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Nicolaus Copernicus and medicine – 550th anniversary of the birth and 480th anniversary of the death of a scientist who turned the view of the world upside down

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SUMMARY
This year sees the 550th anniversary of the birth and 480th anniversary of the death of Nicolaus Copernicus, internationally recognized as the father of modern astronomy, who "stopped the Sun, moved the Earth" and turned the view of the world upside down. However, the fame of Nicolaus Copernicus is not referred only to the fields of astronomy, mathematics, canon and civil law, as well as theology, economy and diplomacy. This Renaissance polymath was also one of the most respected practicing physicians at the time. Noteworthy, Nicolaus Copernicus paid special attention to the poor, supplying them with free medical advice, assistance and medicines. Therefore, our paper deals with this less known aspect of the famous scientist's life.
Keywords: Nicolaus Copernicus; medical education; medical practice; history of medicine

INTRODUCTION

The scientist's job is to search for truth within the framework approved by God and morality.
Nicolaus Copernicus

The father of modern astronomy, Mikolaj Kopernik (Mikolaj Koppernigk), better recognized by his Latin name Nicolaus Copernicus (1473–1543) was a 16th century Polish priest who devoted his entire life to a heliocentric (sun-centered) model of the universe [1–8] (Figure 1).

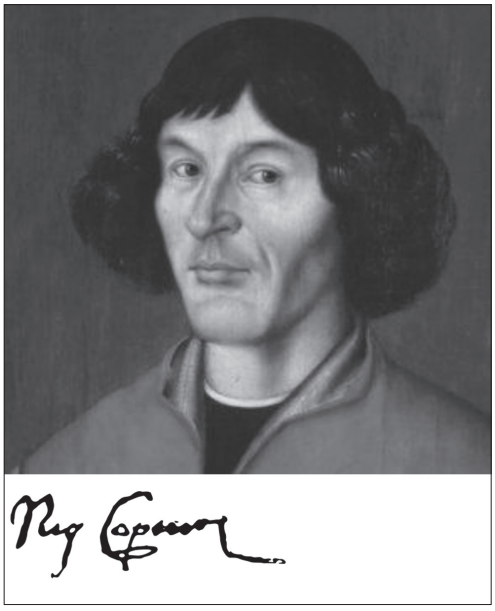

Figure 1. Nicolaus Copernicus (1473–1543); the portrait of Nicolaus Copernicus with his signature below; (Town Hall in Toruń, anonymous painter,1580); source: https://en.wikipedia.org/wiki/Nicolaus_Copernicus

Although Copernicus's name refers to the theory of heliocentrism, the ancient Greek astronomer Aristarchus of Samos was the first man who introduced the idea of solar centrality in the third century B.C. [1, 6, 9]. Unfortunately, his idea was not accepted [9]. Moreover, according to the contrary explanation of the universe, also known as the geocentric theory of an Egyptian astronomer from Alexandria named Claudius Ptolemaeus (Ptolemy, 87–150 A.D.), the Sun, as well as the planets and stars moved around the motionless Earth [5, 6, 7, 10]. This doctrine (Ptolemy's cosmic model) had been the only undoubtedly accepted way of understanding the universe for centuries [10].

Ptolemy's cosmic model was strongly supported by two millennia of philosophical earth-centered view of the universe, geocentric doctrine described in the Bible, religious authorities, and many people across the Christian world [1, 3, 6, 10, 11]. However, Copernicus realized that geocentric vision of the solar system was unworkable [7]. In his groundbreaking book called *De Revolutionibus orbium coelestium libri sex* ("Six books on the revolutions of the heavenly spheres") published

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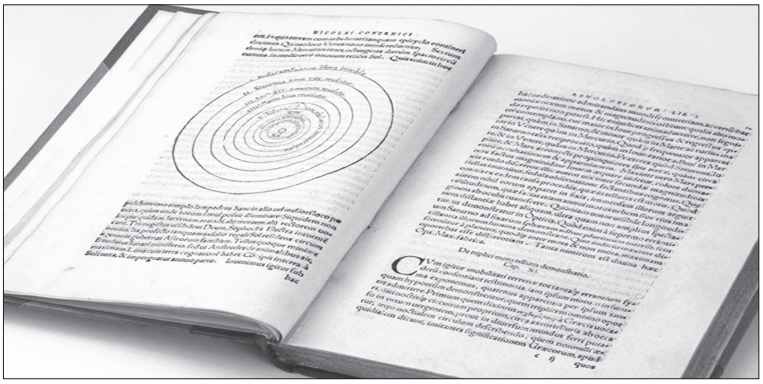

Figure 2. One of the first copies of Copernicus's famous treatise titled *De revolutionibus orbium coelestium* ("On the Revolutions of the Heavenly Spheres"), with a schematic diagram of his heliocentric theory; source: https://goaravetisyan.ru/bs/chto-sluchilos-s-kopernikom-kto-takoi-kopernik-nikolai-kopernik/

in the last hours of his life, in 1543, he "stopped the Sun, moved the Earth" and "turned the whole science of astronomy upside down" [3, 6, 10] (Figure 2).

In such context, in *De Revolutionibus orbium coelestium* (into English it is also translated as "On the Revolutions of Haevenly Bodies") Copernicus said: "At the middle of all things lies the Sun. As the location of this luminary in the cosmos, that most beautiful temple, would there be any other place or any better place than the centre, from which it can light up everything at the same time? Hence the Sun is not inappropriately called by some the lamp of the universe, by others its mind, and by others its ruler" [12]. In the intended Preface of the same book, Copernicus also noted: "Perhaps there will be babblers who, although completely ignorant of mathematics, nevertheless take it upon themselves to pass judgement on mathematical questions and, badly distorting some passages of Scripture to their purpose, will dare find fault with my undertaking and censure it. I disregard them even to the extent as despising their criticism as unfounded" [11, 12]. It was the very beginning of the Scientific Revolution (the so-called Copernican Revolution), which has been fundamental for understanding the real nature of matter and space and further development of the modern concept of science, philosophy, and religion [3, 4, 7, 8, 10].

Although most people did not believe Copernicus, and despite the fact that his book was on The Catholic Church Index of Forbidden Books (in Latin, *Index Librorum Prohibitorum*) from 1616 until 1835, Copernicus inspired scientists, such as Tycho Brahe (1546–1601), Johannes Kepler (1571–1630), Galileo Galilei (1564–1642), and Isaac Newton (1642–1727) [2, 3, 7, 11]. From that moment, thanks to the revolutionary work of Copernicus, his successors continued to strengthen evidence-based science by means of observations, mathematical measurements, and logical arguments [2, 4, 7]. Among a plenty of published data regarding Copernicus's outstanding contributions to the development of human civilization, it seems that German writer Johann Wolfgang von Goethe has been the most concise when he wrote the following: "Of all discoveries and opinions, none may have exerted a greater effect on the human spirit than the doctrine of Copernicus … In its converts it authorized and demanded a freedom of view and greatness of thought so far unknown, indeed not even dreamed of" [1]. Noteworthy, Copernicus's fame is not referred only to the field of astronomy [8]. This Renaissance polymath was also a canon, mathematician, jurist, and a practicing physician, as well as an economist, classical scholar, polyglot, writer, translator, cartographer, governor, administrator, military leader, and a diplomat [3, 10, 13].

A BRIEF BIOGRAPHY

Copernicus was born on February 19, 1473 in Torun (in Polish, *Torún*), a major port on the Vistula River [1, 3]. Before Copernicus's birth, this northern trading city belonged to the Prussian Confederation [5]. However, after the Thirteen Years' War against the Teutonic Order, according to the Second Treaty of Torun in 1466, the so-called Royal Prussia, consisting of Torun and the western region of Prussia, became a part of the Kingdom of Poland [3, 5, 10].

Copernicus's father, also named Mikolaj Kopernik, grew up into a family of prosperous copper traders in Cracow (in Polish, *Kraków*), the capital of Poland at the time [1, 5]. It is speculated that there is a link between the word 'copper' and the family name Kopernik [3]. In 1460, Copernicus's father left Cracow and went to Torun, where he was a copper trader, as well as a civic leader and a magistrate [12]. Three years later, Mikolaj Kopernik married Barbara Watzenrode, who came from a rich family of merchants and municipal officials from Torun [3, 5, 12]. They had two sons (Andreas and Nicolaus) and two daughters (Barbara and Katharina), of whom Nicolaus Copernicus was the youngest child [3, 12].

When Nicolaus was only 10 years old, his father passed away [12]. In such circumstances, his uncle, Lukas Watzenrode, a thoroughly educated man and the future Bishop of Warmia (in German, *Ermland*), took care of his nephews and cousins [1, 3, 5, 10]. Nicolaus and Andreas completed their elementary education in Torun [3, 12]. In 1488, at the age of 15, Copernicus continued his education at the cathedral school of Wloclawek [12]. The teacher of Copernicus was Mikolaj Wodka (1442–1494) of Kwidzyn, called Abstenius, a famous Polish physician and astronomer [14]. After three years of study there, Copernicus enrolled at the Cracow Academy (today the Jagiellonian University), where he obtained a good standard academic training (*facultas artium*) [1, 10, 14]. Shortly thereafter, in the autumn of 1496, thanks to the support of his eminent uncle, Copernicus went to Italy to improve his academic learning at the most prestigious universities at the time [1, 10]. In such context, he studied canon and civil law in Bologna (1496–1501) and medicine in Padua (1501–1503), which he combined with receiving the degree of Doctor of Canon Law in Ferrara (1503) [10].

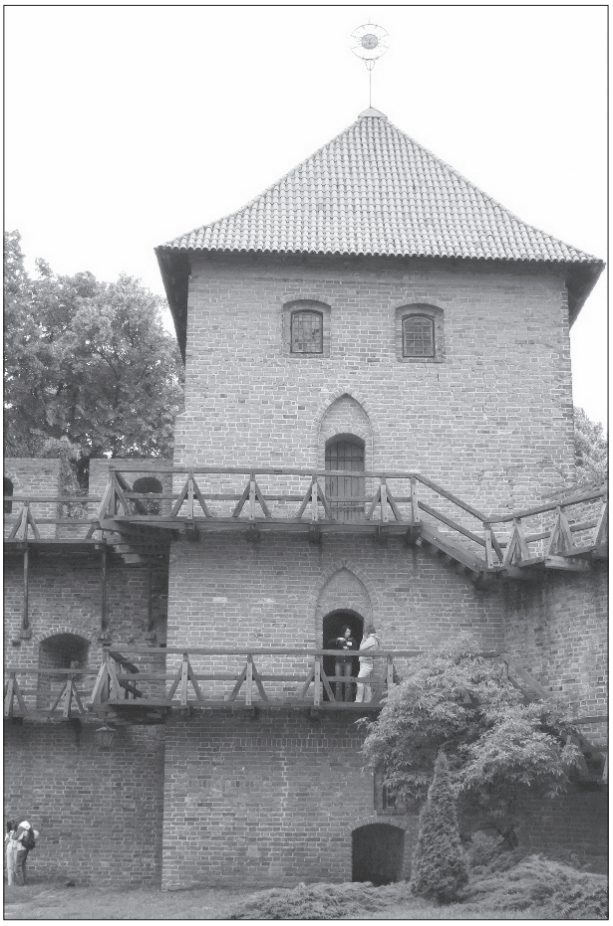

Figure 3. Tower of Nicolaus Copernicus at Frombork, reconstructed since World War II; source: https://en.wikipedia.org/wiki/Copernicus_Tower_in_Frombork.jpg

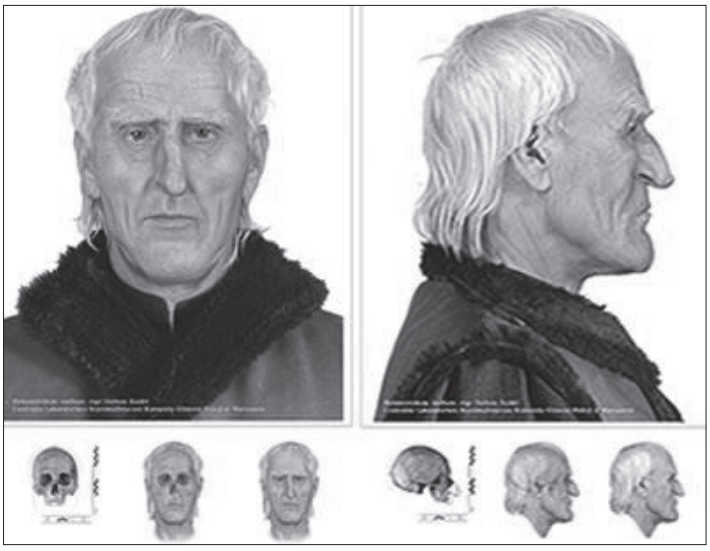

Figure 5. Reconstruction of Copernicus's appearance (2005); source: https://www.vreme.com/mozaik/lobanja-iz-groba-broj-trinaest/

In 1503, Copernicus returned to the northern Warmia region and rejoined his uncle in the Bishopric Palace in Heilsberg (in Polish, *Lidzbark Warminski*) [1]. He spent several years there, predominantly working as secretary and personal physician of his uncle [10]. After his uncle's death in 1512, Copernicus left Lidzbark Warminski residence and moved to Frauenburg (in Polish, *Frombork*), where he spent the rest of his life as the canon of the cathedral [1]. Simultaneously, he took care of administrative and diplomacy matters of the diocese [5]. In March of 1513, Copernicus built an observation tower near the cathedral [1] (Figure 3). There, next almost 30 years, he observed celestial bodies with neverending passion [1, 3].

By 1543, Copernicus was suffering from the consequences of a severe stroke [11]. He was paralyzed on his right side and in addition to his body, his mind was also deeply affected [1]. As it is previously noted, Copernicus received a copy of his printed masterpiece *De revolutionibus* on his deathbed [11] (Figure 4). "Before closing his eyes for the last time, Copernicus was able to gaze for a moment at the book which was to ensure his immortality" [15]. He died at the age of 70, on May 24, 1543. Bishop Tiedeman Giese describes last moments of his best friend: "He suddenly became ill, with blood flowing profusely from his mouth, followed by a paralysis of his right arm and the right side of his body. Death came quickly, as Copernicus himself had predicted" [15].

Figure 4. Death of Nicolaus Copernicus painted by Aleksander Lesser (1814–1884); source: https://en.wikipedia.org/wiki/File:Death_of_Nicolaus_Copernicus.PNG

Copernicus was buried in an unmarked tomb beneath the floor of the Frombork Cathedral, as was common practice at the time [11]. Since the majority of over 100 graves in this cathedral are unmarked, every search for the exact place of Copernicus's grave failed for over two hundred years [16]. Finally, in 2004, Copernicus's biographer Jerzy Sikorski and archeologist Jerzy Gassowski thought that place around the St. Cross Altar could be important for the beginning of a new search of Copernicus's grave, as Copernicus was in charge of this altar

during his priestly service [16, 17]. Indeed, in 2005, in tomb number 13 near the St. Cross Altar, an incomplete skeleton was found [17]. After facial reconstruction, it was postulated that the remains of Copernicus's body have been discovered [16, 17] (Figure 5).

In order to prove it, mitochondrial (mt) and nuclear DNA analyses of the skeletal remains were performed. The mtDNA profiles obtained from three upper molars and the femurs were identical, indicating that the remains belong to the same person. Identical mtDNA profiles were also found in two hairs that were tucked in the pages of a book called *Calendarium Romanium Magnum*, written by a German mathematician and astronomer Johannes Stöffler. This book, that Nicolaus Copernicus had used for many years, currently may be seen in the Museum Gustavianum in Uppsala in Sweden [16].

On May 22, 2010, human remains of Nicolaus Copernicus were reburied ceremonially in the Archcathedral Basilica in Frombork [11].

COPERNICUS'S MEDICAL EDUCATION

The University of Padua was founded in 1222 [18]. Although it was a catholic university, it attracted students from all over the known world due to its tolerant approach and respect for religious and political liberties (*Universa Universis Patavina Liberta* – Paduan freedom is universal for everyone) [14, 19]. Students participated in elections of the deans [14]. They also chose their professors and approved the statutes [14, 19]. The Medical School of this university, opened in 1250, was considered as the best center for medical education in Europe [19].

In October 1501, Copernicus enrolled at the Paduan School of Medicine [15]. At that time, the study of medicine lasted three years [14]. Theoretical Medicine, based on Book I of the *Canon of Medicine* by Avicenna, *Aphorisms* by Hippocrates, and *Tegni* by Galen, was the most important subject in the curriculum [14, 19]. In order to obtain practical knowledge, it was obligatory to read the text about fever (*De febribus*) from Book IV of Avicenna's *Canon of Medicine*, as well as two texts regarding specific diseases ("Specific diseases between the head and the heart" – *De morbis particularibus a capite usque ad cor* and "Specific diseases below the heart" – *De morbis particularibus a corde infra*) from Book III of the Avicenna's *Canon of Medicine* [15, 19]. Book IX of *Almansor* by Rhazes was also a part of the practical medical training [19]. After two years of study, students were qualified for a bachelor's degree, while three years of study was obligatory for a doctorate [15]. Additionally, a training period under a colleague with experience, which lasted one year, was necessary for a degree of licentiate [14, 15].

It is known that Copernicus's professors of Theoretical Medicine were Girolamo de Urbino, Philippo Pomodora, and Girolamo Pindemonte, while Giovanni d'Aquila gave him instructions in practical medicine [15]. Copernicus attended lectures by eminent anatomists, Marco Antonio della Torre (1481–1511) and Gabriele Zerbi (1486–1505) [15], as well as famous anatomist and surgeon, Alessandro Benedetti (1450–1512), who built the first wooden anatomical theatre [18]. Professor Benedetti performed dissections personally there [20]. His medical textbook *Historia corporis humani sive anatomice* ("The history of the human body") published in 1493 was very popular among the students [18, 20]. According to the curriculum of the Paduan School of Medicine, at Copernicus's time, each senior student had to participate in public dissections once a year [21].

Copernicus also attended lectures by Girolamo Fracastoro (1478–1553), who taught logic [22]. This illustrious physician, philosopher, astronomer, mathematician and poet is recognized as one of the founders of modern pathology and epidemiology since he believed that infections were induced by disease-carrying germs [15, 22]. Professor Fracastoro also believed that these germs could be transmitted by air or contact [22]. Unfortunately, his ideas were not accepted [15, 22]. Noteworthy, he wrote an epic poem about syphilis, in which he for the first time used the word 'syphilis' to designate the so-called "French disease," a common incurable disease in Europe at that time [14, 22].

It seems that Copernicus's masters were prominent mathematician and physician Pietro Trapolini, and famous hygienist and anatomist Bartolomeo da Montagna Junior [14].

Copernicus studied medicine in Padua very seriously [15, 21]. Therefore, he purchased the following medical textbooks: *Super quarta Fen primi Canonis Avicennae* by Hugo Senensis (1485), *Practica medicinae* by Joannes Michael Savonarola (1486), *Practica siue Philonium* by Valescus Tarenta (1490), *Liber pandectarum medicinae* by Matthaeus Silvaticus (1498), and *Chirurgia magistri* by Pietro de Argelatta (1499) [21]. On the margin of one of his medical treatises, Copernicus wrote this note: "Remember this, Doctor! Avicennas saying that ignorance leads to manslaughter is true…" [13, 21].

Since archives of the Paduan School of Medicine for the period 1503–1507 have been destroyed, there is no possibility to check if Copernicus obtained the degree of doctor of medicine [15]. However, it is hard to believe that Copernicus practiced medicine without possessing his doctorate, having in mind the strict conditions governing the practice of medicine in Warmia [14, 15]. In such context, in a letter from Duke Albrecht of Prussia, Copernicus is designated as a doctor of medicine [14]. Similarly, in 1581, Marcin Kromer, the famous Polish historian and Bishop of Warmia, placed a commemorative plaque in honor of Nicolaus Copernicus, *artium et medicinae doctor*, opposite the cathedral in Frombork [14, 15]. In addition, the portrait of Nicolaus Copernicus painted by Tobias Stimmer shows him holding a sprig of lily-of-the-valley – a symbol of the medical profession [14, 15, 21] (Figure 6).

During his therapeutic practice, Copernicus continuously kept expanded his medical knowledge [15, 21]. Thus, 14 books that dealt with medical issues were found in his personal library [23], including *De praeparatione hominis* by Hippocrates, *De affectorium locorum notitia* by Galen, *Breviarum practicae medicinae* by Bartholomeus de Montagne (Venice, 1499), and *Practica in arte chirurgica* by Joannis de Vigo (1516) [14].

Figure 6. The portrait of Nicolaus Copernicus with lilly-of-the-valley painted by Tobias Stimmer, 1587; it is the oldest graphic image of the illustrious scientist; source: https://en.wikipedia.org/wiki/Nicolaus_Copernicus

COPERNICUS'S MEDICAL PRACTICE

Copernicus was an experienced physician, full of self-sacrifice and honesty in dealing with his patients [14]. However, he paid special attention to the poor, supplying them with free medical advice, assistance and medicines [14, 15]. Polish historian Szymon Starowolski in his book *Scriptorum Polonorum Hecatontas* wrote that "Nicolaus Copernicus was respected as the second Aesculapius, because he knew various medicines, tried them, prepared them himself and used them with success. The poor people worshiped him as some kind of God" [14]. In the historical-documentary drama titled *Copernicus*, written by Miodrag Ilić, Copernicus is described as a man "whose calm and serious face, long black hair and steely patience in his look, voice and movement reveal spiritual maturity and inner strength" (Figure 1) [24]. In this drama, he remained faithful to the Hippocratic Oath even during the attack of the Prussian army, when he gave birth to the wife of a peasant Tadeusz [25].

In addition to his uncle, bishop Lucas Watzenrode, Copernicus treated four consecutive Warmian bishops (Fabianus Lusianus, who suffered from severe chronic diseases, Mauritius Ferber, troubled by digestive disorders, gout, and nephrolithiasis, Joannes Dantiscus, and Tiedemann Giese, who suffered from malaria and infections of the upper respiratory tract) [14, 21, 26]. He was also a physician of the Frombork's canons, such as his leprous brother Andreas, who was forced to leave Frombork and died in Italy in 1518 [21, 26], as well as Felix Reich, troubled by severe hemorrhages in 1538 [21]. Copernicus provided medical assistance to the relatives of his fellow canons as well [21, 26]. Thus, on February 24, 1532, Copernicus made a prescription with drugs for the stomach for the seriously ill sister of a canon Archacy Freundt [26]. Besides, he was always at the disposal of the patients of the Holy Spirit in Frombork [21].

Copernicus's medical fame crossed the borders of Frombork, so he frequently traveled to Gdańsk and Allenstein (in Polish, *Olsztyn*), providing consultations to the Dukes of Prussia [15]. Copernicus also collaborated with his colleagues from Gdańsk, Olsztyn, Königsberg (in Polish, *Królewiec*), Lubawa, and Elblag [13]. In the most difficult cases, Copernicus asked for medical advice from other distinguished physicians, including Laurentius Wilde and Jan Benedict Solfa, the official physicians to the Polish King Sigismund the Old I (in Polish, *Zygmunt Stary*) [21].

In 1541, when Copernicus received the urgent request of Prince Albrecht Hohenzollern, ruler of Ducal Prussia, regarding treatment of his sick friend, the Prince Counselor Georg von Kunheim, it was undoubtedly the peak moment of Copernicus's medical practice [15, 26]. Interestingly, Prince Albrecht was the same person who, as the great master of the Teutonic Order of Prussia, tried to conquer Olsztyn during Teutonic wars 1519–1521 [26]. At the time, in 1516, Copernicus, as the administrator of the chapter's estates, had a residence in the castle of Olsztyn [27]. In 1520, Copernicus, as a commissioner of Warmia, was nominated by the chapter to negotiate with Albrecht Hohenzollern [12, 27]. Regarding this matter, Copernicus wrote to king Sigismund I the Old that he "would act as befitted noble and honourable citizens faithful to the king, and was even prepared to die for the cause" [27]. He decided to built additional fortifications at the castle of Olsztyn [12, 27]. In that way, Copernicus stopped the invasion of the Teutonic troops [27]. However, times had changed. After a short period of time, the Teutonic order in Prussia ceased to exist, and in 1525, the great master become a secular prince in Prussia [26]. As aforementioned, in 1541, Prince Albrecht wanted to save the life of his seriously ill friend [15], and Copernicus was the sixth physician whom the Prince Albrecht asked for help. It was not surprising, because Georg von Kunheim had a malignant tumor on his neck and all efforts of other physicians to improve his condition failed. Therefore, Copernicus at the age of 68 decided to go to Königsberg. Prince Albrecht expressed his gratitude that the chapter allowed "especially pleasant to him master Nicolaus Copernicus, the doctor of medicine" to travel so far and that "in such an old age" [26]. Copernicus spent over three weeks at the bedside of the patient [15, 26]. When he come back to Frombork, he asked for an opinion from royal physician Jan Benedict Solfa [28]. Later, Copernicus sent opinion of his colleague to Prince Albrecht. In such context, on June 21, 1541, Copernicus wrote to prince Albrecht: "To the serene and honorable Prince Albrecht, by the grace of God margrave of Brandenburg, Duke of Prussia and Wendland, burgrave of Neuenburg, and Prince of Rügen, my gracious Lord: Just yesterday I received from Jan Benedict Solfa, the physician

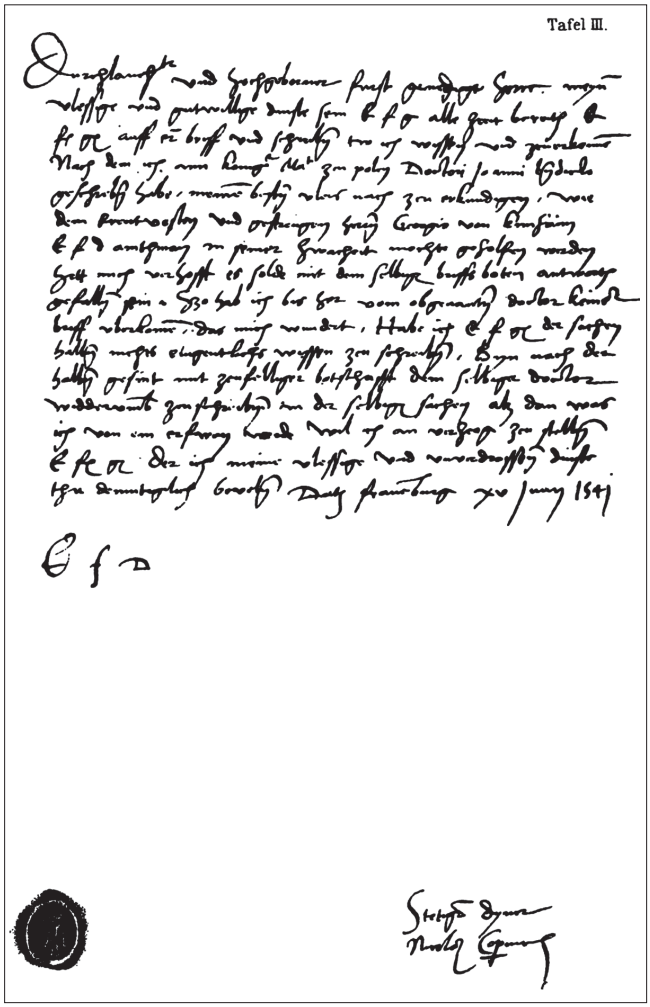

Figure 7. German-language letter from Copernicus to Duke Albrecht of Prussia with medical advice for Georg von Kunheim (1541); source: https://en.wikipedia.org/wiki/File:Copernicus-an-Herzog-Albrecht.png

of his Majesty the King of Poland, a letter and an answer to my message about honorable Georg von Kunheim. But since no mention is made therein of any other special or extraneous matters, I have forwarded the original letter to your Princely Grace. From it your Princely Grace will learn this doctor's opinion and advice. If I knew anything better to contribute there to that would be helpful in restoring that good man, Princely Grace's officer, to health, no labor, exertion, and trouble would be vexatious to me that would be beneficial to your Princely Grace, to whose service I am devoted. Your Princely Grace's obedient servant, Nicolaus Copernicus" (Figure 7) [28]. Georg von Kunheim died in September 1543, at the age of 53 [26].

Books from Copernicus's private collection are of particular interest for investigating his medical practice, since he used to leave hand-written prescriptions on their margins and blank pages [15]. Thus far, 14 prescriptions in accordance with mediaeval knowledge and practice written by Copernicus have been found [26]. Most of them were used for the treatment of renal disorders [23, 26]. For that purpose, Copernicus often prescribed drugs used by Avicenna [23], and also wrote out herbal remedies described in the widely accepted book *De materia medica* by Dioscorides [14]. In order to treat renal colic and hematuria, Copernicus used herbal ingredients, such as nettle (*Urtica dioica*), goosegrass (*Galium aparine*), rosemary (*Rosmarinus officinalis*), cubeb (*Piper cubeba*), common pumpkin (*Cucurbita pepo*), almond seeds, etc. [23].

In the library of the University of Uppsala in Sweden, one can see on a margin of a Euclides's book typical example of an expensive prescription by Copernicus [14, 15]. This prescription consisted of 21 components of animal, vegetable, and mineral origin, in combination with precious stones and metals (powdered gold, silver, emerald, sapphire, and coral) [15].

Copernicus also believed in simple traditional remedies, as well as medicines based on his own experience [14, 15, 21]. For example, he prescribed cloves with honey against cough, and cloves with warm red wine against diarrhea [14]. On the other hand, Copernicus never prescribed drugs whose components were obtained from urine, frogs, snakes, bats, animal claws, etc. [21].

In 1519, Copernicus successfully struggled against epidemics [13, 14, 15]. Namely, he constructed an innovative drinking-water supply system for Warmian population [14, 15]. With profound gratitude, Copernicus's fellow citizens engraved on the watermain in Frombork a poem with the following verse: "His wisdom has given to men what nature had denied them" [15].

Published data indicates that Jan Brożek, the most prominent Polish mathematician of the 17th century, was in a position to read Copernicus's correspondence and notes [15]. According to his reports, Copernicus investigated an analogy between human body and the mechanics of Archimedes, in order to apply mathematics in medical practice [14, 15]. Unfortunately, the reports quoted by Brożek have been lost, so there is no way to know more details regarding this Copernicus's idea [15].

CONCLUSION

The main interest of Nicolaus Copernicus was reflected in the heliocentric planetary system. His autography "On the Revolutions of Haevenly Bodies" has changed the way people saw the universe and was inscribed on the UNESCO Memory of the World Register in 1999. In addition, Nicolaus Copernicus permanently developed a growing interest in medicine and was a prominent and beloved physician. This aspect of his life also deserves to be remembered.

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Никола Коперник и медицина – 550 година од рођења и 480 година од смрти научника који је преокренуо поглед на свет

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САЖЕТАК

Ове године се навршава 550 година од рођења и 480 година од смрти Николе Коперника, међународно признатог оца модерне астрономије, који је „зауставио Сунце, покренуо Земљу" и преокренуо поглед на свет. Међутим, слава Николе Коперника се не односи само на области астрономије, математике, црквеног и цивилног права, као и на теологију, економију и дипломатију; овај ерудита из доба ренесансе је такође био и један од најцењенијих лекара практичара у то време. Важно је истаћи да је Никола Коперник посебну пажњу посвећивао сиромашним људима, пружајући им бесплатне медицинске савете, помоћ и лекове. Стога се наш рад бави овим мање познатим аспектом живота славног научника.

Кључне речи: Никола Коперник; медицинско образовање; медицинска пракса; историја медицине