in the Andes, so people carried provisions, tents, and equipment on the backs of mules, or in backpacks.

Malinowski's project has been called daring, even visionary. The technical and engineering solutions he proposed, were innovative on a global scale. The government decided to implement it, but needed vast amounts of money. The salvation turned out to be bird excrement, i.e., guano, which in the 19th century served as a popular fertilizer. It so happened that Peru had a massive supply of guano on one of its islands, the sale of which supplied the state coffers and allowed the implementation of government projects.

Construction of the trans-Andean railroad began in 1870. Ernest Malinowski was 52 years old at the time. More than 60 tunnels were dug to get through such high mountains. In some places, the tracks were laid on rock ledges. Where the tracks could not turn, they were led in zigzags down steep slopes. In other places, over valleys, dozens of bridges were thrown. Sailors, used to working on shaky masts, were hired when it became apparent, that the local workers could not work suspended on ropes over the abysses. The highest of the bridges at Verrugas was 77 meters high and about 200 meters long. Malinowski descended into every valley and chasm by himself, and when this was not possible, he was lowered on a rope. Well – he had to check everything himself.

When Peru's economic crisis broke out, Malinowski contributed his own money to finish the railroad line. He wanted the railroad to be a gift to his new homeland. Construction was completed twenty years after it began, in 1890. The highest point of the Transandine Railway is at the Ticlio Pass at 4818 meters above sea level, and until 2005 it was the highest railroad in the world.

Magdalena Bendzisławska
(17th century – 18th century)

She was a phenomenon on a world scale. She became a surgeon working in the salt mine in Wieliczka in the 17th century. In the profession reserved exclusively for men, Magdalena Bendzisławska proved her competence, courage, and self-confidence.

Medicine in the 17th century was different from today – not only because of the state of knowledge. There was a strict belief that certain men could practice medicine and become a surgeon, called a "barber" at that time. Magdalena Bendzisławska's husband Walenty was a surgeon, who took care of injured miners in Wieliczka. Magdalena was his assistant, as it turned out, a very competent one. After her husband's death, she took over his duties. Her decision did not quite fit into the traditional scheme of those times.

Men's Profession

The situation was unusual for many reasons. Firstly, the guilds associating "barbers" accepted only men. Secondly, because of the seriousness of the organization and the trust of the king himself, they were governed by internal laws and customs, that had proven solutions for various contingencies. One of these was the "management" of the fate of widows. They could take over the business after their deceased husbands, so that they would not become impoverished. The condition was, that they find a suitable person who would take over the practice and the medical responsibilities. The guild did not accept random "barbers", so it must have been a skilled professional who would take over the master's duties. The matter was important, because the rulers to whom the mines belonged to, cared about the workers. Probably, not out of the goodness of their hearts, but because of the enormous profits they made from salt-mining.


I WAS THE FIRST WOMAN SURGEON WITH A ROYAL DIPLOMA IN POLAND AND ONE OF THE FIRST IN THE WORLD.
AT THE TURN OF THE 17TH AND 18TH CENTURY I RAN A "BARBER SHOP" AT THE WIELICZKA SALT MINE.

Already in 1289, Duke Henry IV Probus ordered the establishment of a bathhouse in Wieliczka, where miners could use the services of a "barber". In 1363, Casimir the Great founded a hospital and a hospice. The monks working there treated the sick and took care of the disabled and old miners. It was financed with money from the mine. If Bendzisławska was not skilled enough to make good use of the tools inherited from her husband, no one would risk employing her.

High skills and surgical artistry allowed her, after the death of her husband, to run a medical practice in the Salt Mine in Wieliczka.

Female Surgeon

The 1834 an issue of the "Krakow Weekly" featured a document about Bendzisławska. Unfortunately, the original burnt during the great fire of Krakow in 1850. It contained a note entitled a "Woman Surgeon". It described, in both Polish and Latin, a visit of a royal commission to Wieliczka. The documents contained information about a widow of a "barber" Walenty. She presented a royal privilege to practice the profession of a "barber" issued by Jan III Sobieski to her husband. She also showed a similar one issued by Augustus the Strong, granting this privilege to her. The document confirmed Magdalena Bendzisławska's appropriate knowledge and skills.

In the old days, only men could become "barbers". That is why it is all the more admirable, that Bendzisławska became an independent surgeon in such a respectable institution as the Wieliczka Mine.

Self-Confidence and Nerves of Steel

What were the duties of the first female surgeon? She probably performed the responsibilities of today's dentists (although certainly limited to removing teeth, not treating them). She probably had the most frequent contact with trauma surgery, ranging from everyday injuries or abrasions, to fractures and injuries, which were not difficult to come by working underground. It is well-known that the working conditions those days were poor – from proper lighting to safety measures. All the medical procedures were performed without anesthesia, so the surgeon's confidence had to be accompanied by nerves of steel.

Jan Heweliusz
Johannes Hevelius (1611–1687)

Johannes Hevelius, known in Poland as Jan Heweliusz, was one of the most outstanding scholars in 17th century Europe. Scholars from the most prominent scientific circles of England and France, recognized his achievements. They found him inspiring – both in terms of the subject matter and his scholarly assiduousness. He was a city councilor, brewer, constructor, and scientist. He focused on many fields, but he was always diligent.

Johannes Hevelius was born in Gdańsk in a family of brewers and merchants, as the eldest son of Abraham and Cordula née Hecker. Despite the many variants of his name, he liked most the Latinized form – Hevelius, which he used since his studies, along with the first name Johannes. Before entering university, Hevelius received education from professors at the academic gymnasium located in his hometown. The road he had to take to become an academic was not an easy one. Other responsibilities awaited him, which eventually helped him become one of the most famous sky observers in the history of the world.

In 1630, he went to Holland, to the city of Leiden, to study law and economics. These majors were supposed to help him run the family business in Gdańsk. However, these disciplines did not particularly interest him, and after about a year, he resigned. Since the local university did not teach astronomy at a high level, Johannes decided to go on a scientific trip around Europe. He seized the opportunity to conduct sky observations wherever he could. After staying in London for some time, he moved to France, to meet many famous scientists. He also wanted to go to Italy, but his father's illness forced him to return home. Someone had to run the family business. Keeping with family traditions, Johannes worked in a brewery and became a member of the brewers' guild. His brewery made a strong beer called Jopenbier, which was considered one of the best in Europe. The brewery was not his only workplace, as he


I WAS AN ASTRONOMER, DESIGNER OF SCIENTIFIC INSTRUMENTS, A MATHEMATICIAN, AND A VERY GOOD BREWER.
I CREATED SELENOLOGY, THE SCIENCE OF THE MOON. I WAS THE FIRST TO MAKE ACCURATE MAPS OF THE SURFACE OF THE SILVER GLOBE.
I DISCOVERED 4 COMETS, 12 CONSTELLATIONS AND CREATED AN ATLAS OF THE POSITIONS OF 1,564 STARS.

also held various public offices. He administered St. Catherine's Church, became a juror, served as a councilor and inspector dealing with matters of several guilds. He also held the office of the judge of the Old Town.

Finally, Astronomy!

It took some time before he became seriously interested in astronomy. It was at the request of his favorite teacher, who was still at a school in Gdańsk. On his deathbed, Piotr Krüger asked Johannes to return to observing the sky. The first task, was to observe an upcoming solar eclipse. The teacher's words were prophetic. Hevelius did not regret his decision, and his choice brought fame not only to him, but also to his hometown.

He was the eldest son of a well-known Gdańsk merchant and brewer. According to tradition, he took over the business after his parents.

His new profession was not easy, however. Discovering the secrets of the sky required instruments and unique rooms adapted for this purpose. The family business helped Hevelius. The funds needed for the investment, came from the production of beer in two breweries.

He founded the first astronomical observatory in 1640 – it was located in the attic of his tenement house. He called it *Stellaeburgum*, which means the Constellation or the Star Garden. In equipping it, Hevelius' glassworking and mechanic skills he had acquired earlier, came in handy. Johannes himself made telescopes, for which he precisely ground the lenses. In addition, he constructed a sextant and an octant – instruments measuring the height of celestial

After returning to Gdańsk, he took up his family's business, but he was so attracted to sky observations, that he eventaully did. The breweries, which he owned, provided him with the means to conduct research.

bodies above the horizon and a quadrant determining the position of stars. In 1650, he completed the construction of a new 140 sq.m. observatory. It was then the most modern object of its kind in the world. Unfortunately, as a result of an unfortunate accident, a fire broke out in the observatory and burnt the library, the printing shop, and the workshop, where Johannes created illustrations for his books. Hevelius, who was 68 years old at that time, had a strong supporter and immediately began the reconstruction works. It was possible thanks to the Polish King John III Sobieski, who exempted his breweries from tax and offered him an annual salary.

Talent for Drawing

Johannes illustrated all of his works himself, for drawing was one of his many talents. He wrote several books, but *Selenography* that described the Moon, brought him the greatest fame and recognition. At that time, it was the best and most detailed scientific study of our satellite. For the next 100 years, no one managed to do it more precisely. Three maps drawn by Hevelius accompanied the description of the Moon's surface. Johannes depicted the movement of the Moon and its phases. Some observations were quite surprising – the Moon "wobbles" a little (this phenomenon was explained in detail only by Isaac Newton). The book also included information about the moons of Jupiter and conclusions from observations of sunspots and planets. There were more than 40 drawings, also made by Hevelius.

To study law and economics, he traveled to the Netherlands. There he discovered, that he was more interested in sciences and decided to organize a scientific trip around Europe.

Johannes also attempted to describe comets, as he discovered several of them. He described 400 of them in another work entitled *Cometography*. Four hundred and six drawings illustrated the history of their appearance. At that time, he was the first to believe that comets move in an arc. Other astronomers claimed that they move in straight lines. It turned out, that it was Hevelius who was right. However, he was wrong when he claimed – as did other comet researchers of the time – that they arise from the fumes of celestial bodies. His subsequent great work was the two-volume *Celestial Machina*. He described the history of astronomy and summarized 20 thousand of his observations of the sky. Hevelius did not manage to publish his most excellent work before his death. It was done by his second wife, Elizabetha. It is the *Annunciation of Astronomy*, a large atlas describing over 1500 stars. Hevelius also wanted to publish the correspondence he had with scientists and rulers from all over Europe. The number of letters reached 3 thousand. He meticulously collected all of them and had them transcribed. However, they have never been published, either by him nor his heirs.

He was the author of books and studies, which were considered to be the best, even many years after his death. He was known and respected for the accuracy of the illustrations he made for his books.

Johannes Hevelius was very precise. Not only when he was grinding lenses for his telescopes or building measuring devices. Not only when he drew maps and made drawings, but above all when he made calculations. By adding his scientific bricks, he filled in places that would have remained empty for a long time.

Stefan Banach
(1892–1945)

He did not finish his studies, received his Ph.D. by accident, but became a professor. We would probably never have heard about him, if it had not been for an accident in the Planty park in Krakow. His whole life seems to be a tangle of amazing coincidences. Today streets, squares, and university halls bear his name. He is called the father of the Polish school of mathematics.

Stefan Banach had a tough start. He was born in Krakow on March 30, 1892, and raised in a foster family. He only met his father. Life was certainly not easy, but he showed exceptional mathematical and linguistic abilities at school. Even before passing his matriculation exam, he was giving private lessons. After passing the exam, he worked in a bookshop, but he devoted every free moment to mathematics. He also started to study at the Lviv Polytechnic, at the Faculty of Civil Engineering. He continued his education there for two years only. Probably we would never have heard about Stefan Banach, if it was not for a coincidence. One day in 1916, a young scientist Hugo Steinhaus was walking in the park in Krakow, when he heard two men saying the words: "Lebesgue's integral." He was stunned by this fact, because this term was a novelty, known only to specialists. Steinhaus approached the young men. One of them was Stefan Banach, and the other was Otto Nikodym, a graduate student in mathematics and a teacher. The men explained to Steinhaus, that they often met together with another student, Witold Wilkosz, to discuss mathematics for pleasure.


ALTHOUGH I DID NOT GRADUATE, I DEFENDED MY PH.D. AND THEN I BECAME A PROFESSOR.
MATH WAS MY LIVE. I LOVED TALKING ABOUT IT IN PARKS, CAFES, AND LECTURE ROOMS.
I SOMETIMES DELIVERED LECTURES DRESSED UP IN A TUXEDO, BECAUSE I WOULD RUN DIRECTLY FROM A BALL.

Surprise Doctorate

It is not often, that in public places, you find young people discussing news from the world of mathematics. Steinhaus, curious about his new acquaintances, told the students about an interesting scientific problem he was working on at the time. How surprised he was when, after a few days, he received a ready solution from Banach! They soon published it as a joint paper in the "Bulletin of the Krakow Academy". This unanticipated event became the beginning of a long and fruitful scientific relationship. Many years later, Steinhaus said that his most significant discovery in life was... the discovery of Banach!

Banach was a co-founder of the Lviv school of mathematics, thanks to which Poland became a mathematical powerhouse. Banach himself became one of the most recognizable mathematicians in the world!

In 1917, Banach traveled to Lviv to attend Steinhaus' habilitation lecture. Three years later, he was appointed an assistant at the Lviv Polytechnic by Professor Antoni Łomnicki. The university regulations were very strictly bent, as Banach had not finished his studies! The condition was that Stefan submitted his doctoral thesis within a year. However, he did not want to spend any time preparing the dissertation. His friends encouraged Banach's assistants to follow him step by step and write down all his thoughts, theories, and ideas. It took them six months to collect material for a substantial publication. Still, the author steadfastly refused to appear before the committee. They had to use a tric.

His genius might not have been discovered,
had it not been for an accidentally overheard discussion
on a park bench, that Stefan Banach was
having with his friend.

One day, one of the employees asked Stefan to come to the secretary's office. There were a couple of gentlemen from Warsaw waiting there, who had an interesting problem to solve. Attracted by the prospect of an exciting discussion, Banach eagerly agreed to talk to the newcomers, who were very curious about his current work. Imagine his surprise when the gentlemen announced a positive result of his doctoral defense after the conversation!

In 1922 Stefan Banach defended his habilitation thesis. He was 30 years old then! After another few years, he became a professor. That is an awe-inspiring career for such a young scientist. There was nothing strange about it. Banach, in addition to giving lectures, very quickly took up scientific and research work. He became one of the founders of a new mathematical field, called functional analysis. Young, talented mathematicians gathered around

Steinhaus and Banach, who created the Lviv School of Mathematics. The Poles gained worldwide recognition at that time. It is a phenomenon that during the interwar period, in a challenging time for Poland, Banach's homeland grew to become a mathematical power; although, it did not have such traditions before. Banach created almost 60 scientific papers in that period, but he also wrote many books and textbooks. One of the most famous is *The Theory of Linear Operations*. The Pole became very recognizable in the world of mathematicians. His concepts, such as the "Banach space", are known today to every mathematician in the world.

He survived the war thanks to Professor Rudolf Weigl, who employed him in his medical laboratory as a "lice feeder".

The Lice Feeder

When the war broke out, Stefan Banach found himself at the University of Lviv as dean of the Faculty of Mathematics and Physics. Under the German occupation, the universities were closed. The academic staff, who comprised of the Polish intelligentsia, was exposed to the danger of arrest, deportation to concentration camps, or even death. Professor Rudolf Weigl (you can read about him in this book) came to help his colleagues. At that time, he was working on the world's first vaccine against spotted fever. The Germans gave him more freedom of action, because of the high demand for the vaccine, also among German soldiers. Weigl could therefore employ workers as... lice feeders. Banach was one of them. The activity itself was not time-consuming, so Stefan Banach could conduct scientific work. The work at the Weigl Institute was partly a cover for his underground activities and secret scientific courses.

Despite the war, the mathematicians tried to maintain normality. Their meetings in the Scottish café became famous. They would discuss various issues, often writing the solutions in pencil directly on the tables or napkins. After they lost their notes several times, Banach's wife, Łucja, bought a special notebook in which they noted riddles or solutions. The book was in the café, and visitors could write down answers at any time. Sometimes they received a reward, for example, a live goose. Specific issues remain unsolved today and are waiting to be deciphered.

Strange as it may seem, Banach was utterly undisturbed by the café noise and loud music. He was able to concentrate his thoughts in any circumstances. Moreover, Banach enjoyed the company of people and lively discussions – many of his works resulted from disputes with students. He was also a frequent guest at private balls. Sometimes students saw Banach giving a lecture in a tailcoat at eight in the morning. At first, they suspected that he had some important lectures that day, but they soon realized that Banach's way to work led straight from the last dance at the ball. Stefan Banach lived to see the end of the war, but he became very ill and died of lung cancer in 1945.

Stanisław Lem
(1921–2006)

According to Philip K. Dick, Stanisław Lem was said not to exist, although his books have been translated into 40 languages. Czesław Miłosz swept the Nobel Prize under his nose, and Andrzej Wajda sought inspiration in his works. Today, Lem is considered the most outstanding representative of Polish fantasy, who had a significant impact on the development of the entire genre and instilled in the minds of scientists ideas for technologies that are only now coming into everyday use.

"Does Stanislaw Lem exist? Or is he just a communist annex – a committee made up of communist writers to infiltrate the international science fiction community?" – such fantastic theories emerged in 1974 in the mind of American writer Philip K. Dick. In his opinion, one person couldn't present such a multitude of styles and subjects, so he concluded that an entire organization was operating under the pseudonym "Lem."

Dick's conspiracy theory even made its way to the FBI's desk, but investigators did not give it credence. As a result, further works of the Pole broke through the Iron Curtain, and he gained honorary membership in the American Guild of Science Fiction Writers. However, the popularization of Lem's works abroad was hampered by his compatriots themselves. Censors checked and detained his correspondence with foreign publishers, and later blocked his departure from the country. Despite this, Lem is listed among the most influential science fiction and futurological authors today. He succeeded in predicting, among other things, e-books, tablets, the Google search engine, 3D printing, virtual reality, and the... The Matrix, a giant simulation in which we might all participate.


A PLANETOID HOLDS MY NAME – 3836 LEM.
I HAVE WRITTEN MORE THAN 40 BOOKS, THE MOST IMPORTANT OF WHICH ARE: SOLARIS, CYBERIAD OR FUTUROLOGICAL CONGRESS – ARE ALL AMONG THE WORLD CLASSICS.
I PREDICTED THE CREATION OF E-BOOKS, TABLETS, GOOGLE SEARCH, 3D PRINTING AND VIRTUAL REALITY, MANY YEARS BEFORE INTRODUCTION OF COMPUTERS.

1 in 17 million

When was Lem born? Seemingly a simple question, but the answer is not unequivocal. "Who would want to celebrate his birthday on the thirteenth day of the month, if it brings bad luck?" – stated the young parents of little Stanisław, who on paper became one day older than in reality.

Lem was born in Lviv, which in the interwar period was the second most important city of the Rzeczpospolita. Lviv lay at the junction of East and West, and was full of social diversity: from children of the poor fighting over lumps of coal falling from porters' carts, through neighborhoods of Jewish merchants and districts filled with traces of the Polish-Ukrainian war.

Lem, however, was fortunate to be born into a home where there was money. From the beginning, he showed above average talent.

In an intelligence test, he boasted the highest score among all middle school students in southern Poland. The future writer achieved the result of 180 points, which statistically comes once in 17 million cases! Such a result meant that he could have successfully pursued philosophy or quantum physics. However, his plans were thwarted by the war.

Although he passed his exams to the Lviv Polytechnic, his bourgeois background closed the door to the world of mathematics for him. It was already the time of Russian occupation and the communist regime promoted the working class. Lem, therefore, followed in his father's footsteps, joining the ranks of medicine doctors. However, his studies were interrupted by the Nazi invasion, which Lem's family of Jewish descent could have feared much more than the Soviet Union. Fortunately, thanks to forged falsified documents, everyone managed to avoid being sent to the ghetto, and Stanisław began working as a welder in German factories, where he obtained ammunition to support the resistance. Unfortunately, the turmoil of war soon threw Lviv outside the borders of Poland. The Lem family decided to emigrate. In the East, they left the achievements of their entire lives.

Cosmic Debut

What kind of portrait of Lem arises in our heads when we try to recall him? Probably it's a smiling older man in a beige sweater and a shirt. He has glasses with thick, round lenses on his nose, and a scientific periodical on his lap. On the table stands a typewriter, and in the background, a bookshelf stacked with books. This is precisely how Lem's life after moving to Krakow looked like, but he didn't immediately begin to make a living from writing.

Consistent with his education, Lem tried a job as a doctor, but he was discouraged by a large amount of blood (he was supposed to assist

in 20 births and cesarean sections). So he thought about returning to the learned trade of a welder. At the same time, he began to publish poems and short stories – first with occupation themes, as in *Hospital of Transfiguration*, the action of which took place in a psychiatric hospital cut off from the world.

The breakthrough was the futuristic novel *Astronauts*, printed in episodes in the "Sztandar Młodych" magazine. The successful debut gave a foretaste of how broad the themes of his future works would be.

Lem's Space Odyssey

Lem set the plot of *Astronauts* in the future, but commented on contemporary events. He had always followed scientists' ideas, and those of the Soviet Union were particularly prolific after World War II. They wanted, among other things, to raise the temperature of the Arctic and build railroads through the Himalayas to be used by nuclear energy powered locomotives. Some of the ideas were implemented, such as changing the course of Uzbekistan's rivers Syr-daria and Amu-daria, which led to the Aral Sea's ecological disaster. Lem gave them other ideas: irrigating the Sahara or building artificial stars.

The Astronauts, in turn, are an interdisciplinary team sent to exploring Venus, after finding the remains of a civilization there.

Each of the protagonists was an expert in his or her field, which was to become characteristic of Lem's novels. When other authors were spinning stories from the perspective of laymen, he was picking on experts.

In *Doctor Diagoras*, the titular scientist creates an intelligent jelly that is able to communicate using ectromagnetic pulses. At another time, in *Invincible*, Lem introduced the concept of the necrosphere to describe life-destroying robots – the biosphere.

In 2011, Google celebrated the 60th anniversary of the release of *Astronauts*. The homepage of the search engine turned into a game inspired by the plot of *Cyberiad*.

In the book *Solaris*, at one point, the researchers turn out to be subjected to the experiments of the Ocean – a more advanced being that covers the titular planet and can not only penetrate the subconscious of humans, but also read the hidden fears and obsessions.

Solaris was Lem's unique novel, because it was the first to get a large-budget screen adaptation – and one that was immediately advertised as the Eastern Bloc's answer to Stanley Kubrick's 2001:

A Space Odyssey. Andrei Tarkowski – in love with the Russian translation – worked on it. Lem, however, had a completely different opinion on the matter. The Pole was interested in the philosophical aspects of understanding extraterrestrial intelligence, while Tarkowski was interested in the romantic relationship between the two main characters and their moral choices.

Reportedly, Lem never fully watched the adaptation of his prose, stressing that Tarkowski filmed not his book *Solaris*, but Dostoyevski's *Crime and Punishment* in Space. The only adaptation he liked was this own screenplay. It was 1968's *Interpreter*. At that time Andrzej Wajda himself was behind the camera, and the main role was played by Bogumil Kobiela. He played the role of an unlucky rally driver, whose successive body parts are replaced by the organs of others. In the end, only the face was left of the original driver – all other body parts, including the brain, had already come from other people. So who was the main character?

Cyber Reality

Lem asked questions, that other authors of his era never have thought of. He kept his concepts fresh when others recycled ideas, for the umpteenth time describing interstellar conflicts. He did not escape into clichés and conventions, precisely explaining to the reader the intricacies of the universe and the frailties of human nature. Moreover, he controlled language as specifically, as no one had managed to do before. This gave Lem great confidence in word games. *Cyberiad* is full of them. It is a series of stories about brilliant constructors and inventors: Klapaucius and Trurl. Once upon a time, the former put to the test, a machine created by the latter. One of the tasks he gave it, was to come up with a poem that consisted of: six lines and in them ideas about love and about betrayal, about music, about Negroes, about the upper classes, about misfortune, about incest, to rhyme, and that all the words should be only beginning with the letter "C" The machine, of course, did a good job.

Lem's language is exceptionally malleable and full of neologisms, which became an incentive for intellectual play, as in the case of the bootcleaner, i.e., a shoe-cleaning computer, or a musical instrument-synorpane.

Trick the censor

Lem also played games with censors, who cared about the purity of the thoughts contained in the books, i.e., making sure that the communist system was described favorably or not at all. In doing so, he did not hesitate to place in his worlds despots torturing subjects and

maintaining political police. His heroes, however, were able to handle trouble every time.

This was Lem's message to artists, who had only their pen, chisel or brush to fight against censorship.

Lem employed such a trick in his novel *Eden*, the title of which perversely refers to paradise. The reality, however, resembled a horror movie, where a "faceless tyrant" condemned his subjects to be exterminated, if they did not fit his personality pattern.

These, on the other hand, were incapable of organizing themselves, drowned in sleaze and deprived of information by propaganda. Thus, one can see here a clear reference to the Holocaust planned by Hitler, the post-war purges of the Soviet Union, and deportations to the gulags.

How did Lem manage to publish such metaphors at a time when the general secretary of the Central Committee of the Communist Party of the Soviet Union was Nikita Khrushchev? The writer quickly discovered that it is enough to set his story in fantasy realities to fool the censors. These, after all, could not argue that degenerate grotesque political experiments from distant planets, resembled the communist system. They would then be exposing themselves to criticism.

The world would not be the same without Lem

Towards the end of his life, Lem devoted himself to his work as an essayist and columnist. He focused on the problems that humanity will have to work through in the near future. He foresaw the post-truth era and warned against disinformation. He did not see technology as a cure for all evil. He suggested that we should not rely on it too much, and admonished that it can be used for good and evil.

Today, the world is rediscovering Lem. Although his greatest works made their way to the West long ago, *Summa technologiae*, for example, was translated into English only after the writer's death. Reviewer of the prestigious "The New Scientist" magazine, enthusiastically emphasized that if the book had gotten into the hands of scientists 50 years earlier, the world would have looked different. Many of Lem's predictions were to come true in practice.

Lem was quickly gaining cult author status in the places where his books found their way without delay, e.g., the Soviet Union. Already in the 60s, he was appreciated by scientific, philosophical, and literary circles. Today, his work is expanding into the Spanish and Chinese world, which shows that it has stood the test of time. *Solaris*, *Cyberiad* or *Invincible* are being reread today. The popularization of the subsequent novels was possible, because of the the celebration of Lem's year. It was in 2021 that the writer would have celebrated his 100th birthday.

The end...
or maybe just the beginning?

This is Maria Goeppert-Mayer, born in 1906 in Katowice. Silesian physicist of German origin, Nobel Prize winner in physics (1963) for "coverings on the shell structure of the atomic nucleus." One of three women in history to receive the Nobel Prize in physics. Do you want to learn more about her story in the next book? Or maybe you want to learn more about Dr. Anna Tomaszewicz-Dobrska, Karol Olszewski, and Zygmunt Wróblewski? Be sure to let us know which biographies you would like to read?

Write to:
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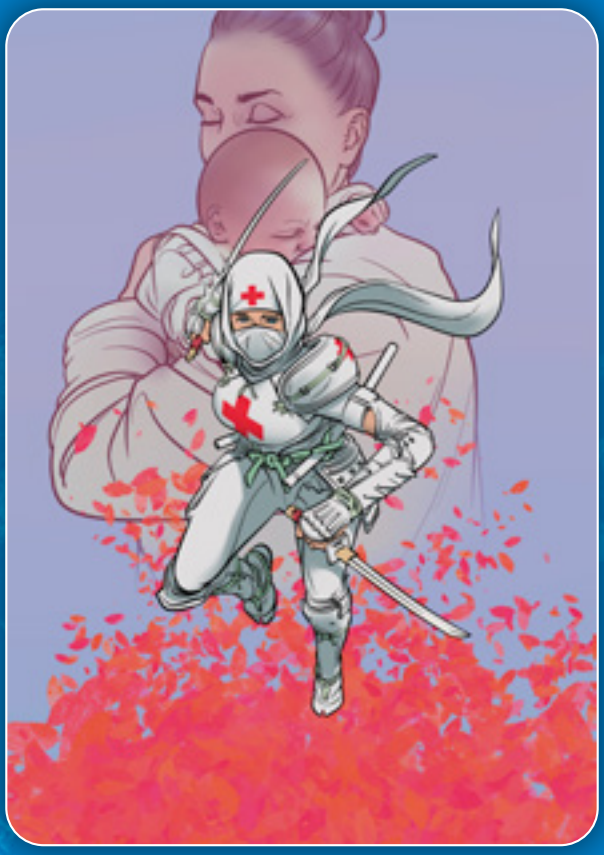
Maria Goeppert-Mayer



Anna Tomaszewicz-Dobrska

Zofia Kowalewska

Karol Olszewski

Zygmunt Wróblewski

About the Foundation

The Foundation Nauka. To Lubię (Science. I like it) was founded in 2020 by Dr. Tomasz Rożek – a physicist, science journalist, and a long-time popularizer of science known from the channel Nauka. To Lubię on the YouTube platform. The goal of the organization is to conduct educational and comprehensive activities, to promote science and technology, as well as give active support to the state and society, especially families, regarding the use of science and technology.

The statutory objectives of the Foundation are carried out primarily through the popular science website **Nauka. To lubię** and the YouTube channel. Both platforms are where Dr. Tomasz Rożek presents scientific discoveries and discusses them simply and understandably. With the youngest viewers in mind, a separate channel was created – **Nauka. To Lubię Junior.** It presents curiosities, educational resources, and exciting experiments for young viewers. Among the organization's key projects is the Academy of the Digital Parent, which guides parents and teachers through the virtual world, which is full of opportunities and dangers for children.

Nauka. To Lubię conducts vigorous activities to promote outstanding Polish scientists and their achievements on a global scale. ***The Academy of Superheroes*** was created for this purpose and is an original educational project of Dr. Tomasz Rożek. The Foundation **Nauka. To Lubię**, as part of its mission, awards grants to talented young scientists. It supports, sometimes crazy, but always valuable projects, of young people with great potential.

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AND THE DEVELOPMENT
OF THE FOUNDATION'S PROJECTS.

Ministry of Foreign Affairs
Republic of Poland

Nauka
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