HISTORY OF SCIENCE IN GDAŃSK

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Abstract: This is the first part of the book entitled *History of Science and Technology in Gdańsk*, edited in 2014 for the 110th anniversary of the Gdańsk University of Technology (*Politechnika Gdańska*). It begins with a concise history of the local education with emphasis laid on schooling in the field of technology. It is followed by the history of the University of Technology founded in 1904 as German *Hochschule* but always having many Polish students. In 1945 it was transformed into a Polish university. The next sections are devoted to the prominent scientists of the old Gdańsk and their worldwide important achievements, not always sufficiently popularized. Many of them were members of foreign academies and scientific societies including the Royal Society of London. Then, the scientific societies of the past Gdańsk are presented, including but not limited to the Experimental Physics Society (later Naturforschende Gesellschaft), one of the first such institutions in the world. Last but not least, scientists of the beginning of the 20th century are presented as well as the pioneers of science in Gdańsk after World War II, who had to rebuild the destroyed infrastructure and create the scientific life in Gdańsk from scratch.

Keywords: history of science, history of Gdańsk

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1. Introduction

The pre-partition *i.e* prior to partitions of Poland Gdańsk, restored to Poland in 1454, was the largest and richest city in the country (with more than 70,000 inhabitants in the 17^{th} century), the main port, and a leading centre of trade, crafts, science and culture. Printing houses started to operate from 1498 and the general compulsory schooling was established in 1526. In 1540 *Narratio Prima* - the first story about the Copernicus system - was published in Rhode's printing shop in Gdańsk. On this occasion, the author, Joachim Rheticus, measured the magnetic declination, initiating the world earliest curve showing its changes. The famous Academic Gymnasium started to operate in 1580, the Gdańsk Library in 1596, and the first periodical newspapers in Poland started to be published in 1619. From 1641 Johannes Hevelius operated the first permanent astronomical observatory in the world which was equipped with telescopes. This was the place of work and birth of such scientists as Philipp Clüver, the founder of historical geography; Daniel Gabriel Fahrenheit and Daniel Gralath, the pioneers of physics; the mathematicians Peter Krüger and Heinrich Kühn; the naturalists Jacob Theodor Klein, Johann Rajnold and Johann Georg Forster, participants of Cook's second expedition, the great philosopher Arthur Schopenhauer; Hugo Conwentz, a pioneer of the European nature conservation, Adolf Butenandt, a biochemist and Noble Prize winner, and many others.

2. Prehistory

When was science born in our land? It is impossible to offer a specific date. It was already the nomadic tribes moving to and from these areas in pursuit of game that must have had the ability to associate facts and draw conclusions. Similar objects and events were linked with one another and the gained experience was used to create an intuitive theory that would help increase the effectiveness of meeting the needs. The equivalent of the scientists of today were elderly people sharing their knowledge with young generations and becoming their teachers. In this way, peculiar schools of life and survival functioned about which we know practically nothing. It was the priests who possessed this peculiar knowledge, intertwined with superstitions, however, they would pass its basics to their successors only. Thus, we can speak about the beginnings of true science in our country only after Christianity had been introduced and church schools where students learned how to write and could read literature, to a modest extent at least had been established. Owing to the far-sighted decision of the first rulers, we stepped into the Western World of the Latin culture - the magnificent heritage of the ancient Rome. Gdańsk Pomerania had a chance to encounter its representatives as early as in the times of the Caesars, when Roman merchants would come to get amber, nevertheless, these were purely trading relations, more on a material than spiritual level. The products they were bringing occasionally may have had an effect on the domestic technology of manufacture, nonetheless, this impact was hardly very profound. Real ties with the Western culture began to take shape only when Pomerania had been incorporated into the state of Mieszko I in the late 10th century. It was the year 997 that was of great significance in this respect, when St. Adalbert and his companions arrived at *urbem Gyddanyzc* - the City of Gdańsk, to pay a visit [Fig. 1]. He celebrated a mass in the Latin rite, baptized plentiful masses of people and sailed to the land of the pagan Prussia to be martyred there. His stay in Gdańsk did not go unnoticed. The first church must have been built, doubtlessly on the territory of the state hillfort where priests started their activities. A school may have been established, about which there is no mention though. All these processes were fairly superfluous at the time. Subsequent relapses of paganism would restore the former state of affairs, nonetheless, the minds of the citizens of Gdańsk and Pomeranians at that time retained the awareness that somewhere in the West there was a world where people lived in a different, perhaps better way; a world it would be worth striving for. Gdańsk and Pomerania eventually became a part of this world when Bolesław Wrymouth had incorporated Poland thereto in 1119. Governors were appointed originating the later dynasty of the Samborides. Gdańsk became part of the Kuyavian diocese (in 1148 – as evidenced) with the seat in Włocławek (Leslau) and a network of parishes and parish schools started to be created. A great breakthrough began.

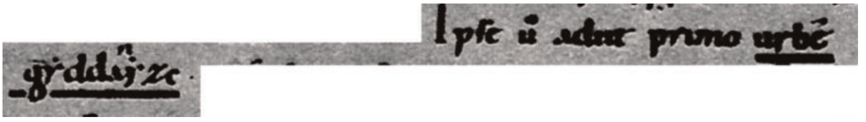


Figure 1. *Ipse adiit primo urbem gyddanyzc* – He (St. Adalbert) first arrives at the city of Gdańsk (997)

3. Education

The first piece of information about a school in Gdańsk is incidental. Three masters: Evrardus, Johannes - described as *physicus* (most probably a physician) - and Gerwinus, "the master of boys" (magister puerorum), *i.e.* a teacher, were mentioned as witnesses of a document of Prince Świętopełek II from 1227 transferring the St. Nicholas Church to the Dominicans who had come from Krakow. This first school in Gdańsk may have functioned at the hillfort parish, and after 1227, at the St. Catherine church. Latin church schools taught reading, writing, the Catechism, singing and calculation. Chalk was used to write on a blackboard, a stylus on a wax tablet, and ink on parchment. There were also monastic schools - with the Cistercians in Oliwa at least from 1224, with the Benedictines in Święty Wojciech (St. Albrecht) after 1236, with the Dominicans in Gdańsk before 1287, etc. The monastery in Żukowo (Zuckau) which was founded in 1214 ran a female school for novices and also for daughters of noblemen and the bourgeoisie at a later time. Girls learned writing, reading and handicrafts. The most educated people were monks, priests, the noble knighthood and the bourgeoisie. Even in the countryside there were quite a lot of people who could read and write.

Mentions about citizens of Gdańsk studying at universities in various countries appeared in the 14^{th} century. In 1357, the name of Peter Pungow from Rybacka Street (Straganiarska Street now) was mentioned; unfortunately, it was not said at which university he studied. In 1376, another student from Gdańsk (the surname was not mentioned at that time) received a bachelor's degree at the University of Prague. In the years 1376-1400, 16 residents of Gdańsk graduated from this university with an academic degree. More information comes from Bologna (1392 and 1395), Erfurt (1400) and Krakow (after 1400, no lists are available from earlier periods). The list of the first students of the University of Rostock, founded in 1419, includes 11 residents of Gdańsk. In the years 1430-1454, 55 students from Gdańsk were enrolled in Leipzig, 34 in Krakow, 24 in Vienna, 15 in Rostock, 8 in Erfurt, 6 in Cologne and 3 in Bologna. More and more representatives of the enlightened classes, clergy and city authorities received PhD degrees. In his *Labyrinth of Married Life* (*Labirynthus vitae coniugalis*, 1432) the city writer, Konrad Bitschin, a graduate of the Sorbonne, was the first to try to capture the entirety of the knowledge of that time: education of young people, methods of ruling the state, the art of war, horse breeding, etc., intermingling the text with colourful stories, such as the story of Grizeld, the most faithful of wives. The Thirteen Years' War resulted in decreasing numbers of students, especially in Krakow: with only 14 in the years 1455-1466, compared with 18 in Leipzig, 17 in Rostock, 15 in the newly opened university in Greifswald, 2 in Vienna and 1 in Bologna and Cologne. In the subsequent periods, the first place was taken by Kraków, where 67 citizens of Gdańsk studied in the years 1467-1492, compared to 41 in Leipzig, 17 in Rostock, 8 in Greifswald, 3 in Vienna and Erfurt, 2 in Cologne and 1 in Bologna. These preferences could be seen even more clearly in the years 1493-1517: 88 students from Gdańsk studying in Kraków, 34 in Leipzig, 18 in Rostock, 17 in Greifswald, 9 in Cologne, 5 in Vienna, 3 in Erfurt, Tübingen and Bologna, 2 in Heidelberg, etc. After the victory of the Reformation, sons of wealthy patricians more often would choose Protestant universities to the disadvantage of the Catholic Krakow. There was still no university in Gdańsk.

Schools established or reinstated in the $14^{th}/15^{th}$ centuries at: St. Mary's (the first mention in 1350), St. John's (a teacher mentioned in 1472), Peter and Paul's (1436), Barbara's (1421), Catherine's (1422) and Bartholomew's (1416 - in the Young City) churches survived in a more or less altered form until 1945. In the beginning, teachers were staffed by church authorities. This tradition was broken by Władysław Jagiełło in 1410 who conferred upon the City Council the right to appoint and dismiss the Rector of St. Mary's School, the largest and most important university in the city. In 1436, all schools were under the city's patronage. The German language was introduced in addition to the existing Latin.

The Reformation tried to impose compulsory education on all children, rich and poor (1525). The education system was reformed in 1539 by the eminent educator Andreas Aurifaber (Goldschmidt). Latin and German schools were merged. The curriculum was broadened to include the Latin grammar and the basics of Greek. Special care was taken of poor children. From 1551, they would be provided with clothes, books, paper and ink by the school. A typical school building comprised a kitchen and 5-10 rooms. One of the rooms served as the rector's apartment. Unmarried baccalaureates lived in unheated rooms. The discipline was enforced by a rod which could be used to hit "loins in a gentle manner, so that there should be no complaints". The motivation to learn was participation in staged Latin comedies. Some schools had five grades each – where the fifth grade was the lowest. There were up to eight teachers in each school, there were more than 200 students in the grades. Polish was taught in many schools.

In addition to parish schools there were also private schools called 'independent' (54 in 1663). Schools were supervised by the then education office, as of 1600 known as the College of Scholars, composed at a later time of the mayor, three councillors, two jurors and four representatives of the Third Order.

4. Academic Gymnasium

In 1558, the so-called *Particular* or Evangelical Latin secondary school was established in the acquired post-Franciscan monastery by the endeavours of the Mayor, Constantine Ferber, which later, in 1580, was transformed into the Academic Gymnasium [Fig.2] divided into chairs. The first four grades were extended to include two higher grades where philosophy, law, history, medicine, theology, mathematics with geography and astronomy were lectured and retorics, poetry, as well as Polish, Greek and Hebrew were taught. The studies proper, equivalent to the first two years at the university, were pursued by students of knowledge in the highest - second and prime – grades, where each course of study would last for two years. The objective of education in the three lower grades was to prepare students for this stage. The ambitious curriculum covered chiefly the basics of Latin with 15 hours per week in the lowest fifth grade, 12 hours were devoted to calligraphy, calculation and elements of the Polish language, four hours were used to teach the Catechism and sentences from the Holy Bible. In the next grade - the quarter - some of these burdens were replaced by an hour of arithmetic and four hours of music. In the third grade, students were fluent enough in the language of the ancient Romans that they could recite poems and hold debates, and also start to learn classical Greek.

Figure 2. Academic Gymnasium in 1687 (P. Willer)

The curriculum in the highest grades included classes (in Latin) in theology, logic (4 hours per week), philosophy with elements of Hebrew (4 hours), rhetoric (7 hours), etc. In the best years, the Gymnasium was attended by 600 students from various parts of the country and from abroad. The professors were such celebrities as Bartholomew (Bartholomus) Keckermann (1572-1609), author of the first history of logic in the world, Peter Krüger (1580-1639), mathematician and astronomer, student of the great Kepler, teacher of Hevelius, Johann Kulm (1689-1745), whose textbook on anatomy was translated into seven languages (including Japanese), and many others. Their achievements will be discussed in more detail in the chapter entitled *The Gdańsk Coryphaei of Science*. The level of education in the Gymnasium was so high that foreign universities enrolled its graduates for the third year of studies. A high level of education was also represented by the Jesuit College in Stare Szkoty (Alt Schottland) which was opened in 1621.

The Saxon times brought the downfall of schools from which they were lifted by the reform of 1788. It was at the time that schools would be formed in a way similar to those of today. The Prussian authorities transformed the Academic Gymnasium into the City Gymnasium (1817; located in the building designed by Karl Friedrich Schinkel at Targ Maślany from 1837) [Fig.3] and reformed the other schools. From then on, the old traditions were shown by their names only. In 1794, Karl Friedrich Conradi referred to them by creating the teaching foundation "Conradinum" (the school in Jankowo from 1801, moved to Gdańsk in 1901). The School of Arts and Crafts established in 1803, the Navigation School (1817), the Ilgner Music School (1824) and the so-called Trading Academy (1833) should be mentioned among other new institutions. As of 1864, elementary schools started to be transformed into four-grade public schools. The first Real Gymnasium (on Łąkowa Street) with an extended curriculum of mathematics and natural sciences and the first Real Secondary School (former St. Peter's school) were opened in 1876 and 1888, respectively.

Starting from 1900, schools would be reformed in the direction that we know from the history of Poland too. A new quality was brought when the Gdańsk University of Technology (Technische Hochschule - in Polish Politechnika Gdańska) had been established in 1904. The interwar years include, *inter alia*, a period of fighting for the Polish school in Gdańsk. It was operated by the Polish Educational Society [Polska Macierz Szkolna] founded in 1921 by Franciszek Kubacz. More than 1500 young people studied in seven public secondary schools and more than 1200 in seven so-called Senate Schools operated by the Society with Polish as the language of instruction (1936). The last success before the war was the extension of the superbly equipped Polish Gymnasium at Białowieska Street, Augustyńskiego Street today (the Province Governor's Office nowadays) [Fig.4].

There were three higher education institutions in Gdańsk before the last war: the Gdańsk University of Technology (from 1904), the University of Education and the Academy of Practical Medicine - later the Medical University (both from 1934); moreover, 22 secondary, 38 primary and 8 vocational schools.

At the present time (data from 2014), there are 14 universities Gdańsk (including 6 public institutions) with more than 80,000 students, 87 secondary

Figure 3. Gymnasium at Targ Maślany (Photo: Januszajtis A.)

Figure 4. The Józef Piłsudski Polish Gymnasium, development design (Bielawski Z., 1936)

(including 31 secondary and 7 post-secondary), 68 primary and 42 vocational schools. Every third inhabitant of Gdańsk studies. A wide range of scientific disciplines is represented.

5. Libraries

In 1556, Giovanni Bonifazio, Marquess d'Oria, a supporter of the Reformation, forced by the Inquisition, left his native Naples. He supplemented the collected book collection during his journeys on which he spent all his life. In 1591, rescued from a sea disaster, a half-blind old man donated 1040 soaked volumes to “the benefit of young students and to the glory of the city” subject to the reservation that the books should not fall into the hands of the Jesuits. The epitaph in the Holy Trinity Church reads: “Here have the bones tossed over lands and seas for too long finally found the place of rest from wandering”. In 1596, the books having been arranged in order, with more than 1000 volumes of the Franciscan book collection having been added, the City Council Library was opened in former monastery halls.

The first librarian was Daniel Haselwurtz. The preserved regulations instruct to handle books “with clean hands and an open mind”. The number of books was rapidly growing owing to the support of numerous foundations. In the 17^{th} and 18^{th} centuries there were 60 large (more than 1000 books) private libraries in Gdańsk. The largest library - belonging to Heinrich Rosenberg – contained 22 000 volumes, including such rarities as *Flora Japonica*, of which in the World only two copies have survived. Most of these collections enriched the Council Library. Other church collections were added, including, *inter alia*, St. Mary’s Library - one of the oldest in Europe. Founded in 1413 by the parish priest, Andreas of Słomów, it was housed in the All Saints’ Chapel of St. Mary’s Church in 1458. The precious books were chained to the walls. All of these books are currently kept at the Gdańsk Library. Their bindings are masterpieces of the bookbinding craftsmanship.

In 1819, the “City Library” was moved to St. Jacob’s Church, and in 1905 - to the new building at Przybramna św. Jakuba Street (now a section of Wałowa Street) where it has been located to date [Fig.5]. The collections, taken over by the Polish Academy of Sciences after the war, serve thousands of readers every year. In 1914, there were 170,000 items, currently – there are more than 800 000 volumes including 56 000 old prints and incunabula, 10 000 manuscripts, 7 900 items of graphic and 9 800 items of cartographic collections. The exemplarily designed seat of the library became too tight with time. In 2005, a new building on the other side of the street was opened.

6. Pater’s School

The Gdańsk Academic Gymnasium was a school of humanities where special emphasis was placed on the study of philosophy, theology and classical languages: Latin, Greek and Hebrew. Bartholomäus Keckermann, professor of philosophy (1602-1609), was the first to draw attention to the basics of technology. In one of his treatises, he emphasized the special role of mathematics in the field of mechanics, in the construction of military camps and fortresses, and in defending them with the use of war machines. Physics in the Gymnasium was incorporated in the chair of mathematics or - sometimes - medicine. Some teachers introduced elements of technology as part of mathematics, particularly geometry and physics. This was the case in 1645-1660 when Laurentius Eichstadt who would teach physics as an introduction to medical sciences in which he would include optics, astronomy, gnomonics, statics, geography, chronology and architecture (!). One

Figure 5. The Gdańsk Library building (Polish Academy of Sciences) completed in 1905 (illustration from promotional materials of the Library)

of the the most remarkable teachers in Gdańsk was Paul Pater. He was of German descent and was born in 1656 in Wierzbowo - in Spiš which was then part of Hungary. Having graduated from a gymnasium in Wrocław (Breslau), he studied classical languages, philosophy, history and mathematics in Leipzig and Jena. From 1688, he lectured on mathematics at the Gymnasium in Toruń (Thorn). He was also involved in the manufacture of optical instruments.

In 1703 he presented King August II with a polemoscope which he made with his own hands. This instrument, presently known as the periscope, was invented in 1637 by Johannes Hevelius, the great astronomer of Gdańsk. The King repaid Pater by granting him a patent to print calendars in the whole of northern Poland, which provided him with additional income. The Northern War during which Toruń (Thorn) was besieged by XII of Sweden prompted Pater to leave. He intended to return to Wrocław (Breslau), but he visited Gdańsk to see the treasures of the famous Council Library and stayed. At first he made a living giving private lessons in astronomy, geography and the Latin style. In 1705 he was appointed professor of mathematics at the Academic Gymnasium and held the position until the end of his life. He died in 1724. His legacy includes 28 publications and not fewer than 18 calendar annuals. He instructed that the following inscription be engraved in Latin on his tomb in the Lord's Supper Church (the Holy Trinity Church presbytery) to read: "Here lies Paul Pater, professor of mathematics who never in his life struggled with a disease, was filled with anger or consumed with lust". He passed away as a bachelor on 7 September 1724".

In his classes with students Pater laid emphasis on practical skills and applied knowledge - mathematics and technology. He propagated and implemented his ideas already while working at the Gymnasium in Toruń (Thorn). He believed

Figure 6. St. Trinity Church presbytery - place of rest of Academic Gymnasium teachers (Photo: Januszajtis A.)

that "mechanics is the most useful science for all mankind," and that "wrong are those who think that exercises in mechanics are not worthy of a free mind". This was by no means anything new at the Academic Gymnasium in Gdańsk. Although natural sciences and sciences were assumed to be of little or no importance whatsoever compared to the predominating theology, philosophy and logic, some teachers would include them in their classes to an extent larger that contemplated in the official curriculum of education. One of those who would do it was Peter Krüger, professor of mathematics in the years 1607-1639. One of his successors, Friedrich.

Büthner (1663-1701) would additionally introduce knowledge in optics, mechanics, statics, architecture and civil and military construction within a modest number of hours dedicated to mathematics and astronomy. After his death, the earlier approach, not very favourable to this kind of innovation, prevailed. Contrary to the university authorities, Pater tried to enrich the curriculum to include mathematics and applied physics (e.g. simple machines), even with outlines of fortifications. Nonetheless, as it was impossible to fully implement his program in the Gymnasium, he would teach it at private courses. At the same time, he initiated efforts to obtain a concession to operate a printing shop where he could print his calendars. When he finally obtained the permission in 1711, he organized a Mathematical and Mechanic Workshop of Arts at his printing shop. As we will see later, it was the first school of technology in Gdańsk and in Poland. It was located at Żabi Kruk Street, possibly at the later number 39, marked in the land registers with the note “for the use of the Gymnasium”.

More detailed information on this school can be found in the promotional brochure entitled *Practical information on the newly founded Mathematical and Mechanical Workshop of Arts of Professor Paul Pater in Gdańsk*, although published in 1714, but also referring to the earlier period of its activity. Let us quote two from among the 13 items contained therein: 4. As regards the main business of this Workshop and who from among the teachers is in charge of the education, as it was the author himself who had established the facility by his own resources, it is also he who manages all things and carries out inspection not only over those who work in the printing shop, but over all other exercises as well. Before noon, he himself teaches the useful art of calculation, according to the weights and measures, geometry, how to draw any shapes on paper, and how to measure all the desired points and squares in the area or in the field with instruments suited to this purpose. He also shows geography and how to use the sky and the globe with all of their structure and application on maps of the country and in astronomy to easily recognize both planets and stars fixed in the firmament. And he uses many an afternoon hour for mechanical exercises by which he is particularly attracted, and in which he would practice for many years from his youth with the most eminent masters in Wrocław (Breslau), Augsburg and Leipzig. 5. A special room is provided where lenses are polished, perspectives [telescopes], microscopes, magic lanterns, thermometers and other useful optical things are made under the guidance of an experienced master of mechanics. The same master shows how to artfully prepare pipes [tubes] for perspectives and microscopes made of wood or cardboard and how to give them a shining with marrow or lacquer varnish prepared in the Italian way. And also how to meticulously lathe small handy and pocket perspectives, subtle microscopes, snuffboxes, etc. made of metal, ivory, amber, horn and rare types of wood with screws. As well as how to make, with the help of certain instruments and dividing heads, very profitably and quickly, any sundial, lunar and star clocks, transporters, rulers, quadrants, armillary spheres, compasses etc. of silver, brass and other materials. He shows those who have already mastered lathing and carpentry also how to build musical instruments, such as flutes, harpsichords, spins and harps, following the method of organ builders. He gives the basics and rules from the civil and military architecture: teaches how to make various models of churches, palaces, fortresses, pleasure houses [German: Lusthaus], fountains, voice tubes made of sheet metal, plaster, wood or cardboard, according to the scale. As regards statics, he shows the basics, understanding of and differences in the mass and weight, teeth and gears, screws and bolts, bearings and other major implements, and how it happens that we can lift a weight of many centners with one pound only.

We do not know who the “experienced master of mechanics” was, he, under whose guidance youngsters were trained, *inter alia*, in making thermometers, however, much shows that it may have been Daniel Gabriel Fahrenheit who stayed in Gdańsk at that time (until 1713) of whom we know that he worked with Pater. In his lectures, the professor used (as he himself claimed) “his own mathematical method”, based on the works of great English and French naturalists including Hooke, Harvey, Bacon and Descartes. He does not mention Isaac Newton, however, in view of the lively contacts of Gdańsk with England, it seems impossible that he should not have heard about his *Principia*.

Professor Pater was an example of laboriousness. In winter he would get up at 4:00 a.m., in summer at 2:00 a.m. to get on with his activities straight away. Like many scholars, he was known to be absent-minded. His thoughts were constantly revolving around “mathematical and mechanical” problems. Despite his various eccentricities he was liked by his students who defended him against allegations of school officials. A list of objects prepared after his death included many finished or unfinished optical instruments made by his students.

7. Technical Education in Europe

It remains to place Pater’s school against the background of similar initiatives in Europe. Starting from the Middle Ages, young adepts of technology learned its secrets in a guild system: apprentice - journeyman - master (foreman), drawing knowledge directly from the masters of a selected branch of the craft. In guilds and professional associations in general, as e.g. in construction (the so-called Masons’ Guilds), elements of technical knowledge were secret and could not be made public. The accelerating development of science in the 16th-18th centuries was the reason why guild training was not able to keep up with it, and changes were needed. Extending the curricula in the existing schools and universities to include technical subjects encountered resistance. The only option was to create a new type of institutions - vocational and technical schools. In fact, we should begin with those that operated on the borderline of art - civil schools of construction and architecture. The first of such schools to operate was the Academy of the Arts of Drawing in Florence (1563), then the Academy of Saint Luke in Rome (1577). Similar institutions were established in Paris (1671) and Vienna (1692), but these were not schools in the strict sense of the word. The Academy of the Arts of Painting, Sculpture and Construction (Akademie der Mahl- Bild- und Baukunst) founded in 1696 in Berlin was transformed in 1704 into the Royal Prussian Academy of Fine Arts and Mechanical Sciences (Königlich-Preußische Akademie der Kunst und Mechanischen Wissenschaften). The addition of “mechanical sciences” to the name meant only that the Academy was to educate also craftsmen manufacturing artistic objects: weavers, goldsmiths, watchmakers, opticians and mechanics, hence, specialists not so much in the field of technology, but rather in applied art.

In England, the first proposal to establish a school of technology with an extensive curriculum was formulated in 1647 by the learned physician, William Petty, who in a letter to Samuel Hartlib wrote: “I have had many flying thoughts, concerning the Advancement of Real Learning in general, but particularly of the Education of Youth, Mathematics, Mechanics, Physics, and concerning the History of Art and Nature…" He further elucidated his ideas for the reform of education in which he recommended, *inter alia*, that "all children, though of the highest rank, be taught some gentile manufacture in their minority, such as are turning of curious figures, making mathematical instruments, dials, and how to use them in astronomical observations, making watches and other trochaic motions, limning and painting on glass or in oil colours. graving, etching, carving, embossing and moulding in sundry matters, the lapidary's art of knowing, cutting and setting jewels, grinding of glasses dioptrical and catoptrical, botanic and gardening, making musical instruments, navarchy and making models for buildings and rigging of ships, architecture and making models for houses, confectioners, perfumers or dyers arts, chemistry, refining metals and counterfeiting jewels, anatomy, making skeletons and excarnating bowels, making mariners compasses, globes, and other magnetic devices."… "For the advancement of all mechanical arts and manufactures, we wish that there were erected a Gymnasium Mechanicum or a College of Tradesmen wherein we would that one at least of every trade (but the prime most ingenious workman, the most desirous to improve his Art) might be allowed therein"… Whether Paul Pater knew this program - we do not know, but the similarities are doubtless. Anyway Petty's Mechanical Gymnasium was never established. The first schools of technology in England started to appear as late as in the 19^{th} century.

Some elements of technical education were introduced by the so-called military academies, the predecessors of which were various types of specialized training institutes and military schools. In 1600, on the initiative of Maurice, Prince of Orange, a field of study in military engineering called "Low German Mathematics for Future Engineers" (Nederduytsche matematicque voor aanstaande ingenieurs) was inaugurated at the University of Leiden. The curriculum, developed by Simon Stevin himself, included mathematics, land surveying and military construction. Graduates would build fortifications of the Dutch type in many countries, also in Poland - in Gdańsk. The Italian builders of fortifications who were equally famous in Europe were trained rather by practice, although some of them were graduates of studies in mathematics and physics at one of the old Italian universities. In France, the first institution of this type may be considered to be the artillery school in Douai (1679). In 1716, Ecole de Ponts et Chaussées was established to prepare workers to build roads and bridges. In 1720, there were five similar military schools, in 1789 seven, including the famous Royal Engineering School of Mézières, founded in 1748. The School for Mathematicians and Navigators, opened in 1701 in Moscow, intended "for the skills of those who sail on the sea and for engineering skills, as well as for the artillery and civilians" should be considered as the first military academy in Russia. The cities in Europe where subsequent schools of technology were established included Berlin (1717), Turin (1739), Woolwich (1741), Wiener Neustadt (1748), Paris (1749).

Pater may have been influenced more directly by Christoph Semler, a pastor and educator in Halle, who taught courses for young people there in 1707-1710. Classes which were conducted twice a week covered “63 things, presented and explained in all aspects”, including: “a clock mechanism, house model, warship, fortress, salt works, mill, mine, chemical workshop, glassworks, weaving workshop, lathe, horse and wagon, plough, harrow and tillage; then: all kinds of scales, Irish coins, measures, ordinary stones, precious stones, all kinds of wool and silk, spices, seeds, roots, minerals, animals, birds, fish, sea plankton. As well as: geometrical and optical instruments, tools of the art of motion, types of barometers and fountains, a magnet, a compass, weapons, a drawing of a building, the topography of the city of Halle, sky spheres, and much more”. Nonetheless, it was not a school in the strict sense of the word. In 1727, the Prussian king, Frederick William I, introduced elements of technical knowledge to the program of study at the universities of Halle and Frankfurt (Oder), however, no information about the success of this undertaking is available. The first technical school in Germany was founded in 1747 in Berlin by Johann Julius Hecker. Hecker’s School played an important role in the establishment of real schools (e.g. such a school was founded by his brother, Andreas Peter Hecker, in Stargard), and its specialist grades developed later into vocational schools. In France, the first school of technology was the famous Ecole Polytechnique, founded in Paris in 1794. Nowadays, the oldest university of technology in the world is considered to be the Technical University in Prague, founded in 1707 by Christian Joseph Willenberg (1676-1731) of Legnica. Nevertheless, this school started to operate as late as in 1717 - later than Pater’s school in Gdańsk.

The juxtaposition of dates leads to the conclusion that Paul Pater’s Mathematical and Mechanical Workshop of Arts, operating in Gdańsk in 1711-1724 was the first non-military technical school of technology in the world! For the sake of accuracy, let us add that it did not enjoy much interest. Pater had few students, which does not diminish his world pioneer’s input into the education of technology.

8. Engineers

The origin of the word “engineer” is not clear. The Italian *enzignerius* discovered by Franz Maria Feldhaus in a Genoese manuscript from 1195, denoting the builder of fortifications, is supposed to come from Latin *encingere* - to gird. A year later, Alamanus Guitelmus described by this designation, built fortifications in Milan. In 1248, during the Crusade, the construction of siege machines was supervised by *mestre engegnere* Jocin de Cornaut. Another *mestre engingnieur*, Gascon Jean de Mesos, received nobility in 1254. Jean Albom - a clockmaker and engineer (*ingenieur*) of Provence is mentioned in the French accounts from 1537-1540. A different etymology can be found in English dictionaries: “Engineer, early 14c., constructor of military engines, from Old French *engigneor*, from late Latin *ingeniare*; general sense of: inventor, designer is recorded from 15c., civil sense in reference to public works is recorded from c. 1600”. The word engine which originates from Latin *ingenium* - inborn talent - is discussed separately. Let us add that in later dictionaries *ingenium* also means a military engine. The engineer in those times was a constructor of military engines and fortifications, and a constructor of all machines - only from the 18 century. In our area this is explained by Gottfried Lengnich in the Public Law of the City of Gdańsk of 1769: "The master of wall construction, experienced in this work who with time would be called 'engineer' reported to the Fortification Office." One of such builders in 1571 was Thomas Kardinal, who promised to save ten thousand zlotys annually on costs and expenses".

When did the first engineers appear in Gdańsk? By the end of the 16^{th} century, specialists employed to erect fortifications were called master builders, and those higher in rank would be called city master builders (Stadtbaumeister) with the prefix 'city'. Others were given various titles: master builder of walls and buildings (Wall- und Baumeister), master builder of water structures (Wasserbaumeister), master builder of mills or windmills (Muhlen- or Windmuhlenbauer), city master carpenter (Stadtzimmermeister), etc. When submitting a supplication (application) for employment in 1565 the famous Hans Kramer signed it as the Builder of Dresden. Employed in 1592, Jan Vredeman de Fries is recorded in the documents as a city builder, the great Anthoni van Obberghen - as builder of walls, or simply as Master Anton.

The answer to this question is provided by Paul Simson, the author of the History of Gdańsk (Geschichte der Stadt Danzig) from 1913-1917 (unfortunately unfinished): "We do not know much about Dickmann (Aegidius Dickmann, the author of the *Views of Gdańsk*, published in 1617 – author's note), it seems that he was an engineer, in any case in 1624 the Gdańsk City Council ordered Colonel Lisemann to propose the engineer's position to Dickmann, a native citizen of Gdańsk, if he were to meet him in the Netherlands". A year later, Adam Wybe aka Wybe Adams (the creator of the famous cable car at a later time) the "builder of mills " returned from Warsaw with the title of "Royal Engineer".

Nonetheless, this is not a final answer. Earlier pieces of news refer to the Italian engineers, as they are usually referred to, Hieronimo Ferrero and Giovanni Battista, brought in 1600 to give an expert opinion of the Gdańsk fortifications. We owe them the farsighted plan of a magnificent circle of bastions defending the city from the east. But was the word "engineer" used then indeed? In the source materials the former expert is referred to as the captain, and both of them together - as "masters of military construction" (Kriegsbaumeister). In 1619, a citizen of Gdańsk, Hans Strakowski and Dutchman Cornelius van der Bosch appear as engineers serving the city - as it seems for the first time - and they can be considered the first engineers in Gdańsk. In the reports of Order meetings of 4 May 1622, the latter was called "the newly hired engineer".

Here is how Józef Naronowicz-Naroński (approx. 1610-1678), the author of the *Book of Mathematical Sciences*, a three-volume textbook for engineers, written in 1655-1659, described the required qualifications of an engineer. Having emphasized the importance of good preparation in the field of arithmetic, optics and perspective, painting, geography, history and politics, philosophy, artillery, pyroballics (today we would say pyrotechnics), astronomy, mechanics, chemistry, magic (!), gnomonics, and construction and operation of all kinds instruments, he wrote: "For true is the parable that the *ingienier* should have an iron head, so that it should last for work and thinking; a leaden cross in the rear, so that he should stately speculate until he has finished; ostrich eyes, so that he should hatch his thing with inventions like an ostrich would hatch with its sight; deer legs, so that he should not be lazy about delineations and about building fortresses, camps, trenches, but run when founding; a bag of fortunes for expenditures, for instruments and materials, for papers and books, that is why *ingeniors* are paid dearly so that they should have enough for the expenses needed. Not only should my *ingienier* know all this, but he shall also perfect to be called by the title of a good ingienier".

It would not be easy for the engineers of today to meet all these requirements!

9. From Pater's School to the Gdańsk University of Technology

Professor Pater's school ceased to operate with his death. It seemed that his ideas would be forgotten. The curriculum of an innovative school, the so called Conradinum founded by Karl Friedrich von Conradi in Jankowo near Gdańsk which was inaugurated in 1801 was *par excellence* humanistic and remote from technology. The School of Arts and Crafts organized in the Golden Gate in 1803 was artistic in nature, despite the "craftsmanship" in the name. Technical subjects were also missing in the curriculum of the Navigation School which started to operate in 1817. In 1824, the Royal Provincial School of Crafts was opened in one of the tenement houses of the Old Suburb, intended for "young people who want to devote themselves to one of the various building trades (bricklayers, carpenters, well and pipe builders, masters of mills, locks and canals, stonemasons, potters, joiners and locksmiths)". According to the assumptions, each year the best graduate was to receive a scholarship to continue studies at the Craft Institute in Berlin founded in 1821. At first, the school met with such poor interest only one student was sent there by 1833. The poor condition was the reason why it closed down and a new school was established to be headed by the astronomer, Karl Theodor Anger. The restructuring brought an effect: eight graduates received scholarships to continue further studies in 1835 alone. In 1843 the school had as many as 60 students. Operating since 1828, the Craft Association (Gewerbe-Verein) opened an Evening and Sunday Supplementary School for craftsmen in 1838 in which there were as many as 96 students aged 12 to 35 years [Fig.7]. In 1858, specialized sections, including chemical technology, mechanical technology, life sciences and construction were opened in the Association. In 1872, the Craft Association announced the initiative to transform the courses of supplementary study into a school of technology, motivating it in the following way: "The high attendance observed at this school for years provides indeed the most obvious evidence to its importance and the need to expand and reform it in line with the progress of technology.

Figure 7. House of the Skipper's Guild - the later seat of the Crafts Association (Photo: Januszajtis A.)

As the development of the industry in Gdańsk is awakening, a matter of life is to have an institution to educate technicians needed in all factories and to provide the factories with the needed masters and technical managers in the future, while now it is hard to acquire them from far away and for a longer time." The initiative hit a vacuum and still there was no genuine school of technology in Gdańsk. In 1879 the Association opened the School of Steam Boiler Stokers. In 1879, at the Association's request, the Gdańsk Municipality granted a subsidy to the Supplementary School and provided rooms at 65 Piwna Street, and in 1880 even more convenient rooms were allocated in the building of the Saint Catherine School at 4 Katarzynki Street owing to which the number of grades was increased to three. The number of students reached 163. When the State Supplementary School was established in 1892 the Association was released from the obligation to conduct this type of activity. It was recommenced in 1899, when the so-called Master Courses (for craftsmen) were launched. In 1903, the Association took over a private school for stokers and engine drivers founded in 1880 by the engineer and mill builder Friedrich Stahl. Stokers were educated in the lower grade, railway engine drivers - the upper class. The curriculum also included knowledge of the construction of steam engines.

10. How the Gdańsk University of Technology was established

The developing industry was accompanied by the growing need to establish a university in Gdańsk. At first, a university was contemplated, however, as such an institution operated in nearby Königsberg, the concept was changed to a university of technology. The proposal which put forward by Heinrich Rickert, a member of the Parliament, and supported by the Natural Society of Gdańsk and the Craft Association was presented to the authorities in Berlin in 1897. Gdańsk spared no funds to create the desired university. Without waiting for a reply, 6.5 hectares of land were purchased at Droga do św. Michała (Traugutta Street nowadays). Meanwhile, other cities submitted competing applications. As the anecdote says, Minister Bosse – having heard the experts who mostly supported Wrocław (Breslau) - announced: “Thus and therefore, I am announcing the decision: the University of Technology will be built in Gdańsk.” In 1898, funds for this purpose were assigned by the Reichstag. The first, neo-Gothic version of the design of 1899 was rejected. In 1900, at the Kaiser’s request, a version referring to the Gdańsk Renaissance was prepared which was completed in just four years after some amendments had been made. The inauguration ceremony was held on 6 October 1904. It was attended by Wilhelm II who spoke for a long time and reasonably about the role of technical sciences in life and economy, and then uttered the unfortunate sentence, which is repeated until today although it does not deserve it: „The university, erected on the land which was once incorporated by the German energy into the German culture, is to stand here and act like a tower, from which the German industriousness and the German spirit shall spread stimulating, supporting and fertilizing other lands”. In one sentence, he emphasized the “Germanness” of this land four times. Apparently he was not sure of it.

11. What the University of Technology was supposed to look like

The edifices of the original establishment of the Gdańsk University of Technology are among the most outstanding achievements in architecture. Without any hesitation they can be placed as equal with the most famous universities of that period in the world. Even if we can see them in a shape impoverished by the war (especially the interiors), they still compel wonder and admiration - not only with the harmonious proportions, details of beautiful décor, but also with the care with which they were designed and with the exemplary functionality. However, not everyone knows that at the beginning they were supposed to look differently. In 2000, in the PhD thesis by Hans-Dieter Nägelke entitled *The Construction of Universities in the Imperial Reich (Hochschulbau im Kaiserreich)* published in Kiel in 2000 we read: "When, following the Kaiser's intervention, it was decided at the beginning of 1898 that Gdańsk would be the place where the new university of technology would be built, on 16 March the design was presented to the Chamber of Deputies, plans continued to be prepared. It was already on 4 April that the Minister of Finance and the Minister of Public Works inspected the lot of land in Wrzeszcz (Langfuhr) that had been provided by the city of Gdańsk. At the end of the month, a spatial development plan was prepared with the participation of numerous learned experts. On the basis of such data, Hermann Eggert (1844-1920), the civil servant at the Ministry of Public Works responsible for construction, submitted the first concept with the Main Building and two of Chemistry/Physics and Electrical Engineering buildings on its sides, with a magnificent square, a courtyard of honour created between these three buildings with a spectacular view of the whole establishment. During the consultations held in the six following months which were attended also by specialists from Prussian schools of technology, this plan was abandoned to be replaced by the layout where all the buildings were situated in one row - the main arguments were that more backspace should be provided for extension and better connection with the power supply centre and with the Institute of Technical Engineering".

The documents and drawings can be found in the so-called Secret Prussian Archive in Berlin. Some of them were shown in Gdańsk at an exhibition on the occasion of the 100^{th} anniversary of the university in 2004. As it turns out, the style of the buildings was supposed to be different. A sketch of the original concept of the Main Building was published in 1899 by Elise Püttner in the guide to Gdańsk [Fig.8]. The body of the building is shaped in a similar way as today, however, the exterior design refers much more to the Gothic style, *inter alia*, in the stepped gables. The central avant-corps (with the main entrance) is completely different, with a gigantic single gable finished with an allegorical figure. The whole thing seems to be too massive and distant from the atmosphere of the old Gdańsk. It was later replaced with three gables with a fine turret added on the roof which was doubtlessly constructive as was the resignation from the neo-Gothic style in favour of the Gdańsk (Dutch) Renaissance, supposedly in accordance with the Kaiser's wish.

Nägelke continues: "Having been changed and approved in this way, the plans in the form of the first design, including a cost estimate, were adopted by the Chamber of Deputies in March 1899. When the Building Academy had expressed their opinion in May 1899, Eggert made some changes to the projections, and then left the Ministry of Public Works to devote himself entirely to the construction of the new Town Hall in Hanover. Thus, the task to oversee the plans was entrusted to Georg Thür (1846-1924) who had been in charge of University Buildings at the Ministry of Public Works since 1895. Albert Carsten (1859-1943) the former civil engineering inspector at the Government Presidium in Aachen

Figure 8. First concept of the Gdańsk University of Technology (acc. to Püttner E.)

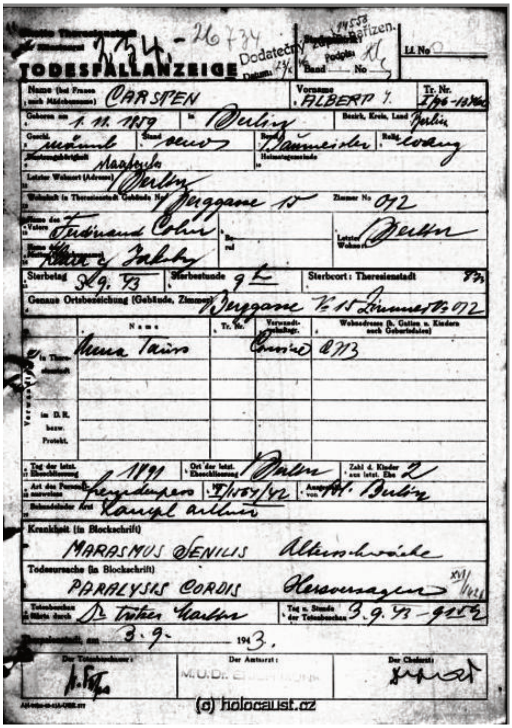
was appointed as the third architect already in April 1899. However, his activity was limited to working out the details and to locally manage the construction of the entire complex which started in the autumn of 1900".

The author clearly diminished Carsten's role. The names of Eggert or Thür are nowhere to be found on the preserved for-construction drawings, however, the drawings contain a note "Fig. (gez.) by Carsten " [Fig. 8]. The drawings themselves are masterpieces of accuracy. Both architects, strongly involved in the ministry's activities, were certainly more famous and influential than their younger colleague (Thur was later a co-designer of the buildings of the Wrocław (Breslau) University of Technology), who, however - as we believe - - did the most important job. We can be practically sure that it was Albert Carsten who gave the buildings of our university their final near perfect shape.

12. Albert Carsten

Professor Albert Carsten - we know him as an outstanding builder, creator of the edifices of the Gdańsk University of Technology, however, we know very little about him apart from this. Much effort is required to find scraps of information to depict his character. In the personal files, partially preserved at the University of Technology we read that he was born on November 1, 1859 in Berlin and was of the Evangelical faith. In 1878 he studied the history of art and mathematics at the University of Berlin, in 1878-1883 he was a student of the Construction Academy and it was there where he became a secret construction consultant (Geheimbaurat) on 26 June 1884. From 1890, he worked at the Ministry of Public Works. He came to Gdańsk in 1899 from Aachen, where he was a domestic construction inspector (Landbauinspektor). At the time when he was admitted to the position of professor (27 July 1904) he was a widower raising two sons. We know the places of his residence: first at 5 Pawłowskiego Street (Parkweg in those times), and from 1910 - at 10 Batorego Street (Steffensweg), in a house which has survived until today, and which may have been designed by himself. In the catalogue of professors in *Contributions and Documents (Beiträge und Dokumente)* to the history of the Gdańsk University of Technology, published in 1979 in Hanover, we read: On 1 May 1933, he retired and applied for a pension." Today we know that it was an anti-Semitic purge carried out upon the order of the Nazi authorities of Gdańsk. The "voluntary" quitting probably looked similar as in Poland in the times of the communist Polish People's Republic. If we look in the address book from 1934 we can still find him at Batory Street, however, in 1935 he is not to be found there, but he is still listed as the owner, with the note: Berlin. In the years 1937-1939 the villa belonged to his son, Hans Carsten, Ph.D., P.Eng. (Berlin). When Gdańsk had been annexed to the Reich, the house was taken over by a housing company. The professor's apartments were inhabited by a barber and four labourers. Hans, the above mentioned son of the professor was born in Berlin. He studied at the Faculty of Mechanical Engineering at the Gdańsk University of Technology (his name is on the list from 1913) and probably received his Ph.D. degree there. Later he returned to Berlin. The second son, Georg, a student of architecture, died on the front line in 1918.

The professor can be found in the Berlin address books. Until 1942, he lived in the exclusive district of Dahlem, at Rheinbabenallee 36, and his son in Charlottenburg, at Neidenburger Allee 5. In 1943, both disappeared from the register of residents. Knowing that the professor was taken away to the Theresienstadt camp, we find an appalling document: a certificate of death occurring on 3 September 1943 at 9:10 hours [Fig.9]. The causes of death were described as "senile weakness" and "heart failure". The place of death in the camp: Berggasse 15, room 12. The personal details of the parent: Ferdynand Cohn (not Carsten!) and Klara, née Jakoby. The box under the heading "nationality" has the entry: "Stateless person". The family status of the deceased: "widower, two children from the last marriage", date of marriage: 1891. Anna Taurs, his cousin, also imprisoned in the camp, was mentioned. Carsten's profession was described as "builder" (Baumeister). It was not mentioned that he was professor, Ph.D. P.Eng. and that he was a secret government construction consultant from 1914, awarded with high orders of the Reich in 1904 and 1907. The religion was mentioned: Evangelical - but a Jew – it was the latter fact only that mattered to the Nazi criminals.


TODESFALLANZEIGE

Name: CARSTEN

Vorname: ALBERT

Sterbeort: Theresienstadt

Krankheit (in Blockschrift): MARASMUS SENILIS

Todesursache (in Blockschrift): PARALYSIS CORDIS

(c) holocaust.cz

Figure 9. Albert Carsten, Death Certificate.

The document also contains information about the transport: No. I/1564 in 1942. The age of over 80 did not save Professor Carsten from deportation and extermination.

The greatest mementoes of Albert Carsten are the edifices of the Gdańsk University of Technology. As has been mentioned earlier, he was not their general designer, but he gave them the final shape and worked out the details. A plaque with an inscription in German has survived in his former office in the Main Building: "To Albert Carsten who built this edifice and taught in it for 29 years, 1933" [Fig.10]. In the times of the Polish People's Republic, attempts were made to hack it off (!), then it was covered with plaster, which was removed after the fall of communism. The plaque commemorates the professor's retirement. As we can see, his associates did not respect the Nazi ideas. A memento is also the house on Batory Street, waiting for renovation, on which a suitable plaque could also be placed.

13. Buildings

At first, magnificent neo-Renaissance buildings were created, referring to the architecture of the old Gdańsk, with Art Nouveau interiors, with the cubic capacity totalling c. 200,000 m^3 [Fig.11]. The Main Building alone occupied 122,000 m^3 containing - not counting the basements and attics - 210 rooms, 17

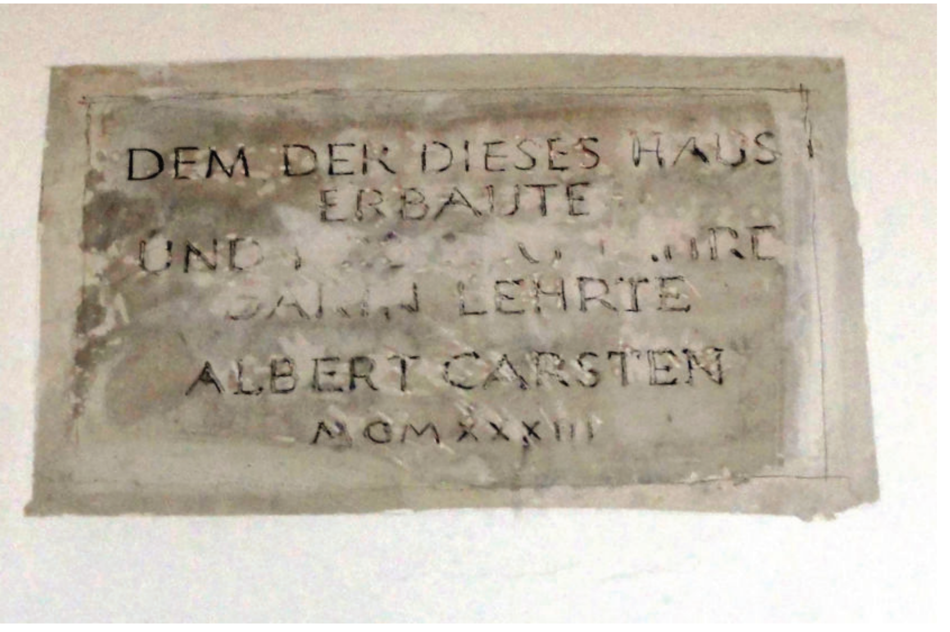


Figure 10. Commemorative plaque of Prof. Carsten from 1933 (Photo: Januszajtis A.)

Figure 11. Gdańsk University of Technology, entrance gate and Main Building, 1904 (Photo: archives)

lecture rooms, 24 drawing rooms, 36 professor's offices, 11 junior lecturer rooms, 11 rooms with research collections, laboratories, etc. The most beautiful interiors - the lecture theatre, the Senate hall and the central staircase - had an impressive

Art Nouveau décor which was unfortunately destroyed in 1945 [Figs. 12a, 12b, 13]. Equally rich, though smaller, were the Chemistry, Electrical Engineering and Machine buildings, luckily preserved until today. To this day, we admire the grand scale, solid workmanship and functionality of the buildings and rooms. In 1909 the complex was extended by the Strength of Materials Laboratory. Some apparatus was brought from America, from the World Exhibition in Saint Louis.

14. Development

In the beginning, there were six faculties at the University of Technology (called Departments): Architecture, Construction, Mechanical and Electrical, Shipbuilding with Ship Machinery Building, Chemical and General Sciences. In the years 1904-1914 the staff consisted of 28-31 professors, 12-26 associate professors and 44-55 assistants (including four teachers). The first rector was Hans von Mangoldt, a mathematician, author of excellent textbooks. The most prominent professors included: Albert Carsten, the previously mentioned constructor of the University of Technology buildings, the offices of the Fire Insurance Company at Wały Jagiellońskie Street (nowadays the Public Prosecutor's Office), a villa at 8 Sobótki Street and many other edifices; Friedrich Ostendorff, a theorist of architecture; Conrad Steinbrecht, the conservator of the castle Malbork [Marienburg]; Adalbert Matthäi, an architectural historian; Reinhold Krohn, a famous designer of bridges; Otto Ruf, a chemist Max Wien a physicist; Hermann Föttinger, a shipbuilder, and many others. A honorary degree of the University was awarded (in 1914), *inter alia*, to Walter Nernst born in Wąbrzeźno (Briesen), a Nobel Prize winner, the author of the 3^{rd} law of thermodynamics.

The number of students increased from 592 (including 191 regulars) to 675. 640 engineers and 62 PhDs had been promoted by 1914. Poles from Gdańsk, the so-called West Prussia and Greater Poland were also among the students. In 1913, they formed the first secret organization - the Union of Gdańsk Academics (later called "Wisła" (Vistula)).

World War I. During the war, the activity of the university was halted, nonetheless, it did not cease entirely. In 1917, a distinction was made between full and associate professors. The number of students varies between 116 and 170. 99 engineering diplomas and 25 Ph.D. degrees were awarded. The end of the war restored independence to Poland. From 1919, efforts were made to give the Gdańsk University of Technology (Politechnika Gdańska as it was officially called in Polish) to Poland. They were ineffective due the need to defend the Homeland against the Bolshevik onslaught.

Interwar period. In 1921, it was recognized that the University of Technology belonged to the Free City of Gdańsk, created a year earlier, which formally guaranteed equal rights to Polish students. A course of Polish and lectures of economic geography of Poland were introduced. In 1922, the structure of the University changed. The number of departments was increased to eight and grouped into

Figure 12a. Upper Hall with the entrance to the Lecture Theatre

Figure 12b. Lecture Theatre in 1904 (paintings on the walls from a later period)

three Faculties. The Faculty of General Sciences included the Humanities, Mathematics with Physics and Chemistry, the Faculty of Civil Engineering - Architecture and Construction, and the Faculty of Mechanical Engineering - Mechanical Engineering, Electrical Engineering as well as Shipbuilding and Aviation Technology. In addition to that, the so-called External Institute conducting classes for students from outside the University of Technology was established. Owing to the construction of the Physics wing with the lecture theatre *(Auditorium Maximum)*, the Hydromechanics and Aerodynamics Laboratory, the Student Dormitory, etc., the cubic capacity of the buildings reached 222,000 m3. In the years 1920-1929, the numbers of professors and associate professors increased from 60 to 66, assistants from 50 to 77, and students from c. 1,000 to 1,650. 77 to 202 engineering diplomas were awarded each year, and 17 or 18 Absolvents received PhD degrees. Owing to the beneficial scholarships, university students were most often of German origin - from 43% to 63% with only 14% to 28% coming from Gdańsk. The second largest group were Poles, who accounted for up to 36%. Their most important organization was the Brotherly Help Association of Polish Students of the Gdańsk University of Technology. Its name and statute were confirmed by the authorities of the University of Technology on 11 November 1921, and later by the Senate of the Free City, thus recognizing that the Polish equivalent of the German name of the University was **Politechnika Gdańska** (Gdańsk University of Technology). In addition to the Brotherly Help Association, the Polish students had 15 other organizations, including four corporations, three sports associations and six science circles; the official name of each of them included the Polish name of the Gdańsk University of Technology. This ostentation in naming was important for Poles studying there as it emphasized their rights to the University and Gdańsk. The attempts to weaken this position observed some years ago (*ex post* after so many years!) are hard to understand.

Let us return to the professors, among whom there were many outstanding scientists. The first mention should be given to the biochemist Adolf Butenandt who received the Nobel Prize in 1939 for his research conducted in Gdańsk. Carl Ramsauer, Walter Kossel and Georg Hass were the most famous in the field of physics, Wilhelm Klemm in chemistry, Karl Kupfmüller in electrical engineering, Karl Gruber and Otto Kloeppel in architecture. The value of the output of the historians, Erich Keyser and Wolfgang La Baume who were related to Gdańsk should not be denied despite the contamination with nationalist tendencies. The guest lecturers were such celebrities as Swante Arrhenius, Max von Laue, Ludwig Prandtl, etc.

Changes came in the Nazi times. The Nazi-propagated principle of "leadership", i.e. one-man leadership was introduced – in fact under the party's dictate. The Jewish professors and those who did not agree with Nazi ideology were eliminated slowly but systematically. Carsten, the distinguished creator of the University buildings was not the only one forced to retire. Professors Wohl, Wartenberg, Jellinek, and Doeinck who was popular among young people as well as many others were made redundant. In 1935, the number of professors and associate professors decreased to 63, and the number of assistants to 56. All students organizations (except for the Polish ones which were not subject to the Nazi authorities) were dissolved and replaced with one National Socialist Union of German Students the membership of which was obligatory for Germans. The curricula were modified to include racial theories. The number of subjects decreased drastically - from 435 to 335. With time, political and national conflicts began to escalate, especially between Poles and Germans. The climax was in 1939: on 24 and 27 February, Nazi militias with the participation of some German students (about 200) forcibly removed Polish students from the University. After many endeavours, they were allowed to return, however, it was practically impossible to make up for the losses, and their return in the conditions of increasing international tension – was even dangerous. In this situation, no Polish student continued studies.

World War II. In September 1939, Gauleiter Forster, illegally appointed by the Gdańsk Senate "Head of State", broke the constitution of the Free City and passed a law to include Gdańsk in the Third Reich, which, of course, willingly approved it. The Gdańsk University of Technology was subordinated to the authorities in Berlin, which introduced stricter discipline. The students were required to provide a certificate of the Aryan origin. Facilitations were introduced for those called to the army. Until January 1945, classes had been held to a limited extent, later they were completely suspended. The Main Building was turned into a military hospital. Numerous workers, the most valuable books and some apparatus were evacuated by sea. A substitute university of technology was to be established in Schmalkalden, Thuringia. On the morning of 26 March 1945, the last German rector, Prof. Martyrer, left the University heading for Stogi [Heubude] via Nowy Port [Neufahrwasser] to take a cutter to Hel [Hela] to set off for Germany from there.

Figure 13. Main Building in 1945

In his dramatic memories, he described a column of fire and smoke seen above Gdańsk from the deck of the cutter. In the afternoon, the Russians took over the University of Technology and set fire to the Main Building. They killed some of the wounded German soldiers, others were taken as prisoners. Fire consumed the central part of the Building with most of the book collection in the Main Library. It was estimated that the buildings were destroyed in 16%, the Main Building – in 60% [Fig. 13]. This was the condition in which the University of Technology was returned to Poland. The legal act of 24 May sealed the return declaring that "the Gdańsk University of Technology (namely the university existing under that name) was becoming a Polish public university". In this way, many years of efforts to have the Polish Gdańsk University of Technology were crowned with success. In 2000 the legal wording used helped, *inter alia*, recover the most valuable part of the collection of the Main Library, taken away to Germany, in the form of over 850 old prints, manuscripts and other materials of the famous Natural Science Society of Gdańsk.

15. Gdańsk University of Technology Today

The Gdańsk University of Technology, transformed into a Polish university in 1945, is now four times larger than before the war and has several dozen more students, and many of its professors have gained international recognition. The Main Building, which regained its winged turret in 2012 has been considered as a masterpiece of architecture [Fig. 14]. Post-war concepts of reconstruction of Gdańsk and innovative methods of shipbuilding were born within the walls of the University. It was here that the Gdańsk School of Liquid Dielectrics and many other research groups were established whose contribution to the world science and technology is indisputable. The scientific base is also incomparably larger than before the war. Today, the University has, *inter alia*, the most powerful non-distributed supercomputer in Poland, called Galera (Galley), with a computing power of 50 teraflops (50 trillion operations per second). Smart buildings have been created, where heating, lighting, air conditioning, ventilation and security are controlled by one electronic management system, programmed in a central computer. There are modern lecture theatres and specialized research and development laboratories, filled with multimedia. In 2013, the Nanotechnology Centre was commissioned, and the *Engineer of the Future* innovative program was launched, and in 2014, the Immersed Spatial Visualization Laboratory exceeding the limits of imagination was opened. There are no reasons to have any complexes indeed!

The development of the University of Technology is evidenced by the fact that it has been achieving high positions in various rankings for three years: it is the second Polish university in terms of interest of candidates to study and second among the most pro-PhD universities, also third in terms of graduate earnings, it has been also awarded for the third time the Leader University title for educating creative, ingenious and innovative graduates. The Gdańsk University of Technology is ranked eighth in Poland in many rankings of universities of various types.

16. The Gdańsk Coryphaei of Science

The pre-partition Gdańsk was the largest Baltic port, as well as the largest and richest city in the Polish Republic [Fig. 15]. The source of wealth were the abilities and industriousness of the inhabitants who knew how to use the privileges granted to them by Polish kings, ensuring them a monopoly in the maritime trade. In practice, up to 80% of all domestic exports and imports went

Figure 14. The Main Building with the turret reconstructed in 2013 (Photo: Januszajtis A.)

through Gdańsk, and the resources of the city treasury were sometimes comparable to the budget of the Polish Republic. A measure of the prosperity may be the outcome of the property census conducted by the Prussians in 1793, after the seizure of Gdańsk – which was already greatly impoverished at that time: it was noted that the city was inhabited by 200 wealthy people owning the property worth millions of thalers and 1700 who had over 100,000. After conversion to the money of today, this means that every twentieth inhabitant of Gdańsk was a millionaire! However, more important than money were the aims for which it was expedited. The largest part of the budget was spent on the defence and the municipal and port infrastructure, nonetheless, a significant amount was also allocated to education, science and culture. The city authorities took care of the development of education. In addition to the Gymnasium founded in 1558, which was academic in nature from 1580 (seven departments), there were six parish schools and several dozen private institutions. In 1596, the Gdańsk Library, still existing today, was opened. It never happened that the Council would refuse someone a scholarship to study abroad. Private contributions of rich burghers were also significant. No wonder then that many outstanding scientific and technical achievements were achieved in Gdańsk. The scientists from Gdańsk gained international recognition. Achievements recognized on a worldwide scale will be discussed here.

The late 18^{th} century was adopted as the upper time limit, with occasional additions up to 1945. The titles of the works and dissertations are given in the English translations.

17. Joachim Rheticus

The importance of the Gdańsk centre for the world science is evidenced by the fact that it is here that *Narratio Prima* presenting the knowledge about the heliocentric system of Nicolaus Copernicus was published for the first time in the world. Its author was the outstanding Austrian mathematician and astronomer Georg Joachim Rheticus. Born in 1514 in Feldkirch, son of physician Georg Iserin, and Tomassina de Porris of Italy, he was educated by his father until the age of 14. After the death of his father, who was executed for alleged sorcery, he took his mother's surname - von Lauchen in the German version, however, he would more often use the toponym Rheticus for his home region where he was born (Rheticus - from Rhaetia). Having graduated from the school at the New Collegiate Church (Neumünsterschule) in Zurich, he began to study mathematics at the University of Wittenberg in 1533.

Figure 15. Gdańsk around 1680 (Stech A., the original in the Museum of the City of Gdańsk)

In 1537, with the support of Philip Melanchthon, he became professor of mathematics and astronomy there. From 1538 he travels, first to Nuremberg, where he meets the publisher Johann Schöner and the printer Johann Petreius. Later he visits Ingoldstadt, Tübingen and his native Feldkirch. In May 1539, he arrives at Frombork to visit Nicolaus Copernicus and gives him as a gift five books, including three published by Petreius:

1. *Almagest* by Ptolemy, Basel 1538 (vol. I);

2. *Opticae* by Witelo, Nuremberg 1535 (vol. II);
3. *Instrumentum primi mobilis* by Apianus, Nuremberg 1534 (vol. II);
4. The Greek edition of *Geometry* by Euclid, Basel 1533 (vol. III);
5. *De triangulis Regiomontana*, Nuremberg 1533 (vol. III).

They spend the summer together in Lubawa with the scholar, bishop Tiedemann Giese of Gdańsk. Rheticus and Giese urge Copernicus to publish his work, and the *First Account* before that. In September Rheticus travels to Gdańsk, where he meets the mayor (Bartholomäus Brandt or Johann von Werden) and obtains financial assistance to publish the account. While waiting for the account to be printed, he measures the magnetic declination - one of the first in history (previously, in 1536, it was measured in Nuremberg and Rome only). Owing to him and his successors, in Gdańsk we have a record of the world oldest curve showing its changes.

The book is published in the spring of 1540 at Franciszek Rhode's printing shop in Gdańsk which had been established two years before [Fig. 16]. Its title takes the form of a letter: ”To the Illustrious Master, Johannes Schöner about the Books on the Revolutions by the Most Learned Man, the Most Magnificent Mathematician, the Venerable Doctor, Nicolaus Copernicus, the Canon of Ermland, the First Account by a young man involved with mathematics.” Its contents are a comprehensible description of the heliocentric system and the arguments to support it. We read there, *inter alia*:

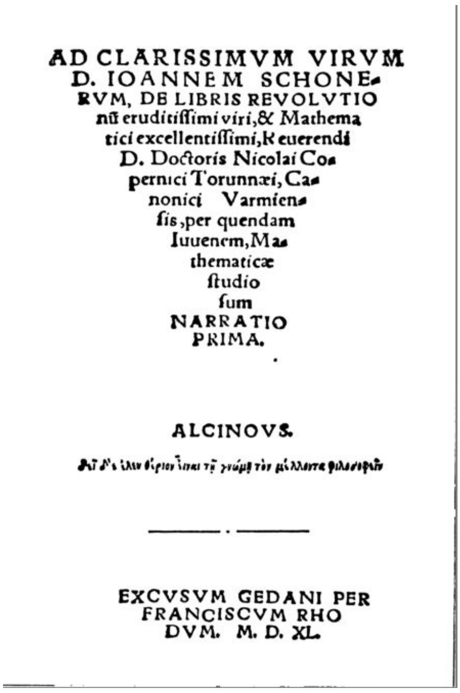
“All (...) the phenomena are admirably linked with each other as if by a golden chain. Each planet, by its place, course, and each change of its motion, provides evidence that the Earth is moving. And we, who inhabit the terrestrial globe, instead of accepting that its position is changing, believe in the wandering of the planets (celestial bodies) that reflect its motion.”

As assessed by Noel Swerdlow in 1992: Copernicus could not have wished for a more learned, elegant and enthusiastic introduction of his new astronomy into the world of writing: *in fact*, Narratio Prima remains the best introduction to Copernicus's work to this day.” Rheticus sent a copy to Schöner of course, and also to Petreius, who found the dissertation magnificent. Here is how he himself expressed his satisfaction:

“I have heard of the fame of Master Nicolaus Copernicus in the northern countries, and although the University of Wittenberg has made me a public professor of these sciences, I would not have thought I could be satisfied until I have learned something more through the information from this man. I will also say that I do not regret any financial expenses or a long journey, or other hardships. On the contrary, it seems to me that I have received a great reward for these troubles, namely, because I, an averagely talented young man, induced this honourable man to make his ideas in this area available to the whole world sooner.”

In August 1541, Rheticus leaves Frombork with the manuscript of *De Revolutionibus* that he has received from Copernicus. In Königsberg he gives Prince

Albrecht a copy of his work over the map of Prussia and gains support for the publication of Copernicus's work. In October, he returns to Witttenberg, where he becomes the dean of a faculty. Faced with the harsh criticism of the heliocentric system by Luther and Melanchton, he teaches astronomy according to Ptolemy. He publishes the first geometric part of Copernicus's work, adding the world's first trigonometric tables (without the names of the *sine* and *tangent* functions as used today and the *secant* introduced by Copernicus). In 1542 he moves to the University of Leipzig. In May, he travels to Nuremberg and commissions Schöner and Petreius to publish Copernicus's work *On the Revolutions*. Lectures in Leipzig make it impossible for him to keep an eye on the printing. Eventually, in 1543, *De Revolutionibus Orbium Celestium libri sex* is released in Nuremberg with a preface and the title changed by Ossiander, the chief pastor of Nuremberg (it was supposed to be *De Revolutionibus coelestibus*). Sent to Frombork the work finds Copernicus on his deathbed.


AD CLARISSIMVM VIRVM
D. IOANNEM SCHONE-
RVM, DE LIBRIS REVOLVTIO
nũ eruditiſſimi viri,& Mathema
tici excellentiſſimi, Reuerendi
D. Doctoris Nicolai Co-
pernici Torunnæi, Ca-
nonici Varmien-
ſis, per quendam
Iuuenem, Ma-
thematicæ
ſtudio
ſum
NARRATIO
PRIMA.

ALCINOVS.

[illegible]

EXCVSVM GEDANI PER
FRANCISCVM RHO
DVM. M. D. XL.

Figure 16. *Narratio Prima* – the title page and the printer's imprint (reprint of 2009 from the author's collection)

The later life of Rheticus was lived far away from Gdańsk. The professorship in Leipzig is interrupted in 1551 by a moral scandal in consequence of which he flees to Chemnitz, then to Prague, where he studies medicine. In the years 1554-1574 he lives in Krakow. He works on 10-digit trigonometric tables with the values of sines, tangents and secant angles every 10". In 1574 he leaves for Košice, where he dies.

As far as the subject of this book is considered, the two most important achievements of Rheticus are:

1. *Narratio prima* published in Gdańsk which owing to the simple language gained more fame (four editions in the 16^{th} century) than Copernicus's work which it was promoting;
2. Measurement of the magnetic declination which initiated the world's oldest curve of its changes.

18. Bartholomäus Keckermann

The greatest fame among the professors of the Academic Gymnasium of Gdańsk was gained by Bartholomäus Keckermann (1572-1609). Having graduated in Germany, he declined the offer to take the chair in Heidelberg and returned to Gdańsk, where he contributed to the establishment of the Department of Law and History. His lectures on philosophy attracted listeners from Poland and abroad.

His works concerned logic (the first history of logic in the world), mathematics, geometry, optics, astronomy and geography, ethics, politics, economics, philosophy, metaphysics, rhetoric and physics! If we add thereto his navigation lectures, for the first time in Poland, the *System of Theology* published in Germany, and the ensuing *Introduction to the Study of Cicero's Writings*, we can claim that Keckermann was one of the most versatile scholars of his era. After his death, it was written: "Great were you with your writings, and since greater you could not be, the Heavens have let you to depart to God". The epitaph in the Holy Trinity Church reads [Fig. 17], *inter alia*: "To the outstanding philosopher and theologian who has laid his mortal remains in this place, who has given his spirit to the Heavens from which he came and who has devoted the fame of his name to eternity. This "monument of the love of his fellow human beings and universal grief" was founded in 1623 by "Joan Caspar Cirenbergius".

19. Philipp Clüver

Philipp Clüver (1580-1622), son of a merchant from Chlebnicka Street, and nephew (son - according to some authors) of the famous coin master - also Philipp, enjoyed no less fame than Keckermann [Fig. 18]. His signed his name in Polish as Kliwer. As a boy, he spent some time at the court of Sigismund III in Krakow. He commenced his studies in Gdańsk and continued his education in Leiden. He abandoned the studies of law preferred by his father and turned his attention to history and geography taught by Joseph Scaliger.

During his numerous travels he walked on foot (!) across England, Scotland and France as well as Hungary and Bohemia where he enlisted in the army to fight the Turks. Having returned from Leiden, he was given a special appointment as an academic geographer, a position created especially for him, after which continued his wanderings across Italy and Sicily.

Figure 17. Keckermann's epitaph in the Holy Trinity Church (Photo: Januszajtis A.)

Clüver was the founder of a new branch of knowledge - historical geography. His six-volume *Introduction to General Geography (Introductio in Universam Geographiam)*, published posthumously in the years 1624-1629, served for over a hundred years as a basic textbook at European universities (also at the Jagiellonian University in Kraków). His earlier works include *Germania Antiqua* (1616), *Siciliae Antiquae libri duo* (1619), *Sardinia et Corsica Antiquab* (1619) and *Italia Antiqua* (1624). He was the first to recognize the Urals as the eastern border of Europe. Whenever we say "ancient history," we repeat the term coined by Clüver.

20. Peter Krüger

Peter Krüger (spelled also as Crüger; 1580-1639), professor of the Academic Gymnasium, was one of the world pioneers in mathematics. He was born on 20 October 1580 in Königsberg. His father, Wilhelm, was the deacon in the Old Town church, his mother, Dorothea née Werner, came from Dryfort, today's Sroków, where her father was the mayor and where little Piotr grew up after losing his parents. From the age of 12 to 17, he was a dancer in the princely band in Königsberg, after which he entered the famous *Pedagogium*. In 1600 he stayed in Prague, where he established contact with Tychon Brahe and Johannes Kepler. From 1603, he was the preceptor of two young noblemen and together with them he came to Gdańsk to study at the Academic Gymnasium taught by the above-mentioned Bartholomäus Keckermann. After two years, he left for Wittenberg to continue his

Figure 18. Phillipp Clüver in 1620

studies crowned by receiving the Master's Degree after public disputes. Having returned to the country in 1607, he settled in Gdańsk and was hired by the Council as professor of mathematics and poetry at the Academic Gymnasium and as a certified measurer and proofreader of mathematical books prepared for printing. He also had the exclusive right in the city to make calendars and to the related title of the calendariographer, confirmed in 1623 by the privilege granted by King Sigismund III. In the years 1627-1630, a student of Krüger at the Gymnasium was Johannes Hevelius (see below) who devoted to him memoirs filled with gratitude. In 1608, Krüger married Elizabeth Reutorff and they had three sons and two daughters. After her death in 1625, he remarried Ursula Remus, with whom he had four sons and two daughters. His son and daughter from the second marriage were the only of his numerous off-springs to survive him. He died on 6 June 1639. He was solemnly buried in the the St. Trinity Church, probably under Tombstone No. 147. Still on his deathbed, he bound Hevelius to observe the solar eclipse (1 June) which he himself was too weak to do.

Krüger has left more than 20 scientific publications. His mathematical works are of the greatest value. The first of these (1607) was an attempt to square the circle (unsuccessful), however, the next attempt - *Sinopsis trigonometriae* (1612) – presented to Johannes Broscius on the occasion of his visit to Gdańsk, proves the author's great erudition and thorough knowledge. It contains basic theorems about triangles, names of trigonometric functions, tables of their values, and examples how to solve planar and spherical triangles. *Logistica sexagenaria* (1616), a treatise on the sexagesimal system, is also interesting, however, his most significant work is the *Practice of Logarithmic Trigonometry (Praxis trigometriae logarithmicae)* published in 1634 and reissued in 1648 and 1654 in Amsterdam. Having explained the basics of the theory of logarithms by Neper, Krüger presents logarithmic tables - the most detailed presentation in his time and the most accurate until the 19^{th} century. The first table contains the logarithms of integers from 1 to 10 000; the second - for the first time separately - the logarithms of the sines and tangents of angles at 1 minute intervals giving proportional parts for every 10 seconds, the third - the logarithms of sines of the angles from 0° to 90° at intervals of one second! The author added a fourth table, compiled by Jacobus Bartschius (Kepler's son-in-law), with logarithms of cosines of angles every 2 seconds from 0° to 1°41'. Krüger explained that he used the less convenient Neper system although the Briggs logarithms were already known because it was the Neper logarithms only that were used in the Rudolphine Tables used in astronomy at that time. In the same work he was the first to formulate the law of cosines in the form:

$$\cos\beta = \frac{a^2 - (b+c)\cdot(b-c)}{2ac}$$

where a, b, c are the sides of a triangle, and β is the angle opposite to side b. Krüger's formula can be easily reduced to the one that we learn at school:

$$b^2 = a^2 + c^2 - 2ac\cos\beta$$

Krüger's other mathematical works include an outline of spherical trigonometry, *Doctrina astronomiae sphericae* (1635). His *Account Book (Rechen-Buchlein)* the popularity of which is evidenced by subsequent editions from 1631, 1635, 1642 and 1648 also deserves attention [Fig. 19]. This small piece of work continues to amaze to this day with the dexterity of the approach, high educational values and the apt choice of examples. "To devote here too many words to the praise and usefulness of the art of calculation is as if to try to help the sun at a bright noon by putting out a candle" - says the author in the introduction. He continues to refer to his over twenty years' teaching practice - also private. Subsequent chapters are devoted to the four operations on integers and fractions, and the simple, inverse and compound rules of three. He considers separately the money and the units of measurement and weight used at that time as well as some elementary commercial concepts. Here is an example of a problem, one of many, that his students, future merchants, had to solve: A servant of a Polish master has 800 zlotys in his pocket for which he is to buy red, blue and green cloth, the same amount of each as of the other; an ell of red cloth costs 5½ zlotys, blue 3¾ and green half of what the red one costs. How many ells of each sort will he get?" Then, there is a hint which shows what a great teacher he was: "It is not as difficult as it seems. Add all the prices up and you will get 12 zlotys for which (the servant) will get 3 ells, so it will be 200 ells for 800 zlotys which have to be divided into 3 portions".

The importance of Krüger's achievements in other fields cannot be denied. Research of terrestrial magnetism should be mentioned in the field of physics to which he devoted his work *De motu magnetis* (1606 and 1615). In the book he describes, *inter alia*, magnetic declination measurements to which he later encouraged Hevelius - the future discoverer of its variability over time. In astronomy, he was distinguished by his observations of comets which he started already under the supervision of Keckermann (treatises of 1605 and 1618), and the design of instruments such as the sextant admired by his contemporaries. Krüger also used the armillary sphere and he built sundials. His handwritten notes on the copy of *De revolutionibus* by Copernicus surviving to this day show that he had given up the cautious views of his young years (treatises of 1614 and 1615) and became a supporter of heliocentrism. He synthesized his astronomical views in the calendars which he published in 1608-1639 and in *Cupediae astrosophicae Crugerianae* (1631). The basics of geography, *Geographiae methodice discende typus* (1635) presented by him in a tabular way are also of some importance.

As a professor of poetry, he was obligated to write occasional poems. He did it willingly and not without talent, showing intelligence and knowledge of human affairs. About 20 German and Latin epigrams have survived and they differ in mood and form.

Ein Newes
Rechenbüchlein
Auff der Feder/
In ordentliche Capitel vnd gewisse Regeln verfasset/ auch mit gnugsamen dieser Lande bräuchlichen Exempeln erkläret vnd an Tag gegeben
Von
M. Petro Krüger/ Königl. Stadt Dantzig Mathematico.
Mit Königl. Privilegio.
16 31.
Dantzigk/
Gedruckt durch Andream Hünefeldt Buchhändler.

Figure 19. Krüger's *Rechen-Buchlein* (original copy in the Gdańsk Library of the Polish Academy of Sciences)

Krüger's duties as the city land surveyor included also preparing maps and plans. By 1615 he had surveyed Wielka Olszynka (Gross Walddorf) and Mała Olszynka (Klein Walddorf), Nowiny or Nowa Wieś (Neuendorf, today Dobrowo) and Płonia (Plehnendorf), belonging to the Construction Office - 131 lans, 20 morgens and 100 rods“ without springs, dams and dikes”. A plan of Stare Przedmieście (Old Suburb) prepared by him in 1617 has survived in the Gdańsk Archive. And in 1624 he measured the gardens in Podlice in Tczew (Dirschau) “which at first aroused many problems among the inhabitants, but they were successfully overcome and each owner had his modest plot of land surveyed”.

Krüger, a hardworking and modest man, was commonly liked. Upon death the city and his friends were in deep mourning and grief. The most famous of them, the poet and royal secretary Martin Opitz, honoured the memory of the deceased with a beautiful poem - the last one in his life - which has been translated into English below:

Earth is not alone to show you its grief
*Which deems you O! K*rüger an honour to be
The stars, they are weeping, the sun's shining rays
Went through an eclipse ere you ceased your days
The Glory of Time and the Pride of the Town
The Earth had no qualms before you to succumb
You measured it up, as the heavenly ways
Gave you the fortune to show their trails
God knew how obedient you were with His laws
What you deserved you get back from all:
The Earth gives you rest, the heavenly vault
the name that shant perish, God gives you salvation.

It would be hardly possible to render more aptly the merits of the great professor of the Gdańsk Academic Gymnasium.

21. Johannes Hevelius

Krüger's student was Johannes Hevelius (1611-1697), the most outstanding astronomer after Copernicus [Fig. 20]. He studied in Leiden, like many citizens of Gdańsk at that time. In 1641 he constructed the famous astronomical observatory on the roofs of the houses on Korzenna Street, one of the first observatories in the world equipped with telescopes. One of these telescopes, installed on a plot of land owned by the astronomer in the suburbs was the largest telescope in the world at the time - it was 45 meters long. Hevelius's scientific activity was supported by the kings of France and Poland. In recognition of his achievements, the Royal Society of London appointed him its foreign member. The scientist's output includes 19 works, 28 dissertations and 16 volumes of letters. Hevelius developed the most accurate maps of the Moon at the time, determined the positions of 1,564 fixed stars, and introduced twelve constellations to the sky maps.

He was the first to use a micrometer screw to precisely adjust instruments. He invented the periscope. He also built prototypes of pendulum clocks - simultaneously with Huygens. By systematically measuring the magnetic declination, he discovered its changes over time and became a co-creator of the world's oldest curve of the change of declination, started in Gdańsk in 1539 by Joachim Rheticus. The illustrations of many of his works made by Hevelius himself are of high artistic value.

Figure 20. Hevelius (Schultz D., 1677, the original in the collection of the Gdańsk Library of the Polish Academy of Sciences)

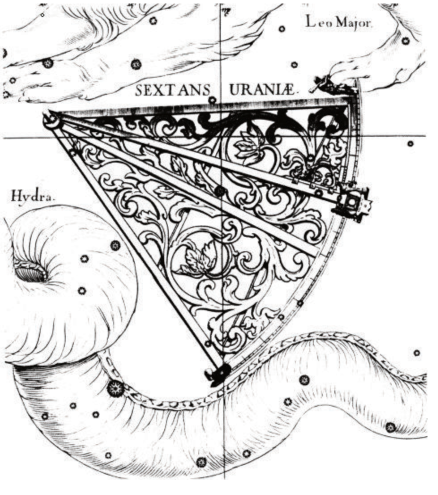


Figure 21. Hevelius's sextants (here on the map of the sky) are real works of art (*Prodromus Astronomiae*, Gdańsk Library of the Polish Academy of Sciences)

Let us move to the life history. Jan Heweliusz, as we call him in Polish, Johann Hewelcke in German, Johannes Hevelius - as he most often called himself in Latin, was born on 28 January 1611 in Gdańsk, in his family house at Grobla IV, on the corner of Straganiarska Street, under the then number 7. His parents were a wealthy brewer Abraham Hewelcke and Kordula née Hecker. He was baptized in St. John's Church. At the age of seven, he started to study at the Academic Gymnasium. According to his contemporaries, the future astronomer was a good student. "As his outstanding talents had been noticed since the sensitive childhood, he was urgently sent to school, where he learned the basics of Latin.

The mysterious enrolment of 11-year-old Hevelius at the "Albertina" University in Königsberg for studies which may not have been completed dates from 1622. In 1624 the plague forced the authorities to close the Gymnasium. To protect their thirteen-year-old son son against illness, the parents sent him to Gądecz near Bydgoszcz (Grudziądz (Graudenz) according to some) where he was to improve his Polish. After three years, he returned and started the second stage of education pursuing an individual course of studies, under the supervision of Peter Krüger. According to Pastor Barth, the author of the posthumous speech, Hevelius "having returned from Gądecz, continued his studies at the local Academic Gymnasium, where he diligently attended both private and public lectures, and he was liked very much by the professors of that time, especially by Mr. Krüger who also noticed that (...)with his zeal for other free sciences, he had a particular predilection for mathematics, as of 1627, in the sixteenth year of his life, he devoted himself to his detailed teachings and learned the basics of arithmetic, geometry, gnomonics, trigonometry, spherics, chronology and astrology". It should be explained that gnomonics is the art of building sundials, the term spherical should be understood as spherical trigonometry, and "astrology" is, of course, astronomy. Hevelius remembered Krüger with the highest esteem: "At that time, Professor Dr. Petrus Crüger lived in Gdańsk and was active in the public Gymnasium, a man of a sharp mind, a rare talent for teaching and of a cheerful disposition. Without neglecting secondary activities in other disciplines, I enjoyed his teachings with great joy ..." Krüger - an outstanding mathematician whose achievements have already been mentioned – focused Hevelius's interests on astronomy, which he practiced by making observation instruments himself [Fig. 21]. While encouraging his extraordinary student to pursue this field, he did not neglect to develop his other talents: The better the progress in the study of mathematics," writes Hevelius, "the more earnestly Crüger was trying to convince me I should pursue the art of drawing to learn not only some technical tricks, but systematically how to draw. The result of these teachings is best evidenced by a later opinion by John Flamstead: "He aspires to be an artist among astronomers".

After such preparation, Hevelius had no problems at the famous Leiden University, which was most often attended by citizens of Gdańsk. The recent discovery of evidence of his earlier stay in Jena requires further investigation. In 1630 he was sent by his parents to Leiden to prepare for a merchant career, which gave him a chance to possibly become a member of the Gdańsk Council in the future. In principle, it was the study of law, however, the young man used his sojourn at the famous university to study optics and mechanics, and to establish contacts with prominent scientists. After a year - to strengthen those ties - he set out on a journey across Western countries which was typical for young people from wealthy families in Gdańsk. The itinerary planned in advance took him to London, Paris and Avignon. His knowledge, eloquence and manners must have made a great impression on the famous scholars whom he met at that time such as John Usher, John Wallis, Samuel Hartlieb, Marin Mersenne, Pierre Gassendi, Ismael Boulliau and others. Lasting friendships formed at that time bore fruit in many years of correspondence, exchange of ideas and scientific achievements. He was to go also to Italy to meet Galileo, but his father's illness - perhaps less serious than presented to him - forced him to interrupt the useful but costly journey. Coming back to the country in 1634, the 23-year-old young man was no longer unknown to the world. When he had returned, he took up the family business. In 1635, in St. Mary's Church, he married Katharina Rebeschke, who brought as a dowry houses in the Old Town (47, 48 Korzenna Street), a brewery, a granary and an adjacent plot (at Bednarska Street). Perhaps, he would have spent the rest of his life as a brewer and possibly a member of the city government, but an event occurred in 1639 that finally put him on the path of astronomy. The terminally ill Professor Krüger asked his former student to replace him to observe a total eclipse of the sun which was supposed to occur in a few days' time. It did happen, and from then on Hevelius devoted himself to science, without giving up other matters though, as long as they would not be in the way: *inter alia*, in 1640 he was elected alderman of the Old Town and the superior of the community of St. Catherine's Church, in 1643 – he became the elder of the beer brewing guild and the superior of the Elizabethan Orphanage, in 1651 – a councillor of the Old Town where he would usually chair the Council. He began with building the Star Castle (Stellaeburgum) - an observatory installed on the roofs of his houses at Korzenna Street, which started to operate in 1641. It was the first huge, regularly operating, well-equipped observatory in Europe - including lunettes [Fig. 23]. It did not take long to wait for the results. In 1647, *Selenography* dedicated to the Gdańsk Council was published, in which Hevelius included a description of his astronomical instruments and the results of his observations of the Moon, as well as the most accurate maps of the Moon at that time, with names given by the astronomer, some of which are still used today. While drawing them, he started the screen projection method. He developed a method for determining the height of lunar mountains. He discovered the longitudinal libration of the Moon (a kind of swaying during the revolution around the Earth) owing to which we can see a little more than half of its surface. The instruments, partly of his own design, allowed him to locate the position of stars and planets with an accuracy of 1 arc minute. Let us remember: a full circle is 360 degrees of 60 minutes of arc, or 21 600 minutes of arc. Hence, such accuracy means an error of 1/21 600, or about five thousandths of a percent. It was the maximum accuracy possible when viewed with the naked eye. Hevelius owed it not only to his legendary sharp eyesight, but also to the excellent workmanship of the instruments in which the only limitation was the diffraction (bending of light rays). In his catalogue, he included 1564 fixed stars (1538 measured personally by him) – 50 percent more than his predecessors. He was the first to present them with the so-called equatorial coordinates. When examining sunspots, he discovered the so-called solar hot spots– brighter spots. He introduced 12 new constellations to the maps of the sky, nine of which are used to date, including *Scutum Sobiescianum*. He discovered the phases of Mercury and the time variability of the Omicron star in the Whale constellation. Doubtlessly he was one of the greatest astronomers of his time.

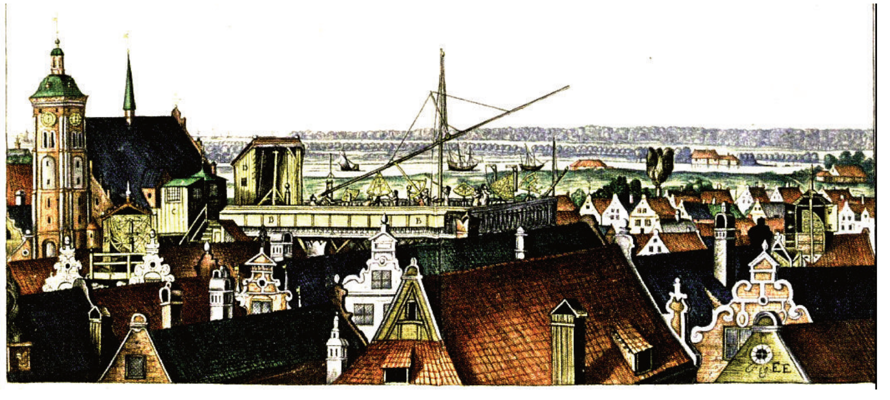


Figure 22. Hevelius's Observatory (*Machina Coelestis*, Gdańsk Library of the Polish Academy of Sciences)

After his father's death in 1649, he inherited the house at 49 Korzenna Street, and the brewery at Piwna Street, a suburban brickyard and a horse farm after his mother's death (1653). In 1659, he is honoured by a visit by King John Casimir and Queen Marie Louise Gonsaga. In 1660 he receives nobility (not confirmed by the Seym) and real estate. The observatory was visited by Christina, Queen of Sweden. In 1662, Hevelius's wife Catharina dies.

In the following year, the astronomer marries Elisabeth Koopman, who was 36 years his junior and who would become his best aide and assistant [Fig. 24]. His intensive work wins him worldwide recognition. King Louis XIV of France gave him a stipend, payable until 1672. In 1664, the Royal Society of London admitted him as its Fellow. In 1664, Hevelius's son Adeodalus (Bogdan) is born but dies after a year. Three daughters are born: Catharina Elizabeth 1666, Juliane Renate in 1668, and Flora Constantia in 1672. *Cometography* is published in 1668, and the first part of *Machina Coelestis* is released in 1673. Contacts with John III Sobieski started following his visit at the observatory in 1673 – to whom the scientist sent three lemons from a tree he had grown himself when he became king. John III repays him with the beer brewing tax exemption (in 1677) and a salary paid from 1678. In 1679, Edmond Halley, sent by the Royal Society, arrives, confirming the accuracy of Hevelius's observations. In the same year, fire destroys the houses, the observatory and almost all of the freshly printed second part of *Machinae coelestis*. The king's financial assistance and the energy of his young wife help restore the damage. In 1684, the grateful astronomer puts the *Scutum Sobiescianum* constellation on the maps of the sky.

Figure 23. Bust of Elizabeth Koopman (lost)

Interesting evidence that Hevelius was involved with various affairs of the city was the Memorial prepared by him in 1677 concerning a device for mountain levelling. A type of a transporter to carry the soil taken from the top of a hill to another place is described in it. Four horses harnessed to a treadmill could, as Hevelius writes, drive up to 150 wheelbarrows full of soil. We do not know whether it was his original idea or a description of an invention used in 1669 at the construction of the Notzke Bastion.

In 1687, on the day of his 76^{th} birthday (28 January), Hevelius dies of a kidney disease. After the astronomer's death, the widow compiled the materials left by him and published the *Catalogue of Fixed Stars (Catalogus stellarum fixarum)* in 1687, and in 1690 the *Sobieski Firmament (Firmamentum Sobiescianum)* with 56 maps and the *Herald of Astronomy (Prodromus Astronomiae)*, dedicated to King John III. The dedication was signed by "Elisabeth, the widow of Hevelius".

She died in 1693 outliving husband by six years. She was buried next to him in the family tomb in St. Catherine's Church in Gdańsk. François Arago, the prominent French scholar, wrote about her: "A reverent memory is always due to Mrs. Hevelius, the first woman I know, who was not afraid to bear the burden of astronomical observations and calculations."

Notwithstanding Hevelius's great services for the city and the world of science, it was as late as in 1780, only when Johann Bernoulli had expressed his surprise that such a great citizen of Gdańsk had no monument in the city that the astronomer's great-grandson Daniel Davisson, funded the epitaph in St. Catherine's Church – by the chisel of Wilhelm Christian Meyer. In 1790, King Stanisław August donated a bust of Hevelius sculpted by Andre Le Brun as a gift to Gdańsk.

Figure 24. Glaser's sundial design in the Gdańsk Archives (APG, Guide)

Hevelius and the sundial at the Town Hall. The sundial seen today on the Main Town Hall may be associated with Hevelius's presence. It was founded by Alexander Glaser, the learned preacher of St. Barbara's Church on Długie Ogrody Street. The colour design of the dial made by him in 1588 with the lines of "equal, unequal, Polish and Italian" hours has been preserved in the Gdańsk archives [Fig. 24]. It is the so called southern clock, i.e., facing directly the south. The shadow of the gnomon set parallel to the Earth's axis, assuming the latitude of 54°54' (in fact it should be 54°21') measures the local solar time on the hour lines. The unequal hours are a remnant of the early Middle Ages, when the day and night were divided into 12 hours - from sunrise to sunset and from sunset to sunrise. The Polish hours were counted from sunrise, and the Italian hours - from sunset on the previous day. The lines of each hour type are marked with Arabic numerals in the appropriate colour. The numbers are 1 to 12 for unequal hours, 1 to 11 - for the Polish hours, 13 to 24 for the Italian hours. All three types of hours are indicated by the shadow of the ball on the gnomon on the appropriate lines. In addition to that, the dial has lines to read the position of the Sun in the Zodiac, and also indirectly the months. The signs of the Zodiac are painted on the edges of the inner green field of the dial. The summer and autumn signs are on the left, and the winter and spring ones on the right: During the day, the shadow of the ball is travelling from left to right along a line corresponding to the season: above the centre line corresponding to the equinox in autumn and winter, and below it in spring and summer. The extreme bottom line corresponds to the summer solstice, the extreme top line to the winter solstice. The centre of the dial is adorned with the coat of arms of Gdańsk with the date: 1588. The lines of the equal hours come out from the image of the Sun. The inscription reads: "Our days are shadows" (VMBRA SVNT DIES NOSTRI). At the bottom of the dial we read: M. ALEXANDER GLASERVS F. ET DDIC: (*fecit et dedicavit* - made and offered by).

Figure 25. Glaser's sundial at the present time (Photo: Januszajtis A.)

The dial of the current sundial differs slightly from the original design [Fig. 25]. The hour lines are the same but placed slightly differently. The equal hours are now marked as "astronomical", and the Polish hours - as "Babylonian". There is no coat of arms of Gdańsk in the centre of the dial, but it has appeared above the dial instead - beautifully composed, though not entirely accurate: it is a heraldic error to place the crown over the shield, instead of - as required by the privilege of Casimir IV Jagiellon - in the upper part of thereof. The upper inscription only has remained from the two inscriptions in the frames: "Our days are shadows". These changes are explained in the books of Kamlaria (the Municipal Treasury) in the fiscal year 1647/1648 under the entry the "Sundial": "the painter Izrael Leon for painting the sundial completely anew on copper plates - 180 marks (monetary unit, equivalent to about 200 g of silver), decorating two lions and the city's coat of arms above the sundial – 45 marks, Hans Miebis for the two copper lions – 135 marks, Wolfgang Günter, the sundial maker for all the works on the sundial - 150 marks, Jan [Jean] Charpentier for the iron triangle [gnomon] - 3 marks, Jerzy [Georg] von Strackwitz [Strakowski] for some expenses related to the sundial – 9 marks". The cost totalled 558 marks. Further renovations did not bring any fundamental changes.

The sundial on the painting *Rental Groschen* by Antoni Möller of 1601 is similar to Glaser's design. Therefore, the changes must have been made during the renovation. Why were they made? Most probably the idea was to improve the indications. We know that Wolfgang Günter was a close associate of Hevelius. The astronomer was interested in gnomonics – he is known to have designed a magnificent sundial for the palace in Wilanów (Sobieski's palace near Warsaw). As the Old Town councillor, representing it in the Main Town Hall, he was often at the place and could not help noticing the incorrect latitude of Gdańsk assumed by Glaser. It is quite possible that the design of the revised sundial was developed by or at least consulted with him. Let us add that the correct latitude was determined for the first time by Hevelius's teacher, Peter Krüger.

A Coryphaeus of Idea. Hevelius was a true light of his time. He did not lock himself up in an "ivory tower", but spread the scientific ideas in his environment and in large circles of his correspondents. Hevelius's circle included the Gdańsk physician Israel Conradt, who, in a series of lectures delivered in 1670, presented the results of his own research on the effect of low temperature on the state of matter. The text published seven years later includes, *inter alia*, a description of the phenomenon of liquid supercooling discovered by the author. Conradt carried out his research in response to an appeal from the Royal Society of London. Such an appeal may have been communicated to him by his friend Hevelius, who was in regular contact with the Society of which he was a member. It can be assumed that Hevelius had a significant share in Conradt's proposal to establish a scientific society following the example of Italian academies. The project was rejected by the Conservative Council, however, the idea of Hevelius and Conradt was still alive and finally - in 1720 - it was implemented when the Scholar Society (*Societas Litteraria*) - the first in Poland, and then - in 1743 - the Society of Experimental Physics (Natural Science - Naturforschende Gesellschaft) were established. More information on this subject can be found in the chapter on scientific societies (p. 84 ff.)

A Pioneer of Physics. "A favourite of kings and dukes, the prince of astronomers," as the Gdańsk Council described him on a medal minted on the hundredth anniversary of his death, he was also famous in the field of physics. It is true that he is wrongly credited with inventing the micrometer screw, which had been known already in Heron's times. Hevelius improved it only and used it in an ingenious way by introducing a gear train to increase the accuracy of reading [Fig. 26]. However, an unquestionable invention of his was the polemoscope, i.e. the periscope: "I invented and built this optical instrument myself in 1637, and I do not think that it had been seen ever before (let it be said without boasting) " [Fig. 27]. We also know that he would build first prototypes of pendulum clocks in Poland [Fig. 28]. At this point another

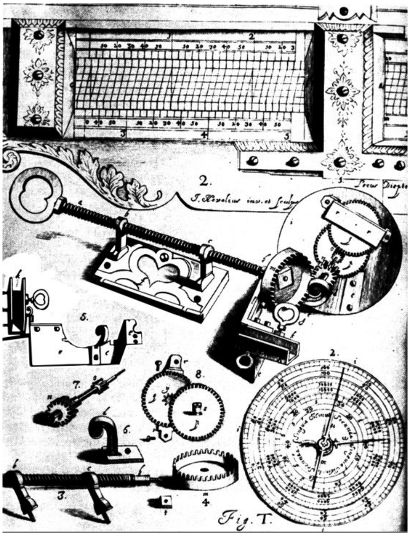


Figure 26. Hevelius's micrometric screw (*Machina Coelestis*, Gdańsk Library of the Polish Academy of Sciences)

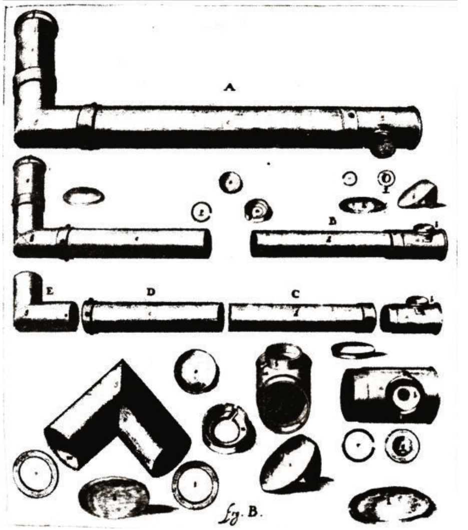


Figure 27. Hevelius's polemoscope (*Machina Coelestis*, Gdańsk Library of the Polish Academy of Sciences)

of his achievements in the field of physics should be mentioned. For many years, Hevelius would measure the magnetic declination with an incredible accuracy for his time, and he can be considered to have discovered or co-discovered its changes over time. For the sake of accuracy it should be added that Hevelius made his first measurement in 1628 under the supervision of Krüger, who, even if he had not known Rheticus's result (over 13°E), must have noticed a significant difference compared to his measurement from 1600: here 1°W, there

8½E. Gdańsk was exceptionally privileged in this respect indeed, as it was here where one of the first measurements of declination in the world was made. As has been mentioned before, it was done in 1539 by Joachim Rheticus - a student and assistant of Nicolaus Copernicus, who came to the city to see to the publication of the *First Account (Narration Prima)* devoted to his Master's system. The next measurement was made around 1600 by Peter Krüger. Hevelius began the series of his measurements in 1628 as a junior high school [gymnasium] student under the supervision of Krüger. It was his first research work. The last time when he measured the declination was in 1682. Thanks to this wonderful series of seven measurements, we have in Gdańsk the oldest magnetic declination curve in the world [Fig. 29].

The discoverer of changes in declination over time is considered to be Henry Gellibrand (1635). The actual discoverer may have been Krüger, but it was Hevelius who realized the significance of this observation and described it. This is evidenced by a fragment of a letter from 1670: "The changes in the magnetic declination over time discovered by me have been sufficiently confirmed by observations of the famous Englishmen: Burrow, Gunther and Gellibrand."

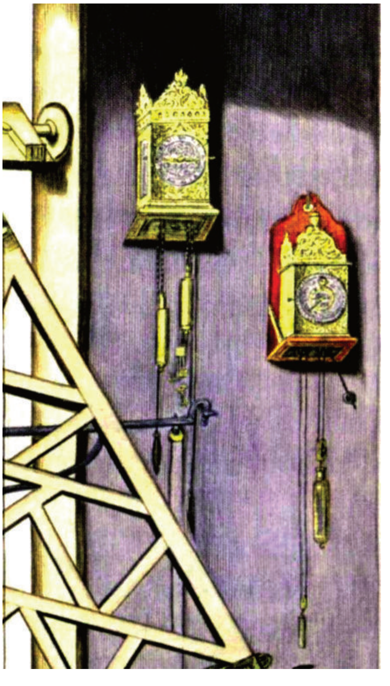


Figure 28. Hevelius's clocks (*Machina Coelestis*, Gdańsk Library of the Polish Academy of Sciences)

Jan Heweliusz, Johannes Hevelius or Johann Hewelcke? Hevelius was born and baptized as Hans or Johann Hewelcke (Hewelke in some more recent records). This was announced by Andreas Barth, the pastor of St. Catherine's

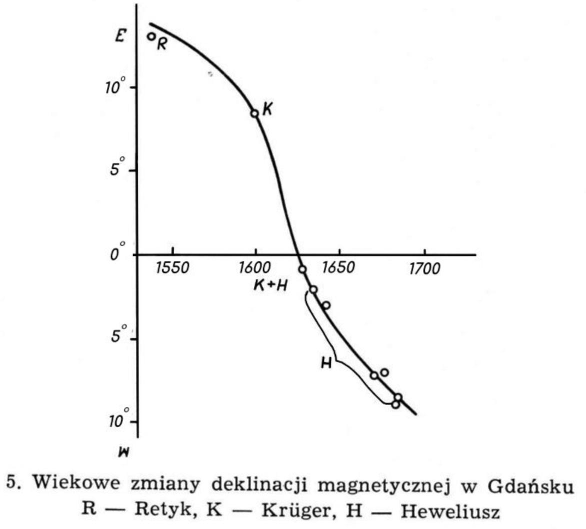


Figure 29. Gdańsk magnetic declination curve
Changes of magnetic declination over time in Gdańsk
R – Rheticus, *K* – Krüger, *H* – Hevelius

Church during the mourning speech. In everyday life the scientist would use German which was the language commonly used in Gdańsk. So why do we say and write "Jan Heweliusz" and not Hans, Johann or Johannes Hewelke? Recently, foreign names and surnames have been entered in records in the original language form, which sometimes leads to errors. For example, some authors refer to the creator of the Gdańsk Arsenal as "Anton" van Obberghen, while he himself signed with the name of Antoni, and in the contemporary documents he appears as Master (Meister) Anthoni – and never Anton! In the catalogue of students of the Academic Gymnasium in 1618, Hevelius was entered as Johannes Hefelke Dantiscanus, and as Hans Hövelke as a juror in the records of the Old Town authorities of 1641. As of 1651 the records contain the councillor: Johann Hövelke, Hovelke or Höfelcke. It was as late as from 1673 that the names Hevelke, Hewelke or Hewelcke start to prevail in the records. They all refer to the same person! No wonder that in scientific works and letters written in Latin, our astronomer decided to use one name: Johannes Hevelius. It happened during his studies in Leiden where the language of instruction was Latin, and it may have happened even at an earlier time, during his studies at the Academic Gymnasium, where it was forbidden to use other languages in higher grades.

How did Hevelius become Heweliusz? What worked here was the mechanism of adaptation of foreign sounding surnames which is typical for many languages. The Greek ending -*aios* was transformed into -*aeus* (pronounced -*eus*) with the ancient Romans which was then adopted by the entire Latin world. In Poland

Figure 30. *Scutum Sobiescianum (Firmamentum Sobiescianum*, Gdańsk Library of the Polish Academy of Sciences)

it was made Polish in the form of *-eusz*. In this way, Greek Ptolemaios and Latin Ptolemaeus have become Ptolemeusz, Italian Medici – Medyceusze, French Conde – Kondeusz, and Hevelius – Heweliusz. Names such as Tadeusz, Juliusz, and even Janusz from Latin Joannes or German Johannes have been made Polish in a similar way.

Figure 31. Hevelius's epitaph in St. Catherine's Church

Nonetheless, the form of Jan is more common in this case. We have the full right to use it also to people of foreign origin, especially related to Poland and widely known in our society. Hevelius was born in Gdańsk, thus, he was a citizen of the Polish Crown by birth, having equal rights with others on its

Figure 32. Hevelius's bust - a gift from King Stanisław August Poniatowski (Photo: Januszajtis A.)

territory. We also rightly name him the most famous astronomer of the Polish Republic after Nicolaus Copernicus, as he was described on a plaque placed in 1987 at the place where - as was believed at the time - his houses and his observatory were once located: at the corner of Korzenna and Heweliusza Streets. What did he think about it himself? His dedications to the highest rulers of Gdańsk – the Polish Kings, usually in Latin are significant in this respect: "To the Highest and Most Powerful Ruler and Lord, Joannes III by the Grace of God, King of Poland, Grand Duke of Lithuania, Rus, Prussia, Mazovia, the Lands of Kiev, Volhynia, Podolia, Podlasie, Smolensk, Siewierz, Czernichowszczyzna (...) Lord and King, always the Most Gracious". Similarly in the header of the letter: 'Your Royal Highness, Most Honourable Lord" How touching and subtle was the gift sent by him to Jan Sobieski when he heard that he had been elected king - three lemons from a tree that he had grown himself! And when in 1660 he was visited by John Casimir at the observatory who was delighted with the first pendulum clocks in Poland made under his supervision, one of which was "humbly and obediently" offered the King by Hevelius as a gift. In a letter to Adam Kochański dated 9 January 1681, he called himself (in Latin) "a citizen of the Polish world who had, for the glory of his Homeland and for the sake of science, did so many works and made so many efforts, without boasting, with the greatest input of his abilities". If we add *Stellae Vladislavianae* or *Scutum Sobiescianum* introduced by him to the maps of the sky which he named Sobieski's Firmament (*Firmamentum Sobiescianum*), there seems to be no need for any other comments [Fig. 30]. The Gdańsk Germans in those times were Polish Germans, and most of them were loyal citizens of the First Polish Republic.

Having reached the age of majority, they swore (in German) loyalty to the kings of Poland, and in times of unrest they kept their oaths more diligently than many Poles. The preserved texts of oaths speak louder than the contradictory learned interpretations of much later times. Even the oath taken on the ramparts during the rebellion against Stefan Batory in 1577 ends with the reservation: “Without harm to the eternal incorporation and the unification with the Polish Crown, while maintaining our lawful freedoms and privileges. So help us God and His Holy Word!”. It is hard to find a clearer and more explicit formulation of the attitude of the old Gdańsk with respect to Poland.

Monuments. A distinct proof of the respect which is still enjoyed by Hevelius in his hometown are the monuments to him of which we have at least five. The epitaph from 1780 found on a pillar above his tomb in St. Catherine's Church should be considered to be the earliest [Fig. 31]. It was founded by his great-grandson Daniel Gottlieb Davisson, and it was carved in marble by Wilhelm Christian Meyer, a sculptor of Berlin, recommended by the astronomer Jan Bernoulli. A wooden canopy was added at Davisson's wish. Another monument, a master bust by Andre Le Bruno (currently in the National Museum in Gdańsk), was given to the city as a gift in 1790 by King Stanisław August Poniatowski [Fig. 32]. The third monument was erected in 1972 in front of a gymnasium school in Gdańsk Przymorze (at Zgody Street). The fourth monument, sculpted by Michał Gąsienica Szostek, was placed in front of the Old Town Hall in 1973. It was moved to its present location at Wodopój Street in 2006 to be replaced by the excellent fifth monument, the work of Jan Szczypka in front of the Town Hall [Fig. 34]. To honour the astronomer, students of the Academy of Fine Arts made a presentation of the sky on the wall of a building neighbouring on one of the houses at Korzenna Street. It is a fragment of a map of the constellations from Hevelius's epochal work *Machina Coelestis*. The sundial at the Great Mill, installed there by the team of Grzegorz Szychliński at the same time as the monument was unfortunately damaged by mindless vandals.

Let us mention three of the plaques dedicated to Hevelius: 1. a memorial plaque with the likeness of the astronomer has been in the Old Town Hall since 1911; 2. an inconspicuous bronze plaque on the corner of Heweliusza and Korzenna Streets (also an expression of remembrance) has reminded us since 1987 where his houses were located according to the knowledge at that time; 3. in 2011 a plaque was placed on Gymnasium No. 2 on Kartuska Street to commemorate giving the name of Hevelius to the school. Another effigy in stone has decorated the bay window of the building where the offices of the National Bank of Poland are located today at Brama Wyżynna (the Upland Gate) since 1906. Another magnificent monument to Hevelius is *Centrum Hewelianum*, a centre for the promotion of science at Grodzisko Hill (Hagelsberg). The numbers of painting with Hevelius has increased recently when the astronomer's face has been discovered in a crowd of figures on *Entry of Christ into Jerusalem* by Bartholomew Milwitz, painted in 1654 for St. Catherine's Church [Fig. 34]. Nonetheless, the greatest

Figure 33. Monument of Hevelius before the Old Town Hall (Photo: Januszajtis A.)

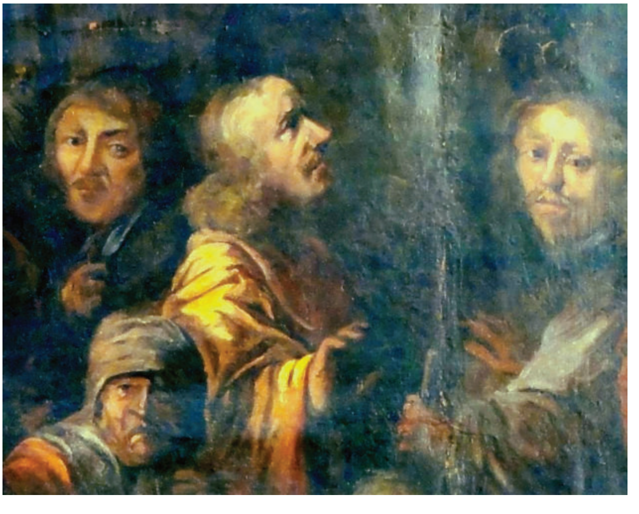


Figure 34. Hevelius in the painting by Miltwitz (Photo: Januszajtis A.)

portrait of him remains the masterpiece by Daniel Schultz, described above, found in the collection of our splendid Gdańsk Library (a copy of Andreas Stech's

Figure 35. Hevelius in the courtyard of his name in Gdańsk University of Technology (Photo: Krzempek K.)

portrait of astronomer sent by him to the Royal Society - now in Bodleyan Library in Oxford).

Johannes Hevelius is the patron of one of the roofed courtyards of the Main Building of the Gdańsk University of Technology - the one with the Foucault pendulum. In 2011, the astronomer's portrait adorned the recess behind the pendulum [Fig. 35].

22. Creators of the Gdańsk Pharmacopoeia

When talking about the history of the Gdańsk science it is impossible not to mention medicine and pharmacy the progress of which played an important role in the development of chemistry. The first item of information about a pharmacy in Gdańsk comes from 1399. Professional physicians were already active in the city at that time. In city statutes, issued in 1455, regulations are found whereby the practice is conditional on the presentation of relevant certificates. The office of the city physician was in place as of 1500. The first information about an infectious diseases hospital, the so-called the House of Smallpox (Pockenhaus) - later the Municipal Lazaret comes from 1515. Doctor **Johann Brettschneider** (Placotomus, 1514-1577), associated with Gdańsk, published an apothecary manual in Antwerp in 1560. The first chair of anatomy in Poland operated in the Academic Gymnasium from 1580. In 1597 the Pharmacy Act was printed. In 1612, *Collegium Medicorum* was established - the first Medical Chamber in Poland. In 1613, Doctor **Joachim Oelhaff** (1570-1630) performed in Gdańsk the first public autopsy in Central Europe. In 1665, following the draft issued three years earlier on the initiative of the City Council, the first Pharmacopoeia, i.e. a collection of official recipes for medicines in Poland was prepared in Gdańsk. The Latin title can be rendered as follows: "The Gdańsk Dispensatory, containing all materials, both galenic and chemical, which are sold in the Gdańsk offices, created under the authority of the Illustrious and Most Distinguished Senate, prepared by the work and efforts of Doctor Johannes Ernest Scheffler and Doctor Johannes Schmiedt, the ordinary physici of the City". The word "physicus" meant in those days the doctor, "offices", of course, pharmacies, of which there were six in Gdańsk then. The profiles of both the creators of the Pharmacopoeia are presented below.

Johann Ernst Scheffler. He was born in Gdańsk on 17 July 1605, son of Christoph Scheffler and his second wife Maria Haderschlieff. Having graduated from the Academic Gymnasium, he studied medicine and philosophy in Louvain. He graduated in 1632 and received the degree of Doctor of Medicine in 1633. Then, he may have stayed at the Royal Court in Warsaw as he would boast to have the royal Polish doctor title. He was married three times. He had three children with his second wife, Susanna Maria von Peschwitz, the widow of Christian Esske. In 1658, two years after her death, he married Adelgunde from the old Gdańsk family von der Becke, the widow of Georg Wolfram. In 1661, he became the city "physicus" in Gdańsk. In 1665, jointly with Johannes Schmiedt, he developed the above mentioned Pharmacopoeia. Born into a Lutheran family, he converted to Catholicism. In 1663, he founded an epitaph for himself in St. Nicholas's church which was carved by Hans Caspar Gockheller, and in 1671 - three altars, one of which has been preserved. He was involved in a bitter dispute with Aegidius Strauch, a fanatical Lutheran preacher, and he wrote a devastating response to his anti-Catholic and anti-Polish statements. He died on 14 August 1673. A week later, against the will of the deceased (!), a Lutheran funeral was organized for him in St. Mary's Church.

A realistic likeness of Scheffler is glancing at us from the epitaph [Fig. 36]. The Latin inscription reads, *inter alia*: "Wherever we turn everything is uncertain, certain is only death whose eventual purpose is eternity. This is where we are going, running and hurrying, remembering Jan Ernest Scheffler, Doctor of Medicine, Physician of His Saint Majesty, who has made this mortal tombstone for himself in his lifetime from his income accumulated in mortality, for the happiness which he expects and is trying to enter. Below the inscription is Scheffler's coat of arms: two scheffels (grain measuring vessels, bushels) in a diagonally divided field. This is the so called speaking coat of arms which is related to the surname Scheffel in German where Scheffler is the person operating a Scheffel. The form of a portal hanging on the wall symbolizes the entrance to the world of eternity, the Phoenix in the finial - resurrection, the burning vases on the pillars - love for God.

On the preserved altar founded by him (St. Rose of Lima, with a painting by Andreas Stech), Scheffler is described as "a doctor of medicine, an ordinary physicist of the City of Gdańsk". His coat of arms is at the top and the figures of his patron saints: John the Baptist and Ernest are at the sides.

Johannes Schmiedt. He also signed with the Latin form of the surname **Fabritius.** He was born in Gdańsk on 1 December 1623. His father Daniel

Figure 36. Scheffler's epitaph in St. Nicholas's Church (Photo: Januszajtis A.)

was a doctor in the city service, his mother Catherina Schewecke came from a well-known patrician family. When he was seven, his parents sent him to Rudno near Pelplin for four years, where he lived with pastor Jan Schroeder who taught him Latin and Polish. Having returned to Gdańsk, he took private lessons, later he studied at the Academic Gymnasium. He became famous for the first oration in ancient Greek in the history of the university. Following his father's will who wanted him to be educated to become a theologian, in 1642 he began studying philosophy at the "Albertine" in Königsberg. It was there where he discovered the vocation to the family specialty (grandfather, father and uncle were doctors) and also attended medical classes. In 1646 he left for Leiden, where he studied botany and Arabic (!), then he travelled to Paris, Lyon and Avignon, and finally, to Montpellier to deepen his medical knowledge. It was there where he received his degrees of Bachelor in 1648 and Doctor of Medicine in the following year. He published several dissertations in which he argued, *inter alia*, against the use of the then fashionable bleeding to cure chronic diseases. Not only that: he also went to Padua for additional studies in anatomy, surgery, physics and chemistry! This trip lasted a year; then Schmiedt returned to Gdańsk and opened a private practice. His father, who had appreciated his achievements, died in 1651, his mother had been dead since 1649. In 1654 Johannes Schmiedt married Dorothea Wulff, the widow of the merchant Heinrich Borbeck, who died childless in the following year. In 1659, he married Anna Maria Riccius, the daughter of a trustee (legal council), with whom he had five children. He lived in his family house at 59 Piwna Street, on the corner of Kozia Street, the front porch of which was decorated with a magnificent baroque balustrade that has survived to this day. In 1664, he became the city "physicus". A year later - together with Johann Ernest Scheffler - he prepared the Dispensatorium (Pharmacopoeia). He was the first doctor in Poland and the third doctor in the world to apply intravenous injections - for the first time in 1666. After the death of his second wife in 1676, he remained single. He died on 3 March 1690. He was buried on 15 March of the same year in St. Mary's Church, in Tomb No. 182, which he had bought 30 years before. His son, Johann Gabriel, promised to be an outstanding scientist, but died of a lung disease in 1686, at the age of 24 - a year after receiving his Doctor of Medicine degree in Montpellier. The father was pain stricken with his death. His daughters, Anna Dorothea and Virginia Renata married doctors, the other two died in childhood. The scientific level of Johannes Schmiedt, in addition to his co-authorship of the *Pharmacopoeia*, is evidenced by 20 Latin dissertations, published e.g. in *Philosophical Transactions* - an organ of the Royal Society of London.

The evidence of his high professional position is the portrait by Andreas Stech, on the basis of which the posthumous engraving by Hainzelmann, preserved in Kraków, was created [Fig. 37].

Figure 37. Johannes Schmiedt (by Hainzelmann, acc. to Stech)

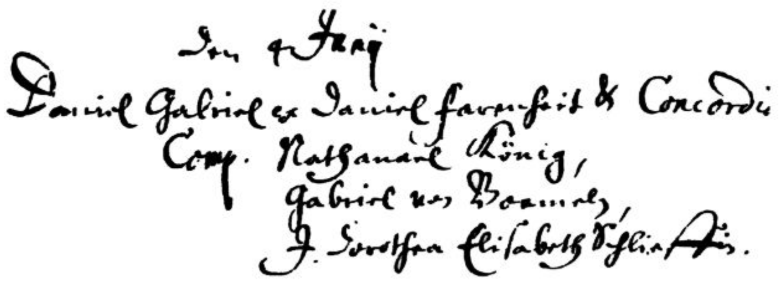
The *Pharmacopoeia* was not the only example of the collaboration between the two doctors. In 1651, they certainly did not remain indifferent to the renewed attempt to establish Collegium Medicum - a professional organization of doctors (the first organization, established in 1612 operated only for some time). It can be assumed that it was they, being well acquainted with the Western European models, who prepared the statutes of the organisation on such basis. However, similarly as in 1636, the city authorities rejected the project. It is almost certain that in 1670 both scholars supported the proposal of the above mentioned Doctor Israel Conradt to establish a scientific society similar to the Italian academies. Later, in 1677, after Scheffler's death, when 14 doctors again applied for establishing a Medical College, Schmiedt was the first to sign the petition. The City Council did not approve the undertaking this time, either.

Daniel Gabriel Fahrenheit. Daniel Gabriel Fahrenheit of Gdańsk (1686--1736), active mainly in the Netherlands, became famous as the creator of the first reliable thermometers (1708), which he filled with alcohol or mercury (1713), as well as the thermometric scale (1713; the scale was corrected by him in 1717 and standardized by the Royal Society in 1777), still used in the USA today.

LIFE HISTORY. Daniel Gabriel Fahrenheit was born in Gdańsk in 1686, son of Daniel Fahrenheit, a merchant and shipowner and Concordia née Schumann. After his initial education at St. Mary's School, he was to study at the Gdańsk Academic Gymnasium. These plans were destroyed in 1701 by the death of his parents. Having been sent to Amsterdam for mercantile practice, Daniel Gabriel, against his curators' wishes, devoted his time to the construction of scientific instruments. In 1708 he left for Copenhagen, where he conducted research under the supervision of Olaf Rømer. Having reached the full age, he returned to Gdańsk and collected his share of his parents' estate. He was involved in large-scale trade for a short time, but then returned to study. In 1712, he started to work with Paul Pater, the founder of the first technical school in Gdańsk and Poland. In 1713 he moved to Berlin and in 1717 returned to Amsterdam, where he spent the rest of his life. He conducted research, delivered private lectures, and built scientific instruments. He maintained contacts with scientists from various countries, and in 1724 he became a member of the Royal Society of London. He died in 1736 in the Hague, probably as a result of mercury poisoning. He is famous as the creator of the first reliable thermometers (1708), which he filled with alcohol or mercury (1713), as well as of thermometric scale (1717) still used in the USA today. Before 1723, he had discovered the dependence of the boiling point of a liquid on pressure. In the same year, he raised the boiling point of water by adding sea salt thereto. He explained both these phenomena with reference to the molecular theory. Fahrenheit was also a pioneer in low temperature physics: in 1729, using a cooling mixture he obtained the temperature of -40°, a record temperature at that time. His other inventions included medical thermometers, which he sold for a florin apiece, and a centrifugal pump for cleaning channels, for which he obtained a patent. The museum in Groningen has a perfect model of the eye made by him in its collection. Despite these achievements, he lived and died in poverty - he could not even afford a portrait.

DATE OF BIRTH. To find the full date of Fahrenheit's birth, let us have a look at the multi-volume Encyclopaedia of the Polish Scientific Publishers issued on the initiative of the daily *Gazeta Wyborcza*. However, we can find only the year there. The case is similar in other publications of this type, which are usually limited to giving the year of birth, death and other events from the life. Therefore, it should be sought elsewhere. It is not difficult to come to the conclusion that whenever the date of Fahrenheit's birth appears in Polish and German publications, starting with an anonymous sketch from the mid-18th century, it is 24 May 1686. The situation is different in English sources. According to the earlier editions of the famous British Encyclopaedia, Daniel Gabriel Fahrenheit was born on 14 May 1686 – later publications give the date of 24 May. The explanation is simple. Gdańsk, similarly to the whole of Poland, adopted the Gregorian calendar reform with its announcement in 1582. The Protestant England did not want to submit itself to the dictate of Rome and maintained the Julian calendar until 1752. The reason for the difference between the two calendars is due to the fact that Pope Gregory XIII cut out 10 days from the calendar: Friday, 15 October followed Thursday, 4 October 1582 (today this difference has gone up to as many as 13 days). In 1686, when it was 24 May in Poland, the same day in England was marked as 14 May. It follows from the above that both the Polish and English publications are right. However, the latter should include a note that the date is given in the Julian system. There are no problems with the date of his death: the scientist died on 16 September 1736 in the Hague. However, there is a problem with the grave. He was buried in the local "Monastery" church (Kloosterkerk), however, today his body is not there, because while modernizing the crypt (in the 19th century) the coffins were moved to the public cemetery. So far, attempts to establish the exact date of relocating the remains and the place of burial in the cemetery have been unsuccessful.

CHRISTIAN NAMES. The title of this section seems to be lacking sense: Daniel Gabriel is Daniel Gabriel. However, when we look up an encyclopaedia, we can have doubts. In some of them, our scientist is entered as Gabriel Daniel. Also on the Internet, which is otherwise full of errors, sometimes it is about Daniel or Gabriel Fahrenheit, and most often about Gabriel Daniel. The correct order of the names can be found in the books of St. Mary's Church, where Fahrenheit was baptized [Fig. 39]. Under the date of 4 June 1686 we read: "Daniel Gabriel ex Daniel Farenheit & Concordia" or "Daniel Gabriel (child) by Daniel Fahrenheit (the scribe misspelled the name - without the first h) and Concordia". The first name was given to the newborn after his father, the second - Gabriel - was popular with the Schumann family from which his mother came. As we can see, the proper names are Daniel Gabriel. Stating the name Daniel only is misleading as that was the name of the scientist's father, a well-known and respected merchant and shipowner, but only him. And which names were used by their owner himself? His signatures in different periods of his life always had the same form: Daniel Gabriel Fahrenheit. This is how he signed his letters, he made such a signature under the oath as a new member of the Royal Society of London. He would never change the order of his names. Sometimes he would use only the initials: D.G. Fahrenheit. Even on his deathbed, when fever had distorted his handwriting to the point of illegibility and affected by it he wrote "Farenheit" instead of "Fahrenheit", but he did not forget about the correct order of the initials: D.G.



Świadectwo chrztu Daniela Gabriela

Figure 38. Baptism certificate of Daniel Gabriel Fahrenheit in Gdańsk Archives

Hence: the correct names and their order are Daniel Gabriel Fahrenheit. Any and all other versions are incorrect.

FAHRENHEIT'S THERMOMETERS. The greatest achievement of Fahrenheit was the practical and theoretical development of the foundations for the construction of reliable thermometers, calibrated on the basis of three fixed points. In the notes from his lectures in Amsterdam in 1718, we find the following description of the characteristics of a good thermometer: 1. It must show the same degree of cold or heat with other ones at any time and place, i.e. thermometers must be the same. 2. It must have variations occurring within the limits of certain findings in the nature. 3. The changes must be seen as quickly as possible, i.e., it must be stimulated by the smallest change that occurs in the air and display it as quickly as possible. 4. The liquid with which it is filled must be connected with air. 5. The liquid must be coloured to a colour that does not change" (Ploos van Amstel). By the concept of limits of findings in the nature, Fahrenheit understood the fixed points used by him, namely: 1. The greatest cold in the surrounding atmosphere that can be found when certain amounts of water, ice and salt are mixed (...). 2. The melting and freezing points which are found by mixing water and ice (...).3. The living creature blood point, which, however (...) is unreliable. 4. The boiling water point".

The reaction speed could be increased thanks to the use of a cylindrical vessel: "Fahrenheit was the first to invent a thermometer of this kind and on 25 March (1718) he showed us clearly the difference in the following way: He took two thermometers with the same readings, one of which was fitted with a spherical vessel and the other with a cylindrical one, he placed both of them at the same height in the flame of a candle (...): it could be clearly seen that the one with the cylinder reacted much faster than the one with the ball, which is due to the fact that the cylinder (which was exactly of the same size as the ball) had a larger surface area than the ball and therefore was faster excited by the air, and as it had a smaller diameter, so it was easier to penetrate".

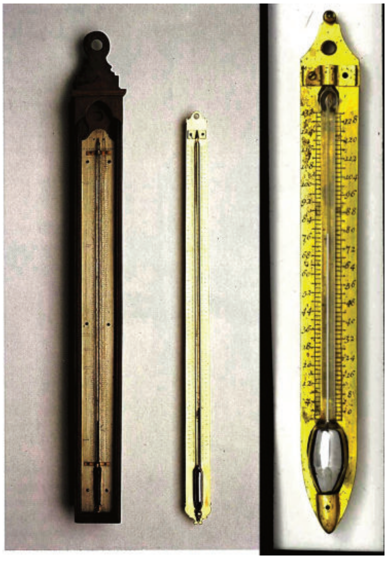


Figure 39. Fahrenheit's thermometers in Leiden (two on the left, photo by Januszajtis A.) and in private possession (one on the right)

It should be added that the Fahrenheit thermometers showing the same reading, which were admired by Chrystian Wolf in 1714 in Leipzig, had vessels 3.7 and 4.2 cm long and 0.66 and 0.5 cm in diameter. The scale length was the same - 17.4 cm. Later thermometers, preserved in Leiden, are much longer [Fig. 40]. It was unusual for Fahrenheit's contemporaries that two thermometers, placed in a vessel filled with hot water, would show the same temperature! Fahrenheit achieved true mastery in building thermometers. When he attended a meeting of the Royal Society of London for the first time on 5 March 1723, he showed something that would still be difficult to achieve even today: two thermometers - alcohol and mercury - with one scale!

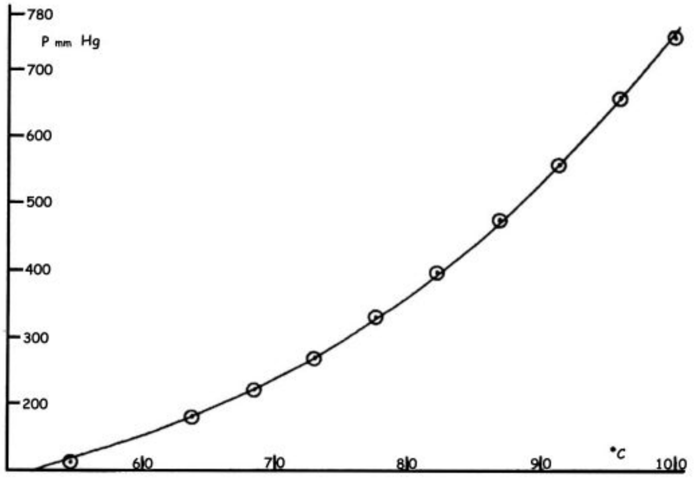
FIXED POINTS. The lecture notes of 1718 show that Fahrenheit marked his thermometers with accurately reproducible temperature standards. The lowest temperature, corresponding to zero on the scale, was obtained with a mixture of water, ice and salt. We do not know exactly today what kind of salt it was, because he referred to it once as sea salt, another time as ammonium chloride. Zero on his scale corresponds to -17.8°C. He chose the composition of the mixture himself - probably during his first stay in Amsterdam - and kept it secret.

The temperature of the water and ice mixture, i.e. the melting point of ice, was in those times reproducible only in winter (unless one had a cellar with supplies of ice). The melting point of ice on the Fahrenheit scale corresponded to 32°. It was much easier to achieve the "blood temperature" point adopted after Rømer, i.e. the body temperature of a healthy human being (36.6°C today) - it was sufficient to hold the thermometer bulb in the mouth or in the armpit. This temperature corresponded to 96° on the Fahrenheit scale (and 98° on a scale corrected later). As can be seen, our scientist considered it as uncertain. In one of his later letters to his protector, Herman Boerhaave, he wrote: “I have always considered the 96th degree (which, as you know, is the temperature of blood on my thermometer) as a fixed point for healthy people, but experience has taught me that children’s blood is hotter than that of older people, when I put a mercury thermometer in the mouths of children aged 8 to 10, the mercury rose 2 degrees higher than in my mouth. Therefore, there is no much more fixed point than that for crushed ice the gaps of which are filled with fresh water, or that for boiling water, as long as the air pressure is taken into account, and then it is always possible to mathematically get the 96th degree, just as I do it.“

Thus, we see that Fahrenheit did not consider the temperature of the human body to be constant enough to be used to gauge thermometers. On the other hand, it was possible to use the water boiling point mentioned here only after he had invented the mercury thermometer. It was not possible to measure the water boiling point with the previously used alcohol thermometers, because ethyl alcohol with which they were filled boils already at 80°C – while mercury only at 357°C. Fahrenheit started to fill his thermometers with mercury in Berlin in 1713. He also could not, as some argue, use his wife’s body temperature to gauge the thermometers for a very simple reason: he had no wife. He spent his entire adult life single.

OTHER DISCOVERIES. Another great achievement of Fahrenheit of fundamental importance before 1723 was the discovery of the dependence of the boiling point of liquid on the atmospheric pressure. He was the first to measure the pressure of saturated water vapour depending on pressure. It was an astonishingly accurate measurement: Fahrenheit’s measurement points are located practically without any deviations on the theoretical Clausius-Clapeyron curve more than a hundred years later [Fig. 41]. Let us listen to his own words: “In the report on my experiments with the boiling point of certain liquids, I mentioned that the boiling point of water at that time did not exceed 212 degrees; later I found in various studies and experiments that this point was sufficiently constant for the same weight of the atmosphere, but that it could change in different ways with a varying weight of the atmosphere (the term “the weight of the atmosphere“ should be understood as the atmospheric pressure). And here is how he explained this relation: “Water does not always boil to the same degree of heat as Mr. Amontons and others, including myself, have always thought. But it boils at a higher degree of heat in a heavier atmosphere (higher atmospheric pressure) and at a lower degree in a lighter atmosphere; thus, the boiling point of water always depends on the weight of the atmosphere, because water molecules, more or less compressed, need stronger shaking to separate from one another and become vapour. The word “shaking“ is defined by Fahrenheit elsewhere as “transmission of vibrations“ (today we would say: energy).

And here is how explained the liquid boiling process: “There are two things to consider with this boiling issue; first - the effect that fire (heat)



Ciśnienie pary wodnej nasyconej w funkcji temperatury: punkty pomiarowe Fahrenheita (wg unormowanej skali) i współczesna krzywa (*P. v. d. Starr*)

Figure 40. Saturated vapour pressure as a function of temperature: Fahrenheit's measurement points (according to a standardized scale) and a modern curve (Starr)

has on and towards liquid particles, and second – the counteraction of liquid particles with which they respond to fire and resist. And as far as the action of fire is concerned, it consists mainly in the fact that violently moving particles of fire transmit their movements (...) in the liquid to particles which are in this way gradually set in motion, and thus affect the particles of the liquid, shake them and make them vibrate, so that finally, by strong movements, the bonds that the liquid molecules hold between one another break, whereby they run away from each other and turn into vapour, and by permanent separation of these vapours the boiling liquid gradually disappears and finally seems to disappear completely." Further, the scientist describes how he increased the boiling point from 208 to 232 degrees on his scale by adding sea salt to water, and he also explains it on the basis of the molecular theory.

Fahrenheit was also a pioneer in low-temperature physics: in 1729 he developed a cascade cooling method that allowed him to lower the temperature of the liquid down to -40°. His other achievements worth mentioning include the extremely accurate measurements of thermal expansion of liquids and solids, measurements of the boiling point, measurement of the density of various substances with the hydrometer improved by him, discovering (independently from Israel Conradt, a Gdańsk physician) and explaining the phenomenon of liquid supercooling, methods of calculating the final temperature of liquid mixtures at different temperatures (calorimetric equation), the first description in the world of the transformation of the state of concentration of solutions and the eutectic point (the lowest melting point for a solution of a given composition), the first description of the properties of platinum, etc. His other inventions included medical thermometers, which would sell for a florin apiece, and a centrifugal pump for cleaning channels, for which he obtained a patent just before his death. A perfect model of the eye made by him can be seen in the museum in Groningen.

Daniel Gabriel Fahrenheit was a true pioneer in many fields of physics. If the Nobel Prize had been awarded in his day, he would have certainly received it.

APPARATUS IN THE HOUSE. After Fahrenheit's death, an inventory of all items in his apartment in Amsterdam was taken. The apparatus was more interesting than the furniture but it was underestimated by the inventory takers who did not see its value. Several flasks and glass vessels, a small mortar, glass tubes for instruments and cases for barometers were found in a "painted chest of drawers" in the front room. In addition to the chest of drawers, a "glass clock", which was probably a mercury hourglass, once proposed by Fahrenheit as a navigation chronometer, more tubes and capillaries, four old prisms and several boxes with copper and iron rings, and "more junk" were also found. Much more was taken down in the inventory in the back room: "16 smooth plates for thermometers, several mechanical devices", and in the chest of drawers "an air pump and various instruments, including optical and hydrostatic devices and several minor items, 2 small balls, iron weights, 2 water containers with copper taps (...), a drawer with tools such as a hammer, pincers, drills, etc., a drawer with some glass tubes for barometers and a chimney gate, a thermometer belonging to Mr. Heshuizen of Haarlem, *ditto* (*ditto* = as above, in this case it is about a second thermometer – the author's note) belonging to Mr. Buck, a coin master from Dort, and one (*ditto*) belonging to Mr. Hendrik de Raad (...) and 1 plate belonging to Vos, the apothecary at Herenstraat." The above mentioned table with bellows found in the hallway was also someone else's property; it belonged to a Costerus, probably one of Fahrenheit's clients.

Let us have a look at the book collection in the office. *Travels on Sea and Land* in 28 parts *in octavo* (small format), a Willem Seewels Dictionary, a two-part van Halma Dictionary, eight bound foliants, 11 d^0 *in quarto* (normal format)" and several other "bound and unbound books *in octavo* (small format) and *duodecimo* (miniature format) "and several "unbound ones *in quarto*", and last but not least, the *Great Book of Mills* (probably windmills) in two parts. The modesty of the book collection must have resulted from the significant deterioration of Fahrenheit's financial situation in the last period of his life.

FAHRENHEIT AS A LECTURER. Daniel Gabriel's share of his parents' estate was quickly expedited on expensive apparatus, materials required to conduct experiments, and books. To make ends meet, Fahrenheit delivered paid lectures for amateurs in 1718-1729. Notes from the first series of these lectures taken down by Ploos van Amstel who attended them have been preserved. Their history was extraordinary. The author gave them to his son, who made clean copies of them. The manuscript later came to Professor Jan Hendrik van Swinden (1746-1823), the author of *A Dissertation on Thermometers Comparatively Considered* (*Dissertation sur la comparaison des thermometres*) published in 1792. In 1866 the notes were put up at an auction in Amsterdam, where they were purchased by the Library of the University of Leiden for one gulden (!).The manuscript illustrated with numerous drawings is an invaluable source to learn the content and methodology of the scientist's lectures. Comparing them with later advertising brochures and letters, it is possible to trace the evolution and continuous perfection of Fahrenheit's teaching methodology. Like every conscientious lecturer, he would deepen his knowledge while preparing himself for lectures. An extremely important role in those lectures was played by demonstration experiments. Here is, for instance, a description of the measurement of atmospheric pressure at the tower of the Western Church (Westerkerk) at the Ducal Canal in Amsterdam using a mercury barometer, as noted by a listener:

"An experiment with a barometer performed on the Westerkerk tower, which shows that air molecules, like all liquid bodies, gravitate towards each other in a straight line.

Experience teaches us that all bodies, both liquid and solid, are heavy, but it is not so obvious that liquids also gravitate towards one another in a straight line and press against one another. But since the gravity of the air has also been demonstrated here before, it is also likely that the air molecules also gravitate towards one another in a straight line or press against one another as well. Many (scientists) have proved it in many places indeed. Nevertheless, we are supposed to go there to have the pleasure of observing it with a double barometer on the West Tower.

At the base of the tower, we found that the barometer indicated 28 inches 11 1/2 lines and the thermometer showed 69 degrees.

In the first gallery the barometer showed 28 inches 9 3/4 lines, and the thermometer 68 degrees.

In the highest gallery the barometer showed 28 inches 8 5/8 lines, and the thermometer - 69 degrees.

So the barometer, counting from the base of the tower to the highest level, showed (a difference) of 2 1/8 lines.

These observations clearly prove the theorem that the molecules of all fluids and air press against each other in a straight line, because a change in the mercury level, which at the height of the tower was the lowest, is caused only by the lower pressure of the air molecules felt by the mercury surface whereby the atmosphere was pressing weaker as much as was at the highest level of the tower; and when we had come back to the base of the tower, the atmosphere or the pressure of the air molecules again became much greater than at the top of the tower; which must have been the reason why the mercury in the barometer went up again to 28 inches 11 1/2 lines. To get a clear picture, it should be said (...) that the mercury level in the barometer is maintained solely by the pressure of the atmospheric air molecules and maintains a permanent equilibrium with them".

During the next lesson, the students learned how to measure the height of the tower with a barometer. "To do this, we need to accurately determine the weight of the air before going up the tower. Then we calculate how many times the air is lighter than mercury and this will show us how tall the tower is." Then listeners were given a sheet to fill with figures and make calculations. They found the height by multiplying the differences in the height of the mercury column in the barometer at the base and in the galleries of the tower by the relation of the density of mercury and air. The resulting height of the upper gallery of the tower was 68 m - two meters more than in reality. This slight deviation resulted from the fact that the air density assumed was a little bit too low. In the next lecture, the listeners measured its value.

The notes are accompanied by drawings, thanks to which we can learn about the demonstration instruments used by Fahrenheit. These included many interesting items which could serve even today, such as an ingenious device for demonstrating the refraction of light in water. The above given examples confirm the high methodological values of Fahrenheit's lectures and show what an excellent teacher he was. He had a clear picture of what he was talking about and he was able to convey it to his audience. Although he was accused of having no proficiency in higher mathematics which was necessary for university lectures it was not required for lectures given to amateurs.

MIRAGES. Even the most outstanding minds sometimes go astray. In 1715, Daniel Gabriel wasted a lot of time for such wanderings. We know about this from the letter of professor Christian Wolff to Gotfryd Leibniz: "Fahrenheit is in Leipzig. He wrote to me a few months ago reporting the great progress he had made in the construction of a perpetual motion machine, but that he was still looking for a way to overcome the equilibrium so that the machine could be stopped. He also wrote that if I was willing to investigate the problem and overcome the deficiency, he would come to me and bring his machine. I replied that overcoming the defect would practically be tantamount to developing an entirely new plan and that I very much doubted a successful outcome. (...) It is admirable that he has so far put so much effort into constructing thermometers and barometers, but has so little experience in mathematics that any discoveries he will make will come rather from chance than understanding." We should not be surprised that the then young Fahrenheit fell under the delusion of constructing a perpetual motion machine, about which already Leonardo da Vinci had known that it could not be built, and which was convincingly justified by Simon Stevin in 1586. It was as late as in 1775 that the Paris Academy announced that it would not consider nonsensical projects, with which, by the way, patent offices have been flooded to this day.

Much more interesting, though hardly realistic, was another idea, on which Fahrenheit was also working at that time: "a machine by means of which (...) it will be possible to obtain the longitude at sea" [Fig. 42]. It was supposed to consist of "two cylinders linked by a curved tube, one of which is constantly filled with mercury while the other is empty; at the bottom (...), in the bend, the tube is equipped with a very small opening through which mercury has to press itself from one cylinder to the other. The machine is attached to a board or a metal plate which in turn is attached to another board, but so that the former can be moved from left to right and backwards and then reattached. This displacement serves to place the cylinder with mercury higher than the other one so that the mercury, when half of its amount has flowed out, does not stop altogether, so it must reach as far at the point of equilibrium. (...) As soon as mercury reaches it, the instrument turns as quickly as possible so that the mercury should flow from the full cylinder to the empty one again. This machine measures the time very accurately." Fahrenheit goes on to encourage to have two such mercury hourglasses on board a ship, one set for 24 hours and the other for a week and estimates the error as one minute, or ¼ degrees of the longitude, and argues a bit naively that the rocking of the ship will have no effect because the "clock" is hanging vertically all the time. The impulse that prompted him to address this subject was the great prize announced by the just established British Admiralty (in 1714).

Wilhelm Leibniz to whom he sent this description advised him in his reply "to investigate the matter more closely because the committee, established by the British Parliament, wants to have not only ideas but ready made objects." He then added several critical comments which made Fahrenheit discontinue further work on the invention.

POLE OR GERMAN?. Earlier encyclopaedias, including Polish editions, usually described Fahrenheit as a German scientist. According to the latest edition of the British Encyclopaedia, he was: a "Polish-born Dutch physicist"(!). What was the truth? Let us recall the most important facts. The Fahrenheit family came from Königsberg, where as early as in 1512 we meet the merchant Hans Fahrenheit, who arrived there from Rostock and came from Hildesheim. A direct descendant of the family's Königsberg branch was, among others, Fritz von Farenheid (1815-1888), spelling his name somewhat differently, the owner of the once famous painting gallery in Bejnuny (currently Czernyszewka) in East Prussia, whose descendants now live in Germany and in the Netherlands. Nonetheless, we are primarily interested in the Gdańsk branch. The first to move from Königsberg to Gdańsk was Daniel Gabriel's grandfather Reinhold Fahrenheit (b. 1617 – ob. 1677) who received the merchant citizenship in 1649. He married Anna Greverath of Gdańsk (1623-1677). Their son Daniel (1656-1701), a wealthy merchant and shipowner, the father of our scientist, married the widow Concordia Runge (1657-1701), daughter of Michael Schumann (1624-1673) and Elizabeth Dassau (1632-1663). Until now, we have been moving in a circle of undoubtedly German burghers. Nevertheless, this does not justify calling Fahrenheit a German scientist in the understanding of today. In his time, Gdańsk did not belong to Germany, but to the Polish Crown (i.e. the Kingdom of Poland). Its inhabitants were rightful citizens of the Polish Republic, having the same rights in every city as other burghers. Every citizen of Gdańsk, reaching the age of majority, wishing to practice a trade, swore to the then reigning king of Poland "to be faithful and obedient, to care for his honour", as well as "to foster and contribute to the common benefit and prosperity of the splendid Polish Crown and these Prussian lands". Their most close homeland was Gdańsk, greater - Royal Prussia, i.e. Polish (Polnisch-Preussen, or Königlich-Preussen Polnischen Anteils), the greatest - Poland. The great Gdańsk historian, Gotfryd Lengnich, teacher and tutor of Stanisław August, from 1718 started to publish his Polish Library (Polnische Bibliothek), devoted to the history of Poland, since he wanted to - as he wrote in the preface - " present the history of his Fatherland (*mein Vaterland*) in a true light".

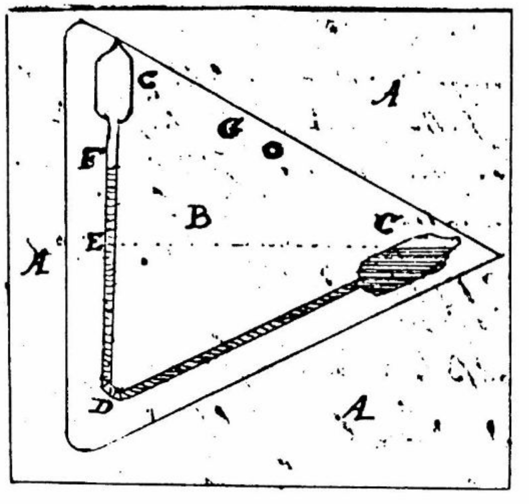


Figure 41. Fahrenheit's instrument for determining longitude at sea

What is the conclusion? As we have already explained in the case of Hevelius, Germans were in a majority in the pre-partition Gdańsk, however, they were Polish Germans, citizens of the Kingdom of Poland. It is not possible, in today's sense of the word, to classify Gdańsk as a German city, and its inhabitants as German. In the period of more than a thousand years of its history, for 146 years Gdańsk was in the state of the Teutonic Knights, for 126 years in Germany, and for 26 years it had the formal status of a Free City – which gives 298 years in total. For the whole remaining period (well more than 700 years) it was under the authority of the Polish rulers. During almost half of this period (in the years 1454-1793), it enjoyed the great freedoms granted by them. The attitude towards Poland was best described by the citizens of Gdańsk during the siege of the city by King Stefan Batory, who wanted them to pay tribute before he confirmed the city's privileges, but they preferred the reverse order. We have already quoted the wording of the unusual oath made on the ramparts facing the besieging royal troops. The eternal annexing and union (uhralde Einvorleibung und Voreinigung) with the Polish Crown of old, and by no means a "Free City in a personal union with the Polish Republic", as some have tried to interpret it until today.

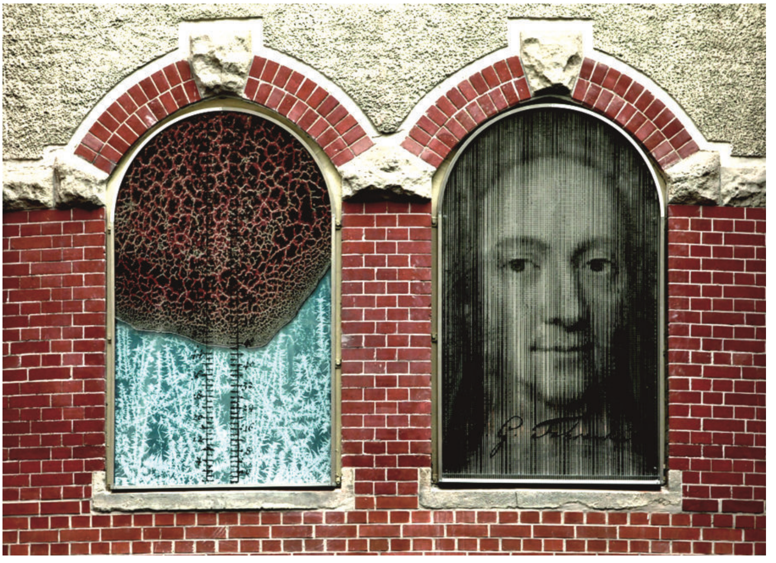


Figure 42. Fahrenheit in the courtyard in the Main Building of the Gdańsk University of Technology named after him

Similarly to Hevelius, Fahrenheit is the patron of the second courtyard of the Main Building of the Gdańsk University of Technology covered with a glass roof, decorated in 2012 with appropriate artistic works, including an electronically generated portrait using innovative methods [Fig. 43]. Nevertheless, the source data was insufficient to treat the portrait as a real image of the scientist. It may only be said that we would have nothing against him looking like this.

Daniel Gralath. Daniel Gralath (Senior) was a son of a wealthy Gdańsk merchant, Carl Ludwig Gralath of Regensburg, and Concordia Grentz of Gdańsk, a goldsmith's daughter [Fig. 44]. The future scientist was born on 30 May 1708 in the Old Town, where his parents had lived, before they moved to the Main Town to a tenement house on 40 Długa Street. Already at the Academic Gymnasium, where he studied under the famous naturalist Johann Adam Kulm, he revealed his outstanding talents and interest in exact sciences. It was also here (in 1729) where his three earliest dissertations were written: *On Water Meteors, On the Origin of Springs, and On Magnetism.* Having studied law and philosophy in Halle, Leiden and Marburg, where he attended lectures delivered by the famous Christian Wolff, he made a short trip to France. Having returned to Gdańsk in 1734, he married Dorothea Julianna, daughter of the eminent naturalist Jacob Theodor Klein, and entered the service in the municipal administration. In 1738 he became a social welfare inspector. In 1742 (and not in 1743, as is usually assumed) he founded the famous Society of Experimental Physics (*Societas Physicae Experimentalis*), better known as the Natural Science Society (*Naturforschende Gesellschaft*), which was the first natural science society in Poland and the second physical society in the world (see below). He also did not neglect the municipal affairs: from 1748 he was the head quartermaster (chairman) of the High Quarter in the Third Order, as early as in 1754 he was a juror, in 1758 a councillor, and the mayor from 1763, one of the last in Gdańsk before the partitions of Poland. During the Seven Years' War, he showed his diplomatic talent, persuading the commander of the Russian army to resign from entering Gdańsk. He died on 23 July 1767. On his deathbed, he founded a beautiful four-row linden avenue, known today as Aleja Zwycięstwa (Victory Avenue). It is also there, at the end of Smoluchowskiego Street, where his monument in the form of a modest erratic boulder with a plaque in two languages restored in 2000 has been standing since 1900 [Fig. 45].

Figure 43. Daniel Gralath, family collection, Gdańsk National Museum (Photo: Januszajtis A.)

Gralath was most interested in electrostatics. As any diligent scientist, he had preceded his research with a thorough study of the literature. His notes served later to create the three-part *Electricity Chronicles* (1747, 1754, 1756) - the first in the world, and the two volume *Electrical Library* (1754, 1756). Both studies have not lost their value until today. After such preparation, Gralath began his research work.

He started with simple experiments with a prototype of Winkler's electrostatic machine. His objective was to obtain the longest possible electric sparks to set fire to spirit, a wick of a freshly blown candle, he would kill small animals and cause electric shocks to people. However, it is his experiments with the so-called Leyden jar that are of the greatest value [Fig. 46]. The name is in fact incorrect as it had been invented by the prelate of the Chapter in Kamień Pomorski (Cammin in Pommerania), Ewald Jürgen von Kleist in 1745, many months before Pieter Musschenbroek began his experiments in Leiden. Kleist sent a letter

Figure 44. Monument to Daniel Gralath in the Avenue founded by him (Photo: Januszajtis A.)

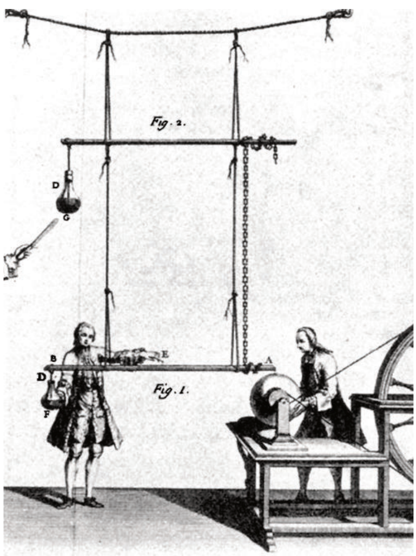


Figure 45. Experiment with Kleist's jar

advising about the discovery to Paweł Świetlicki, deacon of St. John's Church, member of the Gdańsk Natural Society who made Gralath interested in the new instrument. Due to problems which Kleist could not explain, Gralath succeeded with the experiment with the jar as late as on 5 March 1746 only. Musschenbroek was also successful at the same time, and the French Academy of Sciences which was informed thereof in the middle of the year, gave the first electric capacitor the name of the Leyden jar. The protests were to no avail. Although abbot Nollet, whose authority played an important role in this matter, admitted in a letter that if the jar had not been called Leyden, it would have been given the Gdańsk one but, it was where it ended. Gralath himself always modestly called it the Kleist jar.

Gralath's undisputed achievement was the setting of batteries of these prototypes of capacitors in the same year: "So I set up the experiment in such a way that two or three people were holding the tin pipe of the amplifying machine with one hand, I gave each of them a special iron or brass wire to hold in the other hand: the other end of the wire was taken in the left hand by another person who did not hold a vial, and the right hand finger was coming closer to the charged tube, so that the expected amplification should show itself as clearly as possible. When I set up the experiment with two vials in this way, although there were sparks and shocks coming from them felt by the person whose finger was approaching the tin pipe, definitely stronger than those in the experiment with one vial, they were still bearable; however, when I took three vials, there were few who would endure it more than once, as the shocks were powerful and painful. At the same time, it should be noted that other persons who were holding the vials felt as if they were holding one vial only". We should not be laughing at this reference to human sensations as a measure of the effect! Voltmeters did not exist at that time. These phials (Kleist jars) were connected by Gralath in series using people holding them together with wires.

BEFORE COULOMB Gralath was also one of the first researchers to try to quantify the interaction between charged bodies. For this purpose, in the same fruitful year of 1746, he used a precise scale designed by another member of the Natural Science Society, the mathematician Henryk Kühn, about whom we write elsewhere. Gralath placed the end of a metal rod, charged by a glass ball, under the pan of an earthed scale. The force of attraction between the rod and the pan was balanced by weights placed on the other scale pan. The distance between the rod and the pan was changed by adjusting the screws of the stand on which the rod was placed. He also took into account the distance of the glass ball from the rod connected thereto with a brass wire. Here are the results obtained by him:

Table 1. Results of Gralath's measurements of electrostatic force

Distance from the ball	The attraction force in grans for the distance between the pan and the rod surface			
	3 in.	2 in.	1 in.	½ in.
240 feet	1½	4	13¾	44
80 feet	2½	7¼	20¾	70½
10 feet	3½	8¼	26	74

And then, instead of properly interpreting his measurements, Gralath is making intricate reflections about the relationship between the strength of the electrical attraction and the length of the spark! Had he repeated the same experiment with a more favourable geometry, e.g. with two spherical electrodes, he would have doubtlessly arrived at the so-called Coulomb's law formulated 14 years later by Daniel Bernoulli (perhaps after he had read Gralath's work?). I am writing ”so-called” because Augustin Coulomb ”discovered” it, after much more precise, carefully conducted measurements, as late as in 1785. In any case, Gralath's measurements were the first in the world to use an electroscopic scale.

SONS AND DAUGHTER. The scientist's three sons also deserve attention. The eldest, Theodor Ludwig (1738-1761) left a dissertation on the benefits of science, read on the 200th anniversary of the establishment of the Academic Gymnasium in 1758. His promising career was interrupted by premature death. The second son, Daniel Gralath Junior (1739-1809) was an outstanding historian, professor from 1764, and rector of the Gdańsk University from 1799. The youngest of the sons, Carl Friedrich (1741-1818), after his studies and travels, which he described in an interesting journal, was successively a City Council secretary, juror, councillor and - from 1794 - the Mayor of Gdańsk. In the years 1768-1775 he was a Gdańsk resident (representative) in Warsaw. The godfather of his son, Stanisław Karol, was King Stanisław August Poniatowski.

The daughter of Daniel Gralath the Elder, Renate Wilhelmine (1748-1808), also had a scientific flair [Fig. 47]. A friend of Duchess Anna Jabłonowska, in 1778 she helped her organize the famous naturalist collection in Siemiatycze and for two years she looked after a part of the collection in Gdańsk. Let us quote a fragment of her letter to the astronomer Johann Bernoulli dated 29 September 1778, which proves her considerable knowledge in this field:

“The duchess's cabinet deserves the attention of an expert. The Duchess spares neither efforts nor money to complete it, last year numerous boxes containing various natural curiosities for the collection were shipped to her from the Netherlands. The exhibits sent this year which were to complete the collection in the cabinet, are still with me; our library looks more like a museum when I decorated it with over 180 jars containing quadrupeds, fish, snakes, etc. - preserved in spirit. Moreover, birds from foreign countries and stuffed monkeys, shells, where the most valuable specimens are *Pavillon d'orange* and *Natile papirace* ... As far as the collection of shells is concerned, I must confess that I arranged it myself by families according to the combined system of Messrs. d'Argebville and Daville. While the duchess was travelling around Poland, I had the honour of look after her collections in Gdańsk, which I supervised for two and a half years. This evidence of the Duchess' trust flatters me very much.”

Here is what she wrote in her second letter dated 30 April 1779 notifying Bernoulli of another lot of purchased specimens:

“I expect three volumes of your letters on various topics from Nicola to be able to send them to Duchess Jabłonowska. I will also send her a volume with

Figure 46. Portrait of Renate Wilhelmine Gralath, family collection, National Museum of Gdańsk (Photo: Januszajtis A.)

accounts of your recent travels as soon as they appear in print. I have recently received a message that the ship, currently on its way, is carrying a significant number of live birds for the Duchess. This Noah's Ark will arrive in two weeks at the latest. There will be specimens from four parts of the world: ducks and geese from India, roosters and hens from Africa, pigeons from Ceylon. The Dutch gentlemen use the Duchess's permission and send interesting specimens. 200 various birds in total are supposed to arrive, which, according to the bill, will cost 800 Dutch florins. The poultry is quite expensive indeed!"

Unable to accept the Duchess's decision to abandon further collection of specimen that were eventually purchased by Tsar Alexander I, Renate Wilhelmine returned to Gdańsk. In 1790, she married the mayor Eduard Friedrich von Conradi, who was 35 years her senior. After his death in 1800, she remarried the Prussian minister, Baron Frederick Leopold von Schrötter, under whose supervision the most accurate map of Royal Prussia at that time was drawn.

Heinrich Kühn. A characteristic feature of the culture of the old Gdańsk, including science, was its opening to the world. The ties between the Gdańsk community and Königsberg and its university - the famous "Albertine" were particularly close. The activity of Heinrich Kühn can serve as an example. Born in Königsberg on 19 November 1690, he studied there from 1707, and afterwards moved to Halle, where he received his Ph.D. degree in law. However, this did not satisfy his hunger for knowledge and in 1717 he re-enrolled at the University of Königsberg, this time devoting himself to natural sciences. In 1733, he moved to Gdańsk, where he was appointed professor of mathematics at the Academic Gymnasium. The compensation was not high, so on the basis of a special royal privilege, professors of mathematics had the right to issue calendars. Kühn's calendars, issued in the years 1735-1770, were distinct for their logical layout, high level of information and interesting contents. For example, the calendar of 1746 - with a huge eagle on the cover - contains, in addition to astronomical data and historical dates, proverbs, epigrams, a description of sugar production methods, a list of fairs in Poland and Germany, and ... a story about a thief in love.

Kühn was a co-founder of the Natural Science Society established at the turn of 1742 and 1743 and he joined its operation from the very start. It is already in the first volume of *Experiments and Dissertations of the Natural Science Society* (*Versuche und Abhandlungen der Naturforschenden Gesellschaft*) published by the Society since 1747 that we can find five of his dissertations. The first: A detailed description of a new and improved type of a scale ... has a lasting value. In addition to the elementary knowledge in the field of statics, it includes the theory of scales and weighing, and a very valuable description of the scale, constructed in 1743 according to Kühn's guidelines by the travelling mechanic Drunckmüller. As the author was claiming, the scale could be used to weigh "not only equal but also unequal weights (...) precisely with respect to each other, or divide a given weight into smaller ones in any proportion". The original design with shock-absorbing friction wheels and a high sensitivity and accuracy of indications allow Kühn's scale to be considered a successful prototype of later analytical scales [Fig. 48].

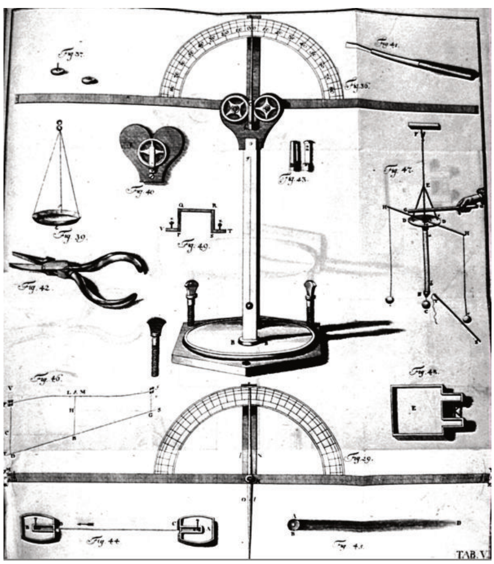


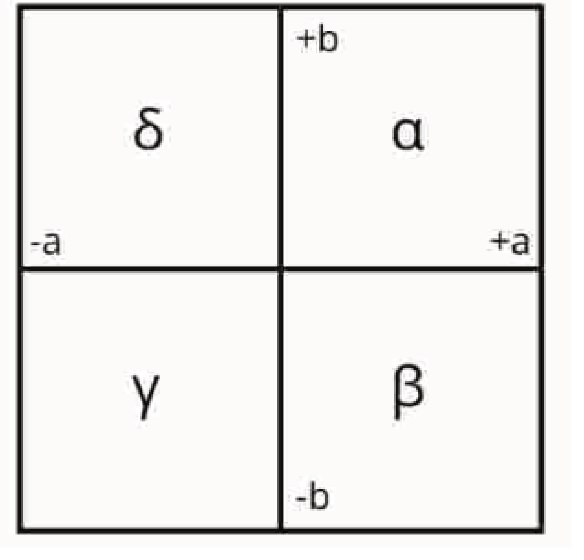
Figure 47. Kühn-Gralath electrostatic scale

The latter dissertation includes a design of ingenious apparatus based on the principle of communicating vessels to be used for measuring the fall of water in rivers; the third work concerns sunspots; the fourth - comet tails;

the fifth contains ideas about the density and clarity of air. Also the third volume of *Experiments and Discourses* of 1756 contains an article by Kühn attempting to explain the causes of ocean tides.

The most prominent work by Kühn, ensuring him a permanent place in the history of science, are *Considerations on Constructing Imaginary Quantities and Extracting Imaginary Roots* from 1750-1751, published in 1756 in the third volume of *New Commentaries of the Petersburg Academy of Sciences*. It was the first attempt at geometric interpretation of complex numbers in the history of mathematics. This dissertation made the Gdańsk scientist internationally famous, and the St. Petersburg Academy of Sciences accepted him as a member.

As a starting point Kühn took rectangles α, β, γ and δ, touching with sides formed on the axes of the coordinate system:



The areas of these rectangles are:

$$S_\alpha = +ab, \quad S_\beta = -ba, \quad S_\gamma = +ba, \quad S_\delta = -ab.$$

If the sides of the rectangles are equal with each other, e.g. $a = b = 3$, then:

$$S_\alpha = S_\gamma = 9 \quad \text{and} \quad S_\beta = S_\delta = -9$$

and their lengths can be represented as: $\pm\sqrt{9}$ and $\pm\sqrt{-9}$.

Kühn continues as follows: "It should not be claimed that such a quantity as $\pm\sqrt{-9}$ is only imaginary, impossible and unacceptable, as that there is no way to extract the square root from $-a2$, since both $(+a)\cdot(+a) = +a^2$, and $(-a)\cdot(-a) = +a^2$ for the calculus which is derived from possible, i.e. real, given numbers and was made in accordance with the unquestionable rules, could in no way lead to something impossible, unreal, unacceptable, and on the other hand, the prescribed construction makes it possible for us to see that the assumption that all real squares should be positive is not true".

It is known that the currently used interpretation of complex numbers as points on a plane was proposed in 1799 by the Norwegian Caspar Wessel, and immediately afterwards and independently by Jean Robert Argand and Charles Frederick Gauss.

The membership in the Russian Academy of Sciences was not the first proof of recognition of Kühn abroad. As early as in 1741, the Scientific Society of Bordeaux awarded his work, *Considerations on the Origin of Sources*, published five years later in two versions - Latin and French.

Kühn's last known publications were: the famous lecture delivered on the occasion of the 200^{th} anniversary of the Academic Gymnasium in 1758 *On the Influence of Mathematical and Natural Sciences on the Temporal Happiness of Mankind* and published posthumously in 1771 which was an attempt to strictly solve certain cubic equations.

Henryk Kühn died in Gdańsk on 8 October 1769. He had a daughter with his wife Julianna Carolina (1701-1793) whose name is unknown and who was buried in 1739 - probably in early childhood. There is no news about other family members. After a long period of oblivion, it was only nineteenth-century historians of mathematics that appreciated Kühn's achievements whereby he can be considered as one of the most outstanding scientists of the $18^{th} centuryinQQPoland$.

Other eighteenth-century Gdańsk scientists recognized worldwide to be mentioned include the botanist **Jacob Theodor Klein** (1685-1759) who developed zoological systematics independent of Linnaeus. The honorary member of the Society **Johann Reinhold Forster** (1729-1798) was the scientific director of Cook's second expedition, and his son **Johann George Forster** (1754-1794), professor at the University of Vilnius who presented the theory of the evolution of species more than 70 years before Darwin. All these individuals are described in more detail in the chapter on the Gdańsk members of the Royal Society of London (pp. 84 ff.)

Arthur Schopenhauer. The greatest fame among the Gdańsk scientists of old is enjoyed by the great philosopher Arthur Schopenhauer (1788-1860) [Fig. 49]. Although he spent most of his life out of Gdańsk, he still maintained ties with his hometown. When somebody said he was German, he would reply: "I am not a German, but a citizen of Gdańsk of Dutch origin" (his grandmother Renata Soermans was the daughter of a Dutch consul). His outlook on life, most fully expressed in his fundamental work *The World as Will and Representation*, enjoyed greatest triumphs - also in Poland - at the turn of the 19^{th} and 20^{th} centuries. Let us recall some dates from his life: Born on 22 February 1788 in Gdańsk, son of Heinrich Floris Schopenhauer and Johanna Joanna Schopenhauer née Trosiner, he spent five years of carefree childhood here. In 1793, on the eve of the second partition of Poland, in which the Prussian king seized Gdańsk, his parents moved to Hamburg. Arthur later explained the reason for the departure in the following way: "My father, who loved both freedom and his homeland, could not come to terms with the fall of the old republic." In the years 1797-1799 the young man stayed with his father's friends in Le Havre, where - to his joy - he almost forgot to speak German. Having returned, he learns the merchant trade, but misses his studies. He makes a grand journey with his family across England, France, Switzerland and Austria that changes his outlook for life: "In the 17th year of my life, without any learned school knowledge, I was struck by the misery of life, like the Buddha in his youth, when he saw sickness, old age, pain and death. Having retuned and after his father's death, he interrupts his work in the office and, thanks to to his mother, begins to study in Gotha and Weimar in 1807. He masters seven languages. There are disagreements with his mother, who thinks that he is trying to be too smart. In 1809, he enrols to study medicine, and in 1810, philosophy in Göttingen. In the years 1811-1813 he studies in Berlin and then graduates in Jena. In 1814, he breaks contacts with his mother and moves to Dresden. In 1818 he completes his most important work *The World as Will and Representation.* In 1819 he travels across Italy, where he creates a scandal in a local German colony with his contemptuous statements about Germans. He himself writes about this period of his life in the following way: The twenties and the young thirties are for the intellect what May is for the trees, during which season only they put forth buds whose later development is the fruit, the observed world has already left its mark and thus consolidated the resource for all future individual thoughts." Having received the news of the bankruptcy of a Gdańsk company, in which he had invested 1/3 of his assets (his mother and sister almost everything), he travels to Gdańsk and successfully settles matters to his advantage. In 1820 he obtains his postdoctoral degree in Berlin and begins to deliver lectures on the essence of the world and the human mind. There are no listeners, because he ostentatiously sets the dates simultaneously with the lectures of the students' idol Georg Wilhelm Friedrich Hegel. In 1822, he bids farewell to Berlin and leaves for Italy again. In 1823, he loses his hearing in one ear. In 1825 he returns to Berlin, where he unsuccessfully tries to obtain reciprocity from several females. Following a scandal with a cleaning lady, whom he threw down the stairs in a tantrum and to whom he had to pay compensation, he leaves for Frankfurt am Main in 1831, for Mannheim - in 1832, and finally in 1833 he settles permanently in Frankfurt, where in 1835 he writes a dissertation on the will in nature, in 1837 the award-winning work on freedom of the will, and in 1839 another - on the foundations of morality. In 1843 he finishes the second volume of his most important work. In 1851 *Parerga and Paralipomena* are published, some of which are Aphorisms on the wisdom of life. In 1859, Elizabeth Ney sculpts a bust of the philosopher. On 21 September 1860, Schopenhauer dies of pneumonia.

Arthur Schopenhauer is considered to be a pessimist – is it right? Although he admits that "there is not much to be got anywhere in the world" and that "it is evil which generally has the upper hand, and folly that makes the most noise. Fate is cruel and mankind pitiable". However, he has a non-pessimistic recipe for this – high spirits: "In a world so arranged, a human being with a rich interior is like a bright, warm, cheerful room in a snowy, frosty Christmas

Figure 48. Arthur Schopenhauer in 1845

night”. Can the author of the following words be considered a pessimist: “That we exist means we will always exist. You can’t fall out of existence in the way you fall out of a speeding coach”? Or such: “It is certainly a very melancholy thing that all a man’s faculties tend to waste away as he grows old, and at a rate that increases in rapidity: but still, this is a necessary, nay, a beneficial arrangement, as otherwise death, for which it is a preparation, would be too hard to bear.” For a pessimist, he quite often gives encouragement with his statements.

23. Gdańsk Scientists at the Royal Society

The famous Royal Society was founded in 1660 in London. The official name (the Royal Society) has been used since the first statutes were adopted on 15 July 1662. The name of the institution was soon expanded to include the Royal Society of London for Promoting Natural Knowledge. When approving the second statutes on 23 April 1663, King Charles II presented the Society with the insignia comprising a sceptre with the coats of arms of England, Ireland, Scotland and France. In May of that year, the Society already had as many as 150 fellows - today there are 1450 fellows, including 80 Nobel prize winners! The Society had also scientists from Gdańsk as its fellows.

The first location of the Society in London was the Gresham College, established in 1579, the second – as of 1710 - the so-called Crane Court on Fleet Street – existing no longer. In 1780 it moved to the Somerset House on the Strand, and in 1857 - to the Burlington Palace on Piccadilly, the main building of which is currently housing the Royal Academy of Arts, which was erected in 1665 by Richard Boyle, the First Earl of Burlington. In the years 1868-1874, the building was extended by new wings, where the Astronomical, Geological, Linnaeus, Antiquarian,

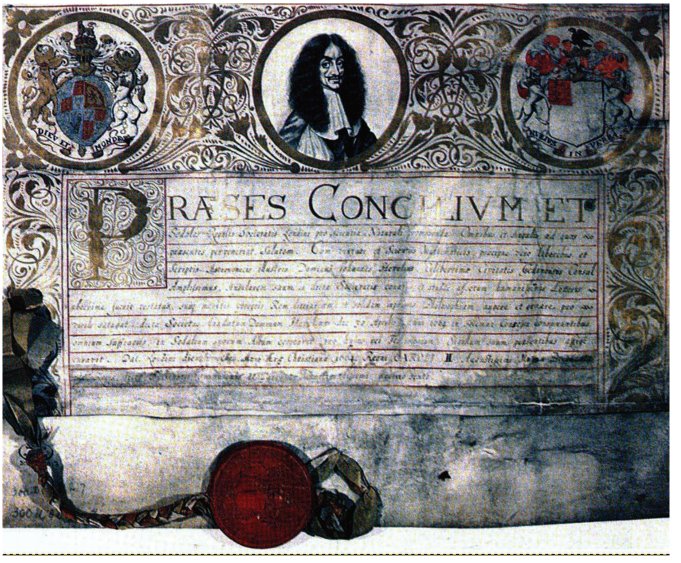


Figure 49. Hevelius's fellowship diploma at the exhibition at the Historical Museum of the City of Gdańsk (Photo: Januszajtis A.)

Chemical Societies as well as the British Academy found their locations. The current address of the Royal Society (since 1967) is Carlton House Terrace Nos. 6-9. This is also the site where the library is located. The magnificent collections comprise more than 150 000 volumes, numerous busts and portraits, Newton's telescope, Humphrey Davy's mining lamp and many more. Minutes of all meetings, including those attended by Gdańsk scientists can be found in the archives.

On 1 January 1662 the Governor of Connecticut, John Winthrop became the first foreign fellow, the second was the brilliant Dutch physicist Christiaan Huygens, two Frenchmen followed. The fifth fellow to be accepted was the "astronomer from Gdańsk", Johannes Hevelius [Fig. 50].

Jan Heweliusz (Johannes Hevelius). Hevelius (who has been described in detail above) was an active fellow of the Royal Society, and corresponded with its secretary Henry Oldenburg and other prominent fellows. The results of his observations were printed in the Society's Philosophical Transactions, published from 1665 until today. When the belligerent Robert Hooke tried to undermine their reliability, the Society, at the request of the offended Hevelius, sent Edmond Halley to Gdańsk, who confirmed the accuracy of the Gdańsk astronomer's observations. The whole matter was noted in the Philosophical Transactions. It should be also remembered that Hevelius sent to England his portrait by Andrzej Stech, which is currently stored in Oxford.

When mentioning Hevelius, we should remember his wife, Elisabeth Koopman, about whom we have already written that she assisted her husband in his observations and helped him after the fire outbreak in 1679 to re-arrange his observatory, edited and published her husband's works after the astronomer's death, including such valuable titles as *Prodromus Astronomiae*, with the above mentioned positions of stars, and *Firmamentum Sobiescianum*. She was not a member of the Royal Society, but she corresponded with its secretary and with some of its fellows. In 1686, Edmond Halley himself bought fabric for a dress in London at her request.

Johann Philipp Breyn. The next fellow of the Royal Society from Gdańsk, admitted on 21 April 1703, was Johannes Philippus Breynius, i.e. Johann Philipp Breyn. Born in Gdańsk on 5 August 1680, he was a son of a well-known merchant and scientist Jacob Breyn, from whom he inherited his enthusiasm for botany. Having graduated from the Academic Gymnasium, he studied medicine in Leiden, then travelled across Western and Southern Europe. He stayed in London and Oxford for the longest time. Having returned to Gdańsk, he practiced as a physician. Following his father's example, he established a botanical garden in Brabank (Stara Stocznia Street), later No. 7. Contacts established abroad helped him acquire exotic plants. According to an inventory taken at a later time the plants growing in his garden included, pineapples (118 plants!), fig trees, coffee plants and oleanders as well as acacia trees, a pomegranate tree, a camphor tree from Japan and a cinnamon tree from Ceylon as well as many medicinal plants. He also collected mineralogical objects, including amber, and paleontological artefacts. In his house at 30 Długa Street he had a huge library and a numismatic collection. He was also a member of the French Academy, the German "Leopoldine" and the first scientific societies in Gdańsk. He died on 12 December 1764. His collection was sold to St. Petersburg. Breyn's publications include a monograph on the Polish cochineal– a beetle from which a red dye for fabrics was obtained - and an album of South African flora based on his father's collections, which was re-issued in 1978 [Fig. 51].]The next fellow of the Royal Society from Gdańsk, admitted on 21 April 1703, was Johannes Philippus Breynius, i.e. **Johann Philipp Breyn**. Born in Gdańsk on 5 August 1680, he was a son of a well-known merchant and scientist Jacob Breyn, from whom he inherited his enthusiasm for botany. Having graduated from the Academic Gymnasium, he studied medicine in Leiden, then travelled across Western and Southern Europe. He stayed in London and Oxford for the longest time. Having returned to Gdańsk, he practiced as a physician. Following his father's example, he established a botanical garden in Brabank (Stara Stocznia Street), later No. 7. Contacts established abroad helped him acquire exotic plants. According to an inventory taken at a later time the plants growing in his garden included, pineapples (118 plants!), fig trees, coffee plants and oleanders as well as acacia trees, a pomegranate tree, a camphor tree from Japan and a cinnamon tree from Ceylon as well as many medicinal plants. He also collected mineralogical objects, including amber, and paleontological artefacts. In his house at 30 Długa Street he had a huge library and a numismatic collection. He was also a member of the French Academy, the German "Leopoldine" and the first scientific societies in Gdańsk. He died on 12 December 1764. His collection was sold to St. Petersburg. Breyn's publications include a monograph on the Polish cochineal– a beetle from which a red dye for fabrics was obtained - and an album of South African flora based on his father's collections, which was re-issued in 1978 [Fig. 51].

Daniel Gabriel Fahrenheit. Another member on the list of the Royal Society from Gdańsk, Daniel Gabriel Fahrenheit, has been described extensively elsewhere. It is his relations with the Royal Society only that will be mentioned in this section. It follows from the minutes kept at the Royal Society of London that "Mr. Fahrenheit, a gentleman from Gdańsk", attended a meeting on 5 March 1723 for the first time. We read, *inter alia* (in contemporary English): "Mr. Fahrenheit showed an interesting small double thermometer of his own invention; about 4 inches long with two tubes, one filled with mercury and the other with wine spirit, which were attached to a silver frame and adapted to a single scale designed in such a way that they should be placed at the same level and rise and fall identically. The same gentleman also presented a paper in Latin containing experiments in which he tested various liquids in order to find their boiling points. He used a mercury thermometer, prompted by the observation that mercury in the barometer reacted to temperature as well as the weight of air, and the desire to see if water and other liquids could have a higher temperature than the temperature sufficient for boiling." Making a double mercury and spirit thermometer with one scale would be considered proof of true mastery even today!

Figure 50. Breyn's drawing from *Flora Capensis* (original in the Gdańsk Library of the Polish Academy of Sciences)

Fahrenheit was in London for the second time in 1724. On 26 March he presented "one of his mercury thermometers, which he has made to test various temperatures of liquids when they begin to boil, according to a report presented to the Society about 3 weeks ago. He also showed a thermometer used by him

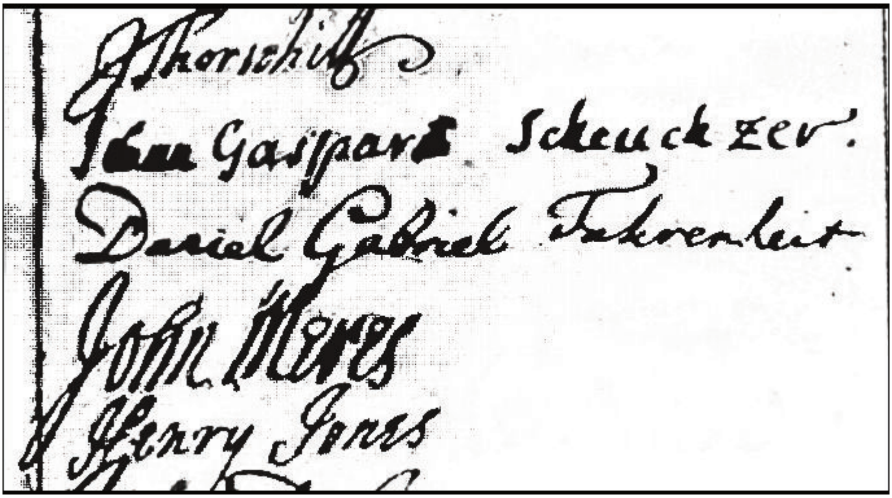


Figure 51. Fahrenheit's signature on the list of new fellows (collections of the Royal Society)

to find the temperature of air. He also presented a paper containing a table of specific weights of thirty substances ..." . And on 2 April "he presented a message about the experiments conducted by him on the freezing of water in vacuum ..." In the next report of 30 April, we find supplementary information that Fahrenheit investigated a metal contained in the gold ore (platinum), namely that it was "heavier than pure gold". Eventually, on 7 May 1724, it was recorded that "Mr. Scheuchzer Jun., Mr. Lister and Mr. Fahrenheit were put to a vote and elected fellows of the Royal Society" [Fig. 52]. Each of them read and signed the Obligation of the Fellowship of the Royal Society reading as follows: 'We who have hereunto subscribed, do hereby promise, that we will endeavour to promote the good of the Royal Society of London for Improving Natural Knowledge, and to pursue the ends for which the same was founded; that we will carry out, as far as we are able, those actions requested of us in the name of the Council; and that we will observe the Statutes and Standing Orders of the said Society. Provided that, whensoever any of us shall signify to the President under our hands, that we desire to withdraw from the Society, we shall be free from this Obligation for the future.'

In 1726, five treatises written by Fahrenheit were published in Philosophical Transactions: 1. *Experiments concerning the Degrees of Heat of boiling Liquors;*

2. *Experiments and observations on the freezing water in vacuo*; 3. *Specific gravity of some substances tested at different times for different purposes.* 4. *Description and application of a new hydrometer* and 5. *Description of a new barometer.* Each of these has contributed something new to the history of physics.

Jacob Theodor Klein. The fourth scientist from Gdańsk to become a fellow of the Society was Jacob Theodor Klein [Fig. 53]. Born on 15 August 1685 in Königsberg, he studied law, history and mathematics at the university there, and then took a research trip across Europe. From 1712, he lived in Gdańsk,

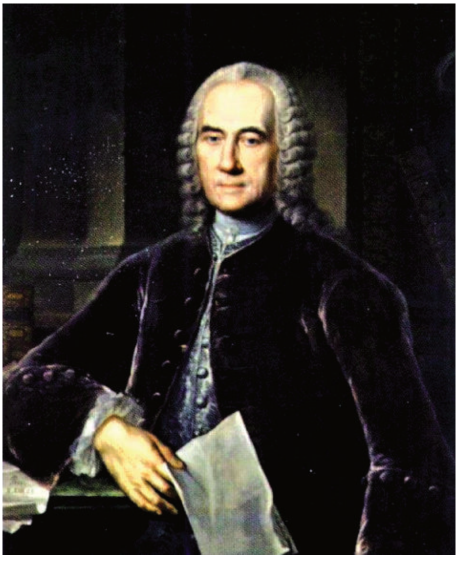


Figure 52. Jacob Theodor Klein (Wessel J., 1759)

where he became secretary of the City Council. Having learnt Polish, he served as the city representative at the court of August II.

Business trips to other countries were used by him to build a collection of plants, insects and animals. In 1718, he founded a botanical garden in Gdańsk at Długie Ogrody (Long Gardens) Street, where he grew exotic plants, including the flowering (!) *Coffea.* He was a precursor of research on the fauna of the Baltic Sea. He developed his own zoological systematics, different from that of Linnaeus, which, however, was not adopted. Similarly to Breyn, he was a fellow of the Gdańsk Academic Society (Societas Litteraria), founded in 1720 as the first scientific society in Poland, and after its decline, he founded, with his friends, the Society of Experimental Physics (Societas Physicae Experimentalis) at the turn of 1742/1743, better known as the Natural Society (Naturforschende Gesellschaft), of which he became secretary and director in 1746. Earlier, on 7 March 1729, he was admitted to the Royal Society. Later the same was done by the Bologna Academy (1748), Deutsche Gesellschaft in Jena (1755) and the St. Petersburg Academy of Sciences (1756). Jacob Theodor Klein left 80 works out of which we will mention the *Natural History of Fish* (*Historia piscium naturalis*) published in 1740-1749 and the *Herald of the History of Birds* (*Historiae avium prodromus*) published in 1750, in which he classified and described previously unknown species. He was married three times and had three daughters, of which the youngest - Juliana Renata - became the wife of Daniel Gralath the Elder. Jacob Theodor Klein died in Gdańsk on 27 February 1759. The book collection left by him, including three thousand volumes went to the Gralath library, the core of which has been preserved to this day in the Gdańsk Library (Polish Academy of Sciences).

Forsters. The fellows of the Royal Society of London related to Gdańsk and the Gdańsk Pomerania region were also the naturalists, Johann Reinhold Forster - admitted on 27 February 1772 - and his son Johann Georg Adam Forster - admitted on 9 January 1777 [Fig. 54].

They should be discussed together as their major achievements were shared. Scottish, German and Polish blood flowed in their veins. **Johann Reinhold Forster**, born on 22 October 1729 in Tczew (Dirschau), son of the mayor, received thorough education, with specific emphasis laid on languages. At home, he was allowed to speak with his father in Latin, and with mother in Polish only. Having graduated from a Latin school, he was sent to a gymnasium in Berlin, and then to study theology in Halle, where he devoted most of his time to study natural sciences and learn languages of which he mastered seventeen. Having not completed his studies, he returned home to become a preacher at St. Peter's Church in Gdańsk. In 1753 he settled in Mokry Dwór (Nassenhuben) near Gdańsk as the preacher of a private chapel of the Schwartzwald family. A year later, he married his cousin Justine Elisabeth Nicolai at St. Peter's Church, with whom he had seven children. In his spare time, he studied mathematics, philosophy, foreign languages and customs of the Eastern nations.

Figure 53. Johann Reinhold Forster and Johann Georg Adam Forster (Rigaud J.F.)

On 27 November 1754, his son **Johann Georg Adam Forster** was born. He was not sent to school by his father who educated him himself. He was helped by 2500 books from his collection. With the hope of improving his life, in 1765 he accepted an invitation to travel to Russia to investigate the life of the Volga colonists. He took his son with him. The report was not liked by the tsarist authorities and the Forsters, deprived of the means of living, moved to England.

They were bad off, Georg gave up education and went for a trading business. He would earn some money with English translations – including the works of Lomonosov. In 1771, the researchers who were supposed to participate in Cook's second expedition refused to go and their places were offered to the Forsters, "to collect, describe and draw the specimens of nature that they will encounter during the expedition". During the expedition, in the years 1772-1775, they gathered a large collection of specimens of fauna, flora, minerals and objects of material culture, especially from Australia and Oceania. Their description of the expedition entitled *A Voyage Round the World*, which also had Polish editions, is a fascinating reading to this day. Here is, for example, an excerpt from the report from the Social Islands: "It was one of those beautiful mornings which the poets of all nations have attempted to describe, when we saw the isle of O-Taheite, within two miles before us. The east-wind which had carried us so far, was entirely vanished, and a faint breeze only wafted a delicious perfume from the land, and curled the surface of the sea. The mountains, clothed with forests, rose majestic in various spiry forms, on which we already perceived the light of the rising sun: nearer to the eye a lower range of hills, easier of ascent, appeared, wooded like the former, and coloured with several pleasing hues of green, soberly mixed with autumnal browns".

Having returned from the expedition, Forster junior lectured at various universities, including Vilnius for three years. Later he moved to Germany and at the time of the Great French Revolution he called for the annexation of the Rhineland to France. Overwhelmed by the new ideas, he left for Paris, where he fell ill and died on the hands of his Polish friends on 10 November 1794, at the age of just 40. His father, professor in Halle from 1780, died on 9 December 1798. Both Forsters, Polish citizens by birth, citizens of the world by their doings, have deserved a prominent place among those who are our pride.

Nathanael Matthäus Wolf. Born on 26 January 1724 in Chojnice (Konitz), he carved out a brilliant career [Fig. 55]. Having graduated from the Academic Gymnasium and having studied in Leipzig, Halle and Erfurt where he received a scholarship from Adam Stanisław Grabowski, the bishop of Warmia (Ermland), he settled in Warsaw. For some time he was a town physician in his hometown. He was the court medic of the Czartoryski and Lubomirski families and a medic of the famous School of Chivalry founded by King Stanisław August in Warsaw. The king himself valued him greatly and ennobled him, in recognition for his achievements. Doctor Wolf accompanied Prince Adam Czartoryski (incidentally, born in Gdańsk) on his trip to Turkey, Germany, France and England. Having returned to Poland, he settled in Tczew (Dirschau), and when the town had been seized by the Prussians during the First Partition, he moved to Gdańsk which was still Polish. Here "he soon gained a wide practice, which, however, did not completely distract him from his passion for astronomy and scientific research similar to medical knowledge." This is what Johann Bernoulli, a well-known traveller, also an astronomer himself, wrote about him. "I went to see Dr. Wolf, who lives at Targ Drzewny in the house of the Abbot of Oliva, on the upper floor. With great pleasure and curiosity I looked at his beautiful astronomical and extremely convenient device with which he managed to create a small comfortable observatory next to his study" (1777). The description of this observatory along with the results of observations has been preserved in foreign journals, *inter alia,* in the Philosophical Transactions of the Royal Society of London, of which he was a fellow from 10 April 1777. Wolf also actively participated in the works of the Gdańsk Natural Society. In 1781, at his own expense, he built an observatory at Biskupia Górka (Bischofsberg), on a plot of land acquired through the intercession of Aleksy Husarzewski, the last royal commissioner in Gdańsk. The establishment was supported by the Czartoryski and Lubomirski families. A detailed description of the observatory can be found in the *History of the Natural Society* (*Geschichte der Naturforschenden Gesellschaft in Danzig*) by Eduard Schumann, published in 1893 [Fig. 56]. In his will, Wolf bequeathed four thousand ducats for the maintenance of the establishment and the astronomer's salary which was to be administered by the Natural Society. Doctor Wolf was also the creator of original natural systematics, which, however, would not be adopted. He donated his herbarium comprising 40 volumes with five thousand specimens, and a rich collection of shells and minerals to the Natural Society. Before the last war, these collections formed the core of the Natural History Museum in the Green Gate (Zielona Brama). A fragment of the herbarium only has survived to this day.

Figure 54. Nathanael Matthäus Wolf

Doctor Wolf died on 15 December 1784. He was buried near the observatory on Biskupia Górka. The funeral speech delivered by Dr. Lampe was printed and sent to King Stanisław August. On the 10th anniversary of his death, a plaque

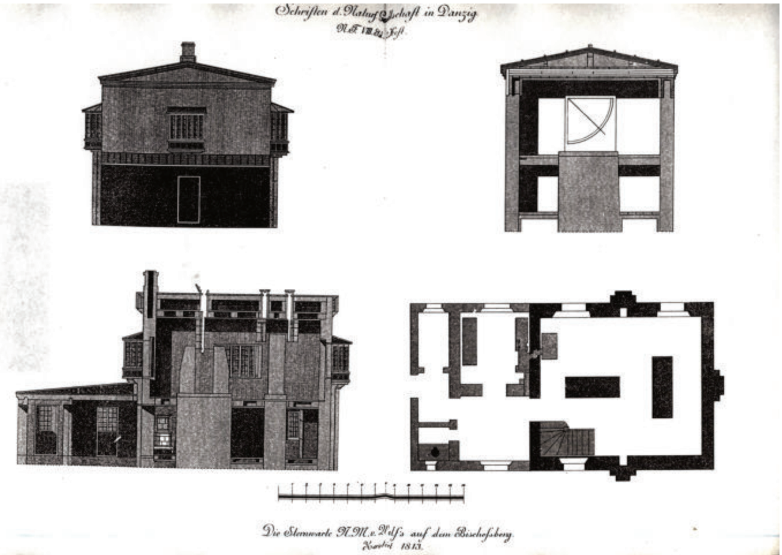


Figure 55. Wolf's Observatory

with the following Latin inscription was placed on the tomb (abbreviations are deciphered in parentheses): "Here lies Nat(haneael) Mat(thäus) von Wolf, founder of the astron(omic) observatory, in the place he chose for himself, the monument to the most distinguished man was founded by memb(ers) of the Gd(ańsk) Soc(iety) of Res(earchers) of Nat(ure) asking that Urania (astronomy) should persevere". The plaque, renovated in 1884, still existed after the last war; attempts to find what happened to it later have been unsuccessful. In 1813, facing the presence of Russian troops besieging Gdańsk, the observatory was demolished, for which the Society later received a compensation of 4621 thalers. The new observatory in Gdańsk was established as late as in 1867 in the Naturalists' House - the new seat of the Society at 26 Mariacka Street (the Archaeological Museum today). At that time, a beautiful tented roof, dating back to the times of Antonis van Obberghen, was dismantled to be replaced with a characteristic observation dome, known from pre-war photographs. During the reconstruction of the Naturalists' House, the Renaissance tented roof from 1599 was restored.

Wolf's contributions were also great in the field of medicine. He was the first in Gdańsk (and probably in Poland) to vaccinate children and adults against smallpox from 1776. An excellent description of such vaccination can be found in Joahnna Schopenhauer's memories of the youth in Gdańsk.

Let us finish this sketch by repeating the question which I asked almost half a century ago in the magazine *Litery* (*Letters)*: I wonder, if there is any trace of the remarkable and familiar personality of Doctor Wolf on Biskupia Górka? As far as I know, no one has answered this question yet.

Adolf Friedrich Johann Butenandt. The last of the fellows of the Royal Society of London associated with Gdańsk was the biochemist **Adolf Friedrich**

Johann Butenandt who was admitted on 25 April 1968 [Fig. 57]. He was born on 24 March 1903 in Lehe (now Wesermünde) near Bremerhaven. Having studied chemistry in Marburg, he received his Ph.D. degree in 1927 in Göttingen in the field of knowledge about insecticidal compounds under the supervision of the Nobel Prize winner Adolf Windaus. It was also there where he began research on sex hormones which was culminated in isolation of the crystalline estrone from the urine of pregnant women in 1929. He isolated the male hormone – androsterone in a similar manner in 1931. In 1933 he became professor and director of the Department of Organic Chemistry at the Faculty of Chemistry at the Gdańsk University of Technology. When studying the molecular structure of the androsterone, he discovered its analogy to the cholesterol structure. It was also here that he synthesized one more hormone - testosterone – after he had isolated it in 1935. In 1939 he was awarded the Nobel Prize for these achievements together with Leopold Ruzicka, who conducted similar research. At that time (1936-1945) Butenandt was already the director of the Emperor Wilhelm Institute of Biochemistry in Berlin and the Nazi authorities did not allow him to accept the prize. He received it as late as in 1949.

Figure 56. Adolf Butenandt, Nobel Prize winner, fellow of the Royal Society

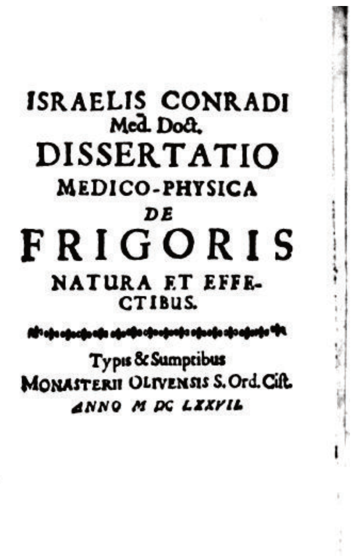
During the war, his studies included, but were not limited to, the influence of genes on the resistance to illnesses. His later achievements worth mentioning include crystallization of the insect hormone ecdysone and its similarity to cholesterol, and research on pheromones. After the war, he remained professor of physiological chemistry at the same institute, moved to Tübingen, bearing the name of Max Planck from 1948. As of 1956 he was professor and director of the Institute of Physiological Chemistry in Munich, as of 1960 - president of the Max Planck Society (the equivalent of the Academy of Sciences). He retired in 1972. He was an honorary member of many societies and academies, received numerous international distinctions, *inter alia,* he was a Knight of the French Legion of Honour. He received honorary doctorates at six universities. The Gdańsk University of Technology joined them in 1994 on the 90th anniversary, awarding an honorary doctorate to its former professor. Adolf Butenandt died on 18 January 1995.

As can be seen, this famous Society - the English equivalent of the Academy of Sciences - has honoured at least eight world-class scientists associated with Gdańsk (even for a short time) with its fellowship. Two of them – Hevelius and Fahrenheit - were honoured in Gdańsk with monuments and plaques, and they are patrons of courtyards of the Main Building of the University of Technology. The others are still waiting to be honoured according to their merit.

24. Scientific Societies

The first attempt to establish a scientific society in Gdańsk was made by the above mentioned **Israel Conradt** (1634-1715) - a physician who was also interested in physics. Responding to the appeal of the Royal Society of London communicated to him, probably through their Gdańsk fellow Jan Hevelius, he undertook research on the influence of low temperature on the physical state of bodies, and on 3-5 February 1670, he delivered a series of lectures on the nature and effect of cold, published in Oliva seven years later [Fig. 58]. The text includes, *inter alia*, a description of the phenomenon of liquid supercooling discovered by Conradt. “Water from fragrant herbs with some portion of French wine spirits added (...) and kept for quite a long time in a cold room in a well-covered dish, so that it should not freeze; at another time (...) in the same room I poured water from a glass bottle into another glass bottle (...) and suddenly, as if in an instant, approximately a fourth or fifth part of the whole was frozen into pieces of ice floating in the remaining liquid, which however, soon afterwards melted again on their own.” Elsewhere we read: “I often wonder how all those acquisitions that we bring back from scientific expeditions to foreign countries after many hardships and costs get lost in the privacy of one’s home. By hiding these objects in private homes and chests, we delay the public benefit to be derived from them and inhibit the development of science and the truth inherent therein.” Following this, he proposed to establish a society similar to the Italian academies, to which all enthusiasts of the Gdańsk science would belong. At the meetings, participants were to present their own works and discoveries as well as other most significant foreign achievements.

Conradt’s efforts were at that time unsuccessful. The first Scientific Society in Gdańsk (and in Poland), called *Societas Litteraria*, i.e. Scientific (not “Literary”!) Society was established half a century later, in 1720, on the initiative of the eminent historian Gottfried Lengnich (1689-1774). It was organized



ISRAELIS CONRADI
Med. Doct.
DISSERTATIO
MEDICO-PHYSICA
DE
FRIGORIS
NATURA ET EFFE-
CTIBUS.

Typis & Sumptibus
MONASTERII OLIVENSIS S. Ord. Cist.
ANNO M DC LXXVII.

Figure 57. Conradt's dissertation

within in a modern organizational framework manifested in the statutes, minutes of meetings and membership fees. The number of members did not exceed a dozen, including nine real members. The objective of the Society was "to build and satisfy the mind not only by true and pleasant stimulation, but also to discuss and develop on this occasion one or another useful and sometimes interesting matter, from history and law, morality, physics, mathematics, literature and other sciences (however, it was not considered good to raise any controversial theological issues)". As can be seen, the statutes also provided for physical issues. Two main trends clashed in the Society's activities - moral and natural. Much time during the meetings was devoted to issues related to the Polish system. In 1727, the Scientific Society ceased to operate for unclear reasons.

24.1. Society of Experimental Physics (Natural Society)

The need to have its organization must have been a strong concern for the scientific community in Gdańsk, because already 15 years later Daniel Gralath, a naturalist and later the mayor, begins to establish a new society, *Societas Physicae Experimentalis*, i.e. the Society of Experimental Physics, better known as the Natural Society (Naturforschende Gesellschaft). The first organizational meeting may be considered to be the private meeting held on 7 November 1742 during which Gralath put forward the initiative to form a society. At first there were five volunteers, and Adrian Söhner, a juror of the Main City, made his room available to the participants. Two weeks later, on 22 November, a meeting on the first statutes was held, and the board was elected on 20 December. The first director, as this was the terminology adopted, was a former member of the Scientific Society, Dr. David Kade. When a vacuum pump had been purchased on Wednesday, 2 January 1743, the first scientific meeting attended by nine members was held. As from 1746 the seat of the society was the Green Gate (Zielona Brama) [Fig. 59]. In the first year of operation, the number of members increased to 14, and in 1793, which ended the first period of operation (Gdańsk was annexed to Prussia), the 91st ordinary member and the 39th honorary member were registered. The members came mainly from the enlightened bourgeoisie – being teachers, doctors, lawyers, clergymen and city councillors (some of them already mentioned). The founding members were: **David Kade** (1688-1763), physician and physicist; **Michael Hanow** (1695-1773) [Fig. 60], professor of the Academic Gymnasium, a versatile scientist, a pioneer in meteorology and demography, the publisher of the first popular science magazine in Poland *Explained Curiosities of Nature* (*Erlauterte Merkwürdigkeiten der Natur*) in 1736; **Heinrich Kühn** (1690-1769), professor of the Gymnasium, outstanding mathematician, a correspondent member of the Petersburg Academy of Sciences; **Daniel Gralath**, physicist; **Jacob Theodor Klein** (1685-1759), Gralath's father-in-law, former member of the Scientific Society, member of the Royal Society of London, botanist; **Adrian Söhner** (1703-1761), juror, later a long-time director of the Society; **Paweł Świetlicki** (1699-1756), clergyman, Polish language teacher at the Academic Gymnasium, pastor of St. John's Church; **Heinrich Rosenberg** (1712-1794), lawyer, royal counsellor, owner of the largest private book collection in the old Gdańsk numbering 22 000 volumes; baron **Friedrich Zorn von Plobsheim** (1711-1789), a conchologist who later looked after the Society's collections for many years. The honorary members included, *inter alia*: the aforementioned naturalist, participant of Cook's 2nd expedition, Johann Rheingold Forster of Tczew (Dirchau) and Johann Bernoulli, the outstanding Berlin astronomer of Swiss origin, as well as three patrons of science from Warsaw: Jean Dubois, chancellor Joachim Chreptowicz and count August Moszyński. An attempt to transform the Gdańsk Society into a nationwide royal scientific society in 1756 failed due to intrigues at the court of Augustus III. As from 1753, the Society also used the name Natural Society, but in Latin it was always referred to as the Society of Experimental Physics. It was the last war only that put an end to the Society's operations, although in 1943, the 200th anniversary of its existence was celebrated with a special session. At the present time, the operations are continued by the Gdańsk Natural Society (Danziger Naturforschende Gesellschaft), founded in 1994 in Lübeck.

Statutes. The earliest statutes of the Society for Experimental Physics, adopted on 2 January 1743 contained 26 sections detailing the forms and scope of operation. The Society was to be self-sufficient and self-governing. There were financial penalties for violating the statutes. Members were divided into ordinary, honorary and free. The number of ordinary members was limited to 20, later it was unlimited. Honorary members were those who "either *in statu politico*, or *in republica litteraria* (in the community of scientists and scholars) have special merits before others and can help the Society and increase its merits by their

Figure 58. Green Gate - the first seat of the Natural Society

Figure 59. Michael Hanow

recognition or exceptional knowledge". Free members could attend regular meetings, but were not required to assist with the experiments. They were divided into educated (*litterati*) and uneducated (*non litterati*), the latter paying higher entry fees. Members were elected by a simple majority of votes. The director, secretary and treasurer were elected from among the ordinary members to compose the board. The term of office was one year, with the possibility of extension.

The members of the Society were divided into classes composed of an operator and two co-operators. The task of each class was to conduct experiments and observations for a month during ordinary meetings: “The operator has the word, supervises over experiments and observes, while the co-operators (assistants) help him and prepare what the operator tells them to. When experimenting and observing, no one is allowed to interfere with their word or with their work, but has to wait until the experiment is over; on the other hand, should anyone notice that the experimenters have lost themselves in lengthiness or in such ways that the experiment cannot be performed, either completely or without unnecessary wandering, then he is allowed, with the director’s approval, to express his opinion on the operation in progress, and it should seem neither scandalous, nor slighting to anyone (...), since the truth is indeed as nice to any other member as it should be to himself.” In other cases, all comments and suggestions for improvement had to be submitted after the experiment was completed.

A separate section, devoted to the art of conducting discussions, cautioned members to avoid contemptuous, bitter, and inadequate statements. The director was obliged to admonish the debaters to “use appropriate words and expressions more gently while defending the truth or confirming an opinion, and, after exposing their views on the issue, reconcile as soon as possible for the triumph of the truth.” Those who did not obey had to pay a fine to the treasurer. The operators had to prepare the equipment for experiments in advance to avoid unnecessary waste of time. Each member could be present at these preparations “as pleased, so that for the benefit and convenience, when his turn comes, to be more skilful; however, no one should be a hindrance to the operators in any way”.

It was planned to regularly conduct the experiments described in the three-volume textbook of physics by Christian Wolff and the Leipzig journal *Acta Eruditorum*. The most interesting of them were to be repeated once more and only then new ones were to be planned.

An important point in the statutes was the provision on the regular recording of experiments and observations. When repeating someone else’s experiments, the author should be mentioned. Should the results be different, they were to be described and published with special diligence. It was the secretary’s job. “Howbeit, to facilitate the secretary’s work, to some extent at least, the operators will tell their cooperators to describe and, after prior checking, deliver to the secretary in due time everything that is peculiar in their experiments with proper understanding and connection, nonetheless, during the experiment, the *Secretarius* will be moving the quill, thus leaving less space for errors and mistakes.” The files of the Society were divided into *History*, including history, resolutions and orders, and *Ephemerides*, containing descriptions and records of experiments, and *Comments*, which included scientific dissertations. “From the discoveries contained therein, no member shall change anything, so as not to deprive the Society of the fame of having made the invention.” The secretary was also supposed to prepare and ensure that the transactions approved by the Society were printed. *Hi-*

stoires et Memoires of the Paris Academy of Sciences were taken as a model for keeping the files (in German).

Each member had the right to report his own work, having written to the director prior to that. Papers from the outside were also allowed - it could be a presentation of a "machine", a drawing or an observed phenomenon. With the consent of the board, third party attendants could also participate in meetings; the secretary's consent was sufficient in urgent cases. In the event of death of any member, the secretary was obliged to prepare a short biography and list the merits and include them in the files. These files are an invaluable source of information today.

Ordinary meetings were to be held every Wednesday "from St. Michael's day until Easter from 3 to 5, and from Easter to St. Michael's day from 4 to 6 pm". The exceptions were the weeks of: Christmas, Holy Week, Easter, Pentecost and Dominic (the beginning of the fair) and when there was a holiday on Wednesday. If the operator was unable to attend a meeting, he had to excuse himself to the director of the Society and indicate the deputy who was to conduct the experiment, if none of the cooperators wished to do it.

A separate section defined the order of taking seats and taking the floor. Priority was given to the director, followed by the operators by class, the secretary, the treasurer and the cooperators. The duties of the director included ensuring that each member should act for the common good and that the actions were in compliance with the statutes. In addition to that, he was responsible for all the affairs of the Society. At the end of the year, on the basis of a list prepared by the secretary and the treasurer, he would decide to cross-out worn-out items and instruments and to enter new ones. A deputy director was provided to help. The treasurer was responsible for the condition and maintenance of the inventory. "If, during an ordinary operation, as well as in a special experiment, an instrument is damaged, the operators will not be charged, but the treasurer should attend thereto. When the operators need one or another instrument for the experiment, and the cost of obtaining it does not exceed 8 florins, the treasurer, when requested, will provide one without any questions: for a larger sum, the financial status of the Society must be consulted." Finally, the possibility of introducing changes to the statutes was discussed. The whole ends with signatures of members.

The first statutes served until 1786. Later they were revised several times, without changing the most important provisions. Major changes were introduced only in 1865, 1875 and 1938. Wednesday was the day of ordinary meetings throughout the whole period of the Society's existence.

Works in Physics *Societas Physicae Experimentalis* was established as a physical society. From the first years, the subject of research was extended to include natural science works. Here we will focus on the achievements in physics - especially those that were of a pioneering nature. The first place should be given to the works of Daniel Gralath. His *History of Electricity* was published in the first three volumes of the *Experiments and Transactions* published by the Society in 1747, 1754 and 1756, containing a detailed outline of all the existing achievements in this field. The author modestly refers to the *Memoirs* by Charles du Fay, but his work is broader and deeper to the extent that it can be safely considered the first thorough study of the history of research on electricity in the world. An even greater achievement of Gralath were his experimental works. As we already know, he established contact with von Kleist from Kamień Pomorski (Cammin in Pommern) through Świetlicki and performed a successful experiment with his jar, later called the Leyden jar, as early as on 5 March 1746 in Gdańsk. Gralath's publications give deeper understanding of the phenomena occurring therein than the superfluous observations of Kleist and Musschenbroek. In April 1746, Gralath set up the first battery of early electric capacitors in the world. In the same year, he was the first in the world to measure the forces of electrical attraction with an electrostatic scale, thus becoming a predecessor of Cavendish and Coulomb.

The achievements of other members of the Society worth mentioning include the prototype of an analytical scale with friction wheels designed by Kühn H., which we already know. In the first volume of the Transactions, Kühn also included the theory of weight and weighing and the design of an instrument using the law of communicating vessels to measure the water drop in a river. The experiments of **Christian Sendel** (1719-1789) on electromagnetism were of a pioneering nature - at least in Poland. In the 1850s, i.e. before Benjamin Franklin, the scientist from Gdańsk succeeded at remagnetizing a magnetic needle due to strong electric discharges. The issues of interest included also: the relationship between atmospheric pressure and altitude (Micheal Hanow); hydrostatic pressure (e.g. Gralath repeated the experiment with Pascal's barrel); refraction and dispersion of light in a prism (Jacob de la Motte); capillary tubes (Beniamin Schröder); cohesion and adhesion (Sendel); thermal expansion and changes of the state of matter (Philip Lursenius); elastic and inelastic collisions (Johann Reinick), with bifilar suspension of colliding balls; free fall of bodies (Gotfryd Reyger); strength of materials (Schröder); evaporative cooling (Hanow) and many other issues. The 48 papers contained in the first three volumes of Experiments and Transactions included 30 works devoted to physical issues, including meteorology, astronomy and works of a utilitarian nature (17 of these were purely physical). Other treaties were related to botany and zoology. In 1778 another volume was published, entitled *The New Collection of Experiments and Transactions*, containing 12 works, including only two addressing physical issues. Ephraim Krüger's treaty on the free fall of bodies in water and a salt solution is worth mentioning among them.

60 works in total were published before the partitions, 32 of which were related to physics. Other achievements that should be mentioned include obtaining the seat in the Green Gate in 1746. An outstanding role in the Society was played by **Nathanael Matthäus Wolf** (1724-1784), a physician of the Chivalry School and of the Czartoryski Princes who lived in Gdańsk since 1772. His activities in the Society (from 1776) and the contributed capital led - as described

in the chapter on the Gdańsk members of the Royal Society (pp. 76 ff.) - to the establishment of the astronomical observatory in Biskupia Górka in 1781. The observatory was destroyed during the Napoleonic Wars.

The process of departing from physics was marked in all the subsequent activities of the Society. In the 19th and 20th centuries, despite a significant increase in membership, with over 200 and later 400 members, few interesting physical treatises can be found. These include works by Strehlke F. from the years 1827-1853 with, *inter alia*, the research theory of Chladni figures, experiments in the field of electroforming, daguerreotype and spectroscopy, performed and demonstrated to the public shortly when the news of their discovery or invention had reached Gdańsk. It was also the research on the surface tension of saturated steam (Kessler F.), measurement of pressure and water flow velocity in pipes (Lampe H.) and works on the history of physics (Momber A., Schumann E. and Schnaase L.) that were of some importance. The lecture of Wolf F. from Oliva about the so called atom splitting in the interwar period may be mentioned, as well.

In the years 1815-1862 six volumes of the Newest Scripts of the Natural Society in total were published in 24 issues. They contain 30 treaties, including only three on purely physical subjects, four on meteorology and four on astronomy and navigation. It is worth mentioning that in 1852 the Society organized an international competition to develop the theory of the Foucault pendulum which had been demonstrated two years earlier in Paris. The award winning work of Hansen P. of Gotha has not lost its relevance to this day. The members of the Society also published their works in Poggendorff's Annals. At that time, the honorary members of the Society were, *inter alia*, Oersted Ch., Bessel F., Encke J., Struve F., Baily F., Arago D., Humboldt A. von, Berzelius J., Pictet F. and the mentioned Hansen P.

In the years 1864-1934, 20 volumes of *Scripts of the Natural Society* were published in the so-called *New Series*. Each volume contained four journals. Physical issues were hidden deep inside.

The achievements in this period should include obtaining the location in the building on 26 Mariacka Street in 1845 [Fig. 61] (the building was called the Naturalists' House after the name of the Natural Society), on the turret of which an astronomical observatory was built in 1867, the opening of the Museum of Natural History in the Green Gate (1880) and active participation in the endeavours to establish the Gdańsk University of Technology (1904).

Who was the first. Let us now arrange a list of European natural science societies according to the date of establishment:

- Accademia dei Lincei - Rome 1603 (operated until 1651, reinstated in 1874 as Accademia Nazionale Reale dei Lincei);
- Collegium Naturae Curiosorum - Schweinfurt 1652 (in 1670 transformed into the German National Academy of Natural Sciences Leopoldina in Halle - existing to this day);
- Academia del Cimento - Florence 1657 (dissolved in 1667);

- The Royal Society - London 1660 (existing to this day);
- The Caen Scientific Society (Academie de Physique de Caen) - Caen 1662 (dissolved in 1672);
- Academie des Sciences - Paris 1666 (now within the structure of Institut de France);
- Accademia Fisico-Matematica - Rome 1677 (existed until 1698);
- Prussian Academy of Sciences - Berlin 1700 (currently the German Academy of Sciences);
- Societas Litteraria - Gdańsk 1720 (existed until 1727);
- The Saint Petersburg Academy of Sciences - Petersburg 1724 (now the Russian Academy of Sciences);
- Societas Physicae Experimentalis - Gdańsk 1742/1743 (existed until 1945, reinstated in 1994 in Lübeck).

As can be seen, the Gdańsk Society of Experimental Physics (Natural Society) was the second scientific and first natural science society in Poland and the third in the world with 'physics' in the name.

Memorabilia. The Society for Experimental Physics had an impressive scientific collection and a rich library of about 30 000 volumes (see below). The part of the collection related to natural sciences, with the second largest amber collection in the world, was the core of the collection of the Natural History Museum in the Green Gate and was destroyed or dispersed during the last war. It is worth finding and taking down what went to museums in Poland, Germany and Russia. The collection of apparatus (including Hevelius's lenses and instruments) suffered a similar fate.

Figure 60. Naturalists' House, seen from Mydlarska Street (Photo: Januszajtis A.)

138 books only from the book collection donated in 1923 to the deposit of the Main Library of the Gdańsk University of Technology survived the fire of the university. The National Museum in Gdańsk keeps a bust of Hevelius - a gift from Stanisław August to the city on the occasion of the centenary of the astronomer's death. Another gift - for the Natural Society - a golden ring with the image of the king, set in diamonds, worn by its directors during their meetings in the 19th century, has been lost without a trace. The subsequent locations of the Society: Zielona Brama (Green Gate) (1746-1829), St. James's Church in the Old Town (1832-1845) and the tenement house at Mariacka Street (1845-1945) were rebuilt from the war ruin. Today, the first hosts exhibitions, the second has been reinstated for religious purposes, and the beautiful Naturalists' House is the location of the Archaeological Museum. As I have already mentioned, it is not known whether the stone commemorating the observatory and the grave of Nathanael Matthäus Wolf have survived at Biskupia Górka (Bischofsberg). Gralath's Stone on Aleja Zwycięstwa (Victory Avenue) commemorates today, as in the past, the main founder of the Society, whose achievements are the pride of Gdańsk and the First Polish Republic. The recognition which it enjoyed is evidenced by the words of Mitzler de Kolof, a scholar from Warsaw: "What a glorious and honourable thing it is that Gdańsk, the queen of Prussian cities in the Polish Kingdom, a pearl in the Polish crown, has within its walls such a gathering of scientists, researching the secrets of nature and sharing the results of their experiments and treaties with the entire educated world. May there be more such societies in Poland to broaden the knowledge". And Alexander von Humboldt, when receiving a honorary membership granted to him by the Society on his 71st birthday (in 1841), said: "One of the most pleasant of the many joys that the fortune has given me (...) was to be able to greet again this city which, surrounded by the charms of nature, evokes great memories of the ancient civilization of the world trade, medieval arts and magnificent scientific works at the same time. Many spiritual embryos have developed here into noble flowers over the centuries. These were diligently and fruitfully cared for by the community of naturalists. On this historic coast, on the shores of an almost enclosed sea, whose most valuable product (amber) first stimulated the peoples of the South to study the shape of the North of Europe, it is a nice duty for me to express to you, my dear colleagues, my firm commitment and grateful respect".

The Book Collection of the Society. Gathered for years, the scientific collections of the Gdańsk Natural Society, including the second largest collection of amber after Königsberg, were the core of the resources of the Natural History Museum established in the Green Gate in 1880. Unfortunately most of the collections were destroyed or dispersed during the last war (some amber specimens went to the Museum of the Earth in Warsaw). The society also had a rich collection of books numbering around 30 000 volumes. In 1923 it was transferred to the Library of the Gdańsk University of Technology. How did it happen? It all started with the exhibition of items collected by two English participants in a historic expedition during James Cook's first historical voyage. The exhibits came from the collections of the Royal Society of London. The exhibition was organized on the occasion of the 180th anniversary of the Natural Society in November 1922. It should be noted at this point that the official date of the establishment of the Society according to its members was 22 November 1742. 2 January 1743, given by many authors was the date of the first scientific meeting and the adoption of the previously prepared statutes.

Representatives of the Gdańsk authorities invited to the opening of the exhibition were shown cramped rooms of the library in the Naturalists' House on Mariacka Street, and it was then when the idea arose to return to the plan of one of the former directors of the Society, Alfred Momber, and donate the collection to the Library of the Gdańsk University of Technology. An enthusiast of the idea was Albert Pedreek, the newly appointed director of the library. Following consultations with the Committee of the Library and the Board of the Society and discussion at the general assembly on 6 December 1922, a relevant agreement was prepared with the authorities of the Free City. Here is its wording (with abbreviations):

"The following Agreement has been executed between the Natural Society of Gdańsk, represented by the Board, on the one part, and the Free City of Gdańsk, represented by the Senate, on the other part:

§1. The Natural Society shall rent the entire library inclusive of the cabinets and shelves thereof to the Free City for a period commencing as of 1 March 1923. The rental shall be extended to include future acquisitions of the Natural Society in the form of books and periodicals.

§2. The rental fee shall correspond to the initial basic wages of the employed person, including the inflation allowance (excluding allowances for wife and children) according to Group VI at the tariff applying to Group 4 and it shall be payable every six months in arrears at the location designated by the Society each time.

§3. The Rentee shall use the library in accordance with the following rules:

1. The book collection shall be placed in the rooms of the Library of the Gdańsk University of Technology, but separately, to be administered by the Head of the University Library in consultation with the Librarian and the Library Committee of the Society.

2. The Rentee agrees, as far as practicable with the resources available in accordance with Section 4 (2), to ensure that:

a) the book collection is professionally arranged and re-catalogued;

b) each book of the Society is marked with the owner's mark;

c) one copy of the new catalogue is made for the use of the Society.

3. The Rentee shall allow members of the Natural Society to freely use the rented and university book collections.

4. Subject to the approval of other authorized persons, the Rentee agrees that:

a) members of the Society can use all the requested books and periodicals of the rented book collection on the Rentee's premises without paying any separate fees;

b) the transactions of the Natural Society shall be exchanged by the University Library at the request of the Society, and the forthcoming transactions shall be added to the Society's book collection.

§4. The Rentee shall pay the amount of 200 dollars to cover the cost of transporting the book collection to and back from the Society's premises for its professional arrangement in the university rooms. All expenses shall be paid out of this sum of money. The Rentee shall be responsible for protecting the book collection during transport, as well as when arranging it at the University of Technology, and for losses, if any.

The costs of cataloguing, management on a daily basis and expanding the collection, as well as the salaries of the required personnel shall be paid by the Natural Society from its annual budget.

§5. This Agreement shall be executed for an indefinite period of time; both parties shall have the freedom to terminate it at any time giving one year's notice of termination.

Should there be any changes in the current legal and administrative relations of the Free City, or in the relations between the Free City and the University of Technology, the Natural Society shall have the right to terminate this Agreement at any time".

On behalf of the Senate of the Free City of Gdańsk the agreement was signed by its chairman Heinrich Sahm and Hermann Strunk, senator for science, culture and education, and by Hermann Stremme the director, and Wolfgang La Baume the deputy director on behalf of the Society. The agreement was executed in 1923. As director Pedreek wrote later, the incorporation of the "miraculous" library of the Natural Society was by far the most important event in the history of the library of the Gdańsk University of Technology. "It was already at the first review that it was clear what a great enrichment it was due to the earlier volumes, particularly the wonderful series of treaties by German and foreign academies and societies. More than 400 societies are involved in the exchange of treaties every year which brings rich growth of exchangeable literature, which is now at the disposal of the University of Technology". The number of periodicals alone increased by 700!

Fragmentary information only about the fate of the book collection during the war can be found. On 31 January 1945 some of the books sailed away together with the rector's files, the most valuable equipment and about 300 people on the "Deutschland" vessel. A total of 500 crates were loaded. Most of them went to in Schmalkalden in Thuringia finding shelter in the local castle. Most of what was left in Gdańsk was destroyed in a fire of the Main Building. 126 titles have survived from the Natural Society's collection. In 1947, 853 books from those taken away to Germany went to the State Library – now the University

Library - in Bremen. They were deposited by the professor of the Gdańsk University of Technology, Ernst Witt (active at the Faculty of Architecture from 1933, died in 1971). The following date was given as the period of storage: "as long as the times do not change." However, something changed, as on 10 June 1993, during the visit of the Gdańsk delegation, the Chairman of the Bremen Parliament, Dieter Klink, in the presence of the media, handed two books from this collection to the author of this book - the Chairman of the City Council at that time - describing it as "the beginning of the return to the rightful owners". These were *History of the Animals* by Konrad Gessner, (vol. IV) published in 1620 in Frankfurt, and the *Index of Plant Names* by Christian Mentzel, published in 1682 in Berlin. Both works are richly illustrated [Fig. 62]. The index includes plant names in several languages, including Polish and Lithuanian. The books bear the seals of the Gdańsk University of Technology and the Natural Society. There were real rarities among the 851 titles that remained in Bremen at that time, such as *The Natural History* by Aldrovandi (Frankfurt 1610), *Musaeum Kircherianum Bonannus* (Rome 1709) or Journals from the Travels of Mr. Nathaniel Jacob Gerlach from his hometown Gdańsk from 1727-1731. There were also original copies of the works by famous Gdańsk botanists - Jacob Theodor Klein and Jacob Breyn - as well as volumes of catalogues of monuments of architecture and art (Bau- und Kunstdenkmaler) from various regions that are missing from our library. Materials related to the Natural Society are of great value, including the earliest list of scientific apparatus compiled in 1746 by the founder the Society, Daniel Gralath, meteorological notes from the 18th and 19th centuries, library catalogues from various periods and 22 volumes of files from 1744-1832.

Figure 61. 2000 - return of the books from Bremen

The return of these works to Gdańsk was delayed by an appeal against the relevant decision of the Senate of the City of Bremen in November 1999 by the board of the reactivated Natural Society in Lübeck. In March 2000, the court overruled the lawsuit whereby in June the priceless historical and scientific treasures returned home to the specially prepared rooms of the Library of the Gdańsk University of Technology. Fortunately, the authorities of the "Gdańsk Natural Society" of Lübeck were successfully convinced that cooperation was a much better way to act for the future. Since 1998, German-Polish Meetings in the field of Science and Culture have been organized jointly with the Gdańsk Scientific Society. The papers presented during these meeting are published in the new periodicals of the Gdańsk Natural Society (Schriften der Danziger Naturforschenden Gesellschaft) 13 volumes of which have already been issued.

As can be seen, today in Gdańsk we have fewer than 1000 titles out of 30 000. There are many reasons to believe that some of the missing books, perhaps even quite a lot, may have been taken to Russia. Experience shows that it will be very difficult to get them out of there or it may be even difficult to obtain information. The Russians consider cultural treasures appropriated during the war as bounty to which they have full rights, and just to be on the safe side, they prefer not to show them to the rightful owners.

At this point, it is worth noting that the Main Library of the Gdańsk University of Technology which had 150 000 volumes in 1943, has over a million items now.

25. Scientists of the Turn of the Centuries

The scientists and scholars closer to our time to be mentioned should include the aforementioned creator of modern nature conservation, **Hugo Conwentz** (1855-1922), who was the director of the Natural History Museum in the Green Gate for many years, and professors of the Gdańsk University of Technology: mathematician **Hans Mangoldt** (1854-1925), physicists **Walter Kossel** (1888-1956) and **Carl Ramsauer** (1879-1955), and above all, the already discussed biochemist **Adolf Butenandt** (1903-1995), who won the Nobel Prize in 1939 for the synthesis of hormones carried out in Gdańsk. Here are the life histories of some of them.

Hugo Conwentz (1855-1922). Amber researcher, pioneer of nature conservation [Fig. 63]. He was born on 20 January 1855 in Święty Wojciech (St. Albrecht) near Gdańsk, in a Mennonite family. Having graduated from the St. John's Real School he studied at the universities of Göttingen and Wrocław (Breslau), where his teaching supervisor was Prof. Heinrich Göppert, a famous botanist who administered the Wrocław botanical garden. In 1876, he defended his Ph.D. thesis *Fossilized Trees from the North German Diluvium* (*Die versteinerten Hölzer aus dem norddeutschen Diluvium*). In 1879, he returned to Gdańsk, at the age of 24 only, to become the organizer and the then director of the newly established Museum of the Provinces of West Prussia in the Green Gate, which opened its doors to visitors in the following year. It had four departments: Nature and Archaeology, History, Inventory of Architecture Monuments, and Industry. Conwentz was also involved in inventorying the provincial forest resources and was active in the Natural Society of which he was a member since 1876. The main object of his research were amber inclusions.

At this point it should be mentioned that Gdańsk, known as the world capital of amber, is the unquestionable leader in the scientific research on amber. Local amber collections began to be amassed in the second half of the 17^{th} century. The main specialty was collecting inclusions. The famous collection of Christoff Gottwald, the city physician, was bought by Tsar Peter I. The collection of Jacob Theodor Klein went to Erlangen. The collections that became famous in the 18^{th} century were those of Daniel Gralath the Elder, Heinrich Jacob de la Motte and Johann Scheffler, and of Johann Aycke, Georg Berendt and Franz Menge in the 19^{th} century. The Natural History Museum established in 1879 in the Green Gate had the second largest collection of amber after Königsberg. After the war a small part of the collections went to the Museum of the Earth in Warsaw. The importance of Gdańsk as an amber research centre is evidenced by the fact that almost all the major works on this subject were written here. Their authors came from the Natural Society. 25 treatises on amber had been published by 1895. The most important works are those by the already mentioned Scheffler J. (1778), Aycke J. (1835), Menge F. (1853-883), Berendt G. (1845).

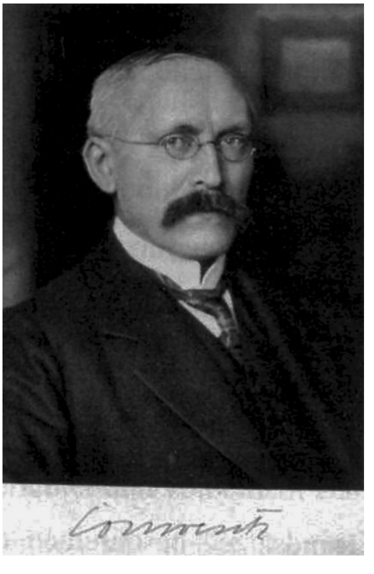


Figure 62. Hugo Conwentz (1855-1922)

The works by Hugo Conwentz published in Gdańsk: *The Flora of Amber* (*Die Flora des Bernsteins und ihre Beziehungen zur Flora der Tertiärformationen und der Gegenwart*, 1886) and the *Monograph of Baltic Amber Trees* (*Monographie* *der baltischen Bernsteinbäume, 1890*) as well as articles published in the *Scripts* (*Schriften*) of the Gdańsk Society are of fundamental importance for amber research to this day. From 1890, Conwentz was a professor of botany and floristics. He also conducted archaeological research that led to many discoveries. *Inter alia,* in 1891 he described bridges over the Dzierzgonka swamps in Bągart dating back two thousand years. In 1907, owing to his efforts, an old settlement in Sopot was purchased from the city and covered by protection.

Seeing the negative impact of the rapidly growing industry on the nature, he devoted himself to its protection. His first lecture on this subject at the Natural Society was delivered in 1900. Four years later, he sent the authorities in Berlin a memorial entitled *Threats to the natural monuments and proposals for their preservation* (*Die Gefährdung der Naturdenkmäler und Vorschläge zu ihrer Erhaltung*) in which he re-formulated the concept of a natural monument, introduced by Alexander von Humboldt, and presented the principles of its protection, thus becoming its world pioneer. He promoted his ideas in different countries. The Swedish government was the first to respond by introducing legislation in the same year. In 1906 the Prussian authorities established the State Nature Conservation Centre in Gdańsk (Staatliche Stelle fur Naturdenkmalpflege) and appointed Conwentz as its Head. The initiative was becoming increasingly popular, national parks, reserves and landscape protection areas sprang like mushrooms after rain. In 1909 Conwentz was entrusted with the honour of presiding over the first session of the First International Congress for Landscape Protection in Paris. In 1910, the Gdańsk institution of nature conservation together with its director were moved to Berlin. After 30 years of administering the Museum in the Green Gate Conwentz had to say goodbye to the museum and to Gdańsk. His activity is illustrated by the figures: 477 business trips, 250 lectures (including 73 at meetings of the Natural Society, 80 at conferences for teachers), over 300 publications (11 books) on palaeontology, geology, nature conservation, forestry, etc., and textbooks for schools.

The nature conservation act law submitted to the parliament in 1912 was not adopted. The Nature Conservation organization was established after Conwentz's lectures in Prague and Brno in Bohemia. In 1915, Conwentz created a landscape protection area in Górki Wschodnie (Östlich-Neufähr) - the today's site of the Ornithological Station of the Polish Academy of Sciences. In 1919 he married Greta Ekelof of Sweden. The marriage was childless. Hugo Conwentz died on 12 May 1922 in Berlin.

A little-known fact from his life is the saving of the most valuable area of the Białowieża Forest during the First World War. In 1916, when the German army occupied the forest, the idea was to use its resources for industrial purposes. They started to build lumber mills to process timber from logging. Owing to Conwentz's efforts, a strictly protected "Nature Park" with an area of 30 km^2 was created in the forks of the Narewka and Hwoźna rivers, where logging was prohibited. Also bisons were covered by protection. It was the area of the later

Białowieża National Park. In 2009, one of the local oak trees there was named after Hugo Conwentz to commemorate this noble action. In Gdańsk, it would be a good idea to place a plaque on the house on 31 Łąkowa Street in which he lived to commemorate it.

Hans Carl Friedrich von Mangoldt. He was born in 1854 in Weimar [Fig. 64]. In the years 1872-1878 he studied mathematics and physics at the universities in Neuchatel, Göttingen, and finally in Berlin, where in 1878 he defended his PhD thesis entitled *Presentation of the roots of a three-part algebraic equation by infinite series*. In 1880 he was a private lecturer in Freiburg, in 1882 - in Göttingen. In 1884 he became full professor at the Technical University in Hannover, and in Aachen from 1886, in the years 1898-1901 he was the rector of the University of Technology there. He was nominated professor of the Gdańsk University of Technology in 1904, he was its first rector in the years 1904-1907. Let us quote a fragment of his biography by Walter Niens: "He always considered teaching as his most important task, to which he devoted all the powers of his mind throughout his life with rare fidelity and devotion". Throughout his activity, he conducted a four-semester major lecture in mathematics. Moreover, he would give various specialized lectures on the number theory, Fourier series, elementary mathematics, adjustment calculus, Maxwell's theory and many other subjects. Also in these fields he was an excellent lecturer who was able to develop and explain the most difficult problems with a rare pedagogical talent.

During the tests, he was a patient and gentle examiner, as long as it was dead knowledge that could be learned, but he made high demands on maturity and independent thinking. His scientific publications cover a wide range of issues. And so, he was interested in the application of the Riemann formula to prime numbers, problems of mercantile arithmetic, presentation of modular elliptic functions by infinite products and their extension to general functions, measurements of length and time in the theory of relativity, and he expressed his position on general problems of technology, e.g. on the views on the essence of electricity in 1905.

His standard work entitled *Introduction to higher mathematics for students and independent study* made it possible for generations of mathematicians, physicists and engineers to take the first step into academic mathematics". Let me add at this point from myself that after the last war, during my studies at the Gdańsk University of Technology, I also used this textbook and with clear conscience I can confirm the opinion of Prof. Niens: "This is the best textbook of higher mathematics I have ever had!"

In 1920, the Aachen University of Technology where von Mangoldt had once been professor and rector, honoured him with an honorary doctorate.

Hans von Mangoldt died on 27 October 1925 in his apartment in Wrzeszcz (Langfurh), currently 8 Walentynowicz Street (Hermannshöfer Weg)

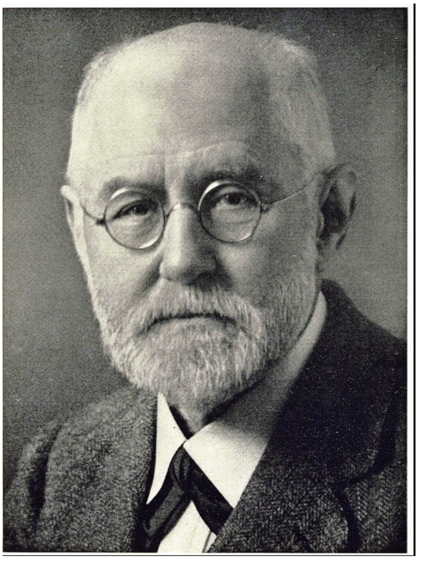


Figure 63. Prof. Hans von Mangoldt

26. Pioneers of the Polish University of Technology

As the centenary of the Gdańsk University of Technology was celebrated in 2014, it is worth mentioning the Polish scientists who organized the research and teaching processes in its walls after the war. Their work was equivalent to the hardship of creating a new university. The real heroes of those hard times were the organizers of the work in individual faculties (the number and names of which would change), and the later deans – including Prof. **Marian Osiński** (Architecture), **Aleksander Rylke** (Shipbuilding), **Włodzimierz Wawryk** (Chemistry), **Karol Taylor** (Mechanics), **Kazimierz Kopecki** (Faculty of Electrical Engineering), **Karol Pomianowski** (Civil and Water Engineering) and, of course, the Rector, **Stanisław Łukasiewicz** and Vice-Rectors **Stanisław Turski** and **Edward Geisler**. In other fields, this refers to **Maksymilian Tytus Huber** (1872-1950) - author of the famous condition of plasticity and popularizer of the theory of general relativity, **Ignacy Adamczewski** (1907-2000) - the creator of the "Gdańsk school of liquid dielectrics", **Arkadiusz Piekara** (1904-1989) - an unparalleled lecturer, discoverer of nonlinear phenomena in dielectrics, **Mieczysław Wolfke** (1883-1947) - co-discoverer of two types of liquid helium and precursor of holography, who, however, was active in Gdańsk for a very short period of time, and many others who were in such great numbers that it would be impossible to include them here. A detailed description of the achievements of all those who deserve it should be the subject of a separate book. I shall limit myself to one outstanding figure whom I know best.

Ignacy Adamczewski. He was born in Warsaw on 25 January 1907 [Fig. 65]. He graduated from the Faculty of Mathematics and Physics of the University of Warsaw in 1931. The subject of his Master's Thesis supervised by professor

Czesław Białobrzewski was the Fermi–Dirac Statistics applied to the theory of electron conductivity in metals. In 1932 he started working as a research assistant in an experimental Dielectric Laboratory organized by his supervisor. The research of liquid dielectrics focused primarily on saturated hydrocarbons of the CnH2n+2 group initiated there was continued by him throughout all his life. The results of the research carried out there in 1934 bore fruit in the publications: *Ion mobility in dielectric liquids* and *Electrical conductivity of X-ray ionised dielectric liquids*. In 1936 he received his Ph.D. degree for his 111-page dissertation entitled *Ion mobility and recombination in dielectric liquids depending on fluid viscosity* in which he determined the laws relating ion mobility and recombination coefficients to ion viscosity. He also researched and interpreted the current-voltage characteristics in ionised liquids. Later, jointly with Janina Świętosławska-Ścisłowska he also measured the ion mobility in very viscous liquids. In 1937 he started his research on ion surges triggered in liquids by cosmic rays. For this purpose, he launched an X-ray plate laboratory at the Kasprowy Wierch peak, which was a novelty in those times. Until 1939 he had published eight valuable publications in Poland and abroad.

His career was interrupted by the war. After the September campaign, in which he took part, Adamczewski managed to avoid the concentration camp and death in Auschwitz, where he was imprisoned for some time. He returned to work in professor Białobrzeski's laboratory, which had to change its field of activity and started service tests for water mains and power stations. This included developing alternative energy sources in case of emergency. When the laboratory had been destroyed by Soviet bombs in 1943, Adamczewski gave lectures in underground classes and wrote *A Brief Outline of Physics for Nursing, Agricultural and Fishing Vocational Schools*. After the Warsaw Uprising, he moved with his family near Łowicz and after the front went through in 1945 – to Lodz, where he took part in establishing the University of Lodz from scratch. In July of that year he came to Gdańsk to get apparatus... and stayed. The fact that both the Gdańsk University of Technology (just transformed into a Polish university) and the newly established Gdańsk Medical Academy lacked physicists, played an important role in this decision. The official transfer was made rapidly and in August 1945 Adamczewski became Head of the Department of Physics, which in November, after another department had been opened, was ranked second at the Gdańsk University of Technology.

It was a pioneer's work to organize the teaching and research work. The wing of the main building that had housed the Department of Physics until 1904, was devastated and the most valuable apparatus had been taken away. In a short time, the rooms were cleaned, broken windows were covered, and the scattered instruments were collected. On 22 October 1945 the professor delivered the first lecture in the re-established university, which was interrupted by the unexpected entrance of the highest authorities. In the plan of the lecture, we read "22 X 45 11-13. Physics A. Arch. Eng. Inform, Introd. meas. instruments, general (President, Prime Minister)" [Fig. 66].

Figure 64. Prof. Adamczewski with Prof. Lewis J. and the author in 1968

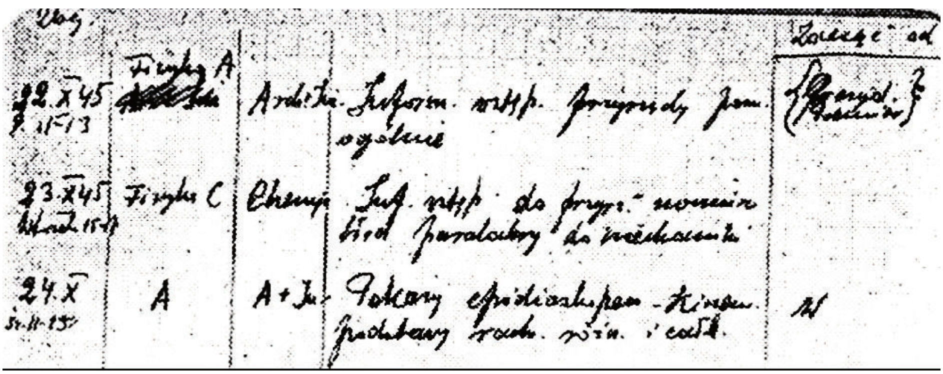


Figure 65. Prof. Adamczewski's notes from the first lectures after the war (Gdańsk University of Technology 50 years)

In December 1945 student laboratories started to operate. Assistants and, from 1947 advanced students, helped with the classes. In addition to the time-consuming teaching activities, Adamczewski, who became associate professor in 1946 and full professor in 1952, attempted to create conditions to develop research – primarily in his own field. Having recovered some of his apparatus from Warsaw and having pieced together the X-ray equipment in Gdańsk (the construction of a Van de Graff high voltage generator was commenced), he began to train staff for research work. The subject of the first master thesis under his supervision in 1948 was research on the breakdown voltage in transformer oil and cable mass. Nonetheless, in addition to engineering works, the major field of interest was the physics of liquid dielectrics, including processes of ionisation, conductivity, and breakdown in these liquids. Detection and dosimetry of ionising radiation was another major specialty of his.

With time his research work gained extraordinary momentum. In the years 1961-1968, the professor promoted 15 PhDs. By 1969, 115 of his papers had been published, and the term "Gdańsk school of liquid dielectrics" had become commonplace abroad. The crowning achievement and summary of his achievements was Adamczewski's monograph *Ionization and Conductivity of Dielectric Liquids*, published in 1965, later translated and published in many countries.

Figure 66. 50 years of Prof. Adamczewski's research work

In the years 1953-1954 and 1965-1968 professor Adamczewski was the dean of the Faculty of Chemistry. When the Interdepartmental Institute of Physics had been established in 1968, he was its first director - until 1971, when he became professor at the University of Salford in England. One of the reasons for his leaving was the suspension of financing of the research on dielectric liquids in Poland. In England, the professor returned to intensive work, which resulted, *inter alia*, in the so-called Adamczewski's formula linking the coefficients of mobility, recombination and viscosity in liquid hydrocarbons with the temperature and number of carbon atoms in a molecule. The professor considered this formula one of his life achievements.

The professor retired in 1974, but continued to stay in Salford from time to time. In 1977 his work *Free and Quasi-Free Electrons in Non-Polar Dielectric Liquids* was released with Józef Terlecki and James H. Calderwood as co-authors. In 1983, Adamczewski celebrated the 50th anniversary of his scientific work [Fig. 67]. On this occasion his former students and colleagues issued a special publication. In 1985 the Gdańsk University of Technology awarded him an honorary doctorate. In 1991, the same was done by the second institution with which he was associated from the beginning - the Medical University. Finally, in 1994, the Gdańsk City Council awarded him with the title of Honorary Citizen of the City. He deserved it with his life and pioneering work, his research and teaching activities, reliability and integrity, high culture and ability to deal with people. He was one of the most active creators of the post-war development of the Gdańsk University of Technology, making its name famous worldwide - from the USA to Japan and Australia.

The professor was married twice. He had a son, Krzysztof with his first wife, Maria, who settled abroad. His second wife Janina was professor at the Medical University. In the last period of his life, marked by disease, in 1994, together with the writer of these words, he published the work entitled *Contribution of the Polish science to the world science in the ionization and electrical conductivity of liquid dielectrics*. Doctors did not allow him to travel to Rome in 1996 for a conference for which, also with my help, he prepared the lecture entitled *Contribution of Polish scientists to a better understanding of ionization and transport processes in dielectric liquids*. During the conference I could see again how much respect Prof. Adamczewski enjoyed among the world specialists in this field.

The progress of the disease made it impossible for him to pursue his further plans. On 23 June 2000, the professor passed away from this world. He was buried with honours in the Gdańsk Srebrzysko cemetery. The following inscription was placed on the grave: "Prof. Ignacy Adamczewski, Ph.D., 1907-2000. Honorary Citizen of the City. Ave Maria". For unknown reasons, after some years, the plaque was replaced by another on which the Honorary Citizenship was omitted.

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Andrzej Januszajtis was born on 18 August 1928 in Lida in the pre-war Eastern Poland (now Belarus). He spent his childhood in Lublin where he acquired higher education. In 1948-1954 he studied at the Gdańsk University of Technology. Having graduated with the Master Engineer's degree in the field of Mechanical Engineering he worked at the Chair of Physics at the same University and in 1964 he received the PhD degree in applied physics. As of 1967 he also delivered lectures on TV. Co-founder and the first Dean of the Faculty of Technical Physics and Applied Mathematics. In 1987 he lectured History of Physics at the University in Lund (Sweden). He retired in 1993. In addition to Physics his passion is the history of Gdańsk in which he is a recognized specialist. In 1990-1994 he was the President of the City Council in Gdańsk. In 2002 he was made an Honorary Citizen of Gdańsk. He was the leader of the group which reconstructed the famous 15th century astronomical clock in St. Mary's Cathedral in Gdańsk. The list of his publications includes 30 books and over 1000 articles.