

Identifying Nicolaus Copernicus' remains

# Finding the Astronomer



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**In Copernicus' day, canons were buried under the altar where they served Mass. As such, the altar of St. Andrew in Frombork cathedral was a natural starting point for researchers looking for the great astronomer's grave.**

Even Napoleon wished to find Copernicus' tomb, with his officers commencing the search in 1807. Earlier attempts had been made by members of the Warsaw Scientific Society; the search was later renewed again by the Germans during WWII. The mystery was finally solved by research carried out by archaeologists from Prof. Jerzy Gąssowski's team from the Pułtusk Academy of Humanities, which commenced in 2004.

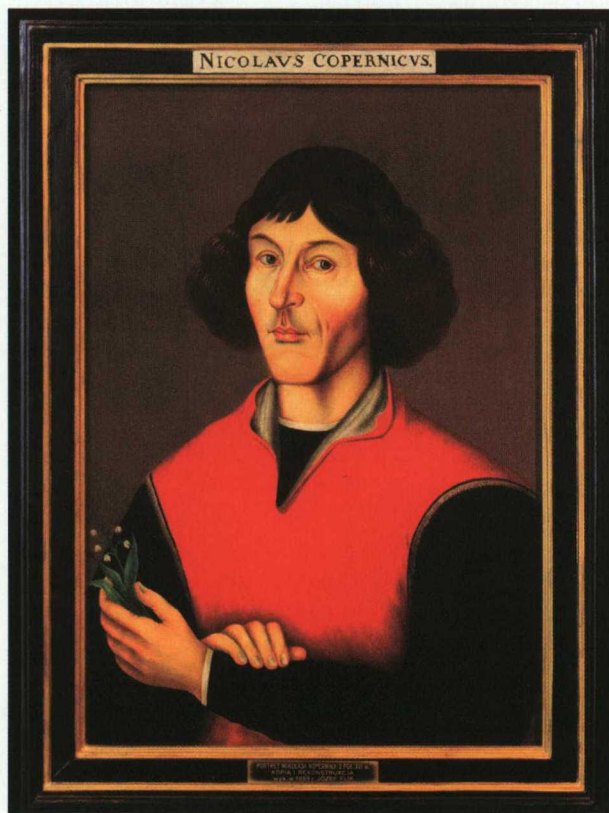
## Initial clues

Archaeologists started with the assumption that Copernicus' body must have been buried in one of the over 100 unmarked graves in the Frombork cathedral, where he served as one of 16 canons. Analysis of historical sources carried out by Dr. Jerzy Sikorski from Olsztyn allowed the researchers to significantly narrow their search. There were almost twenty tombs under the altar in question; the last of the 13 that were examined revealed an incomplete skeleton of a man who had died aged between 50-70 years old. This was at least a clue pointing in the right direction, since Copernicus is believed to have likely reached 70 years of age. The archaeologists next sought help from anthropologists and forensics scientists. Deputy Inspector Dariusz

Zajdel from the Central Forensics Laboratory of the National Police Headquarters in Warsaw prepared an approximate image of the face based on the recovered skull. The result was reminiscent of some of the astronomer's portraits, although this too was certainly not sufficient evidence that the skeleton really was that of Copernicus.

## Help from a zoologist

We heard about these archaeologists' difficulties on the radio. We had recently been doing genetic research on fossil bats, and it seemed that a similar method could prove effective in this case. Dr. Marta Gajewska from the PAS Museum and Institute of Zoology also took an interest in the project. We have one of the most modern genetics laboratories in Poland and have been increasingly working with fossil DNA. I called up Prof. Jerzy Gąssowski to offer our help in defining the genetic profile of the remains. Initially skeptical, the professor eventu-



**The reconstructed facial appearance based on the skull found by archaeologists was reminiscent of certain portraits of Nicolaus Copernicus**





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Scholars had searched for the tomb of the great Polish astronomer in Frombork for many years

ally called me back six months later. The genetic analysis was done by three separate teams, including two from Poland. Our team from the PAS Museum and Institute of Zoology worked alongside Wojciech Branicki and Dr. Tomasz Kupiec from the Institute of Forensic Sciences in Kraków and Dr. Marie Allen and her team from the Department of Genetics and Pathology at Uppsala University in Sweden. The three laboratories carried out their analysis work independently, in observance of all appropriate control procedures.

Genetic analysis indicated that the man's ancestors on his mother's side may have originated from Silesia. Moreover, he was likely to have had blue or grey eyes, while Copernicus is depicted in portraits as having brown eyes. Polish geneticists had been the first in the world to use a genetic method of identifying eye color by analyzing a mutation in the *HERC2* gene. This mutation is present in over 80% of people with blue or grey eyes, but in less than 20% of those with eyes of a darker color.

### Useful loot

When trying to identify a person, the best comparative material is DNA of their relatives. In order to find out if the skeleton really was that of Copernicus, it was necessary to compare its genetic material to that of a known Copernicus family member, ideally on his mother's side; this is because analysis of mitochondrial DNA, inherited maternally, facilitates precise comparisons. Attempts at finding the grave of Copernicus' uncle - Bishop Watzenrode, whose mtDNA

should have matched that of his nephew's - were unsuccessful. Since no other relatives were found, the search was suspended. However, the Swedish team had the idea to analyze some of the items that had been carried off to Sweden as loot during the Polish-Swedish wars from the 17th century, including the astronomical calendar from Copernicus' library, which was taken to Uppsala and has been held in a museum there. The calendar was chosen for particular scrutiny because it had been owned by Copernicus for

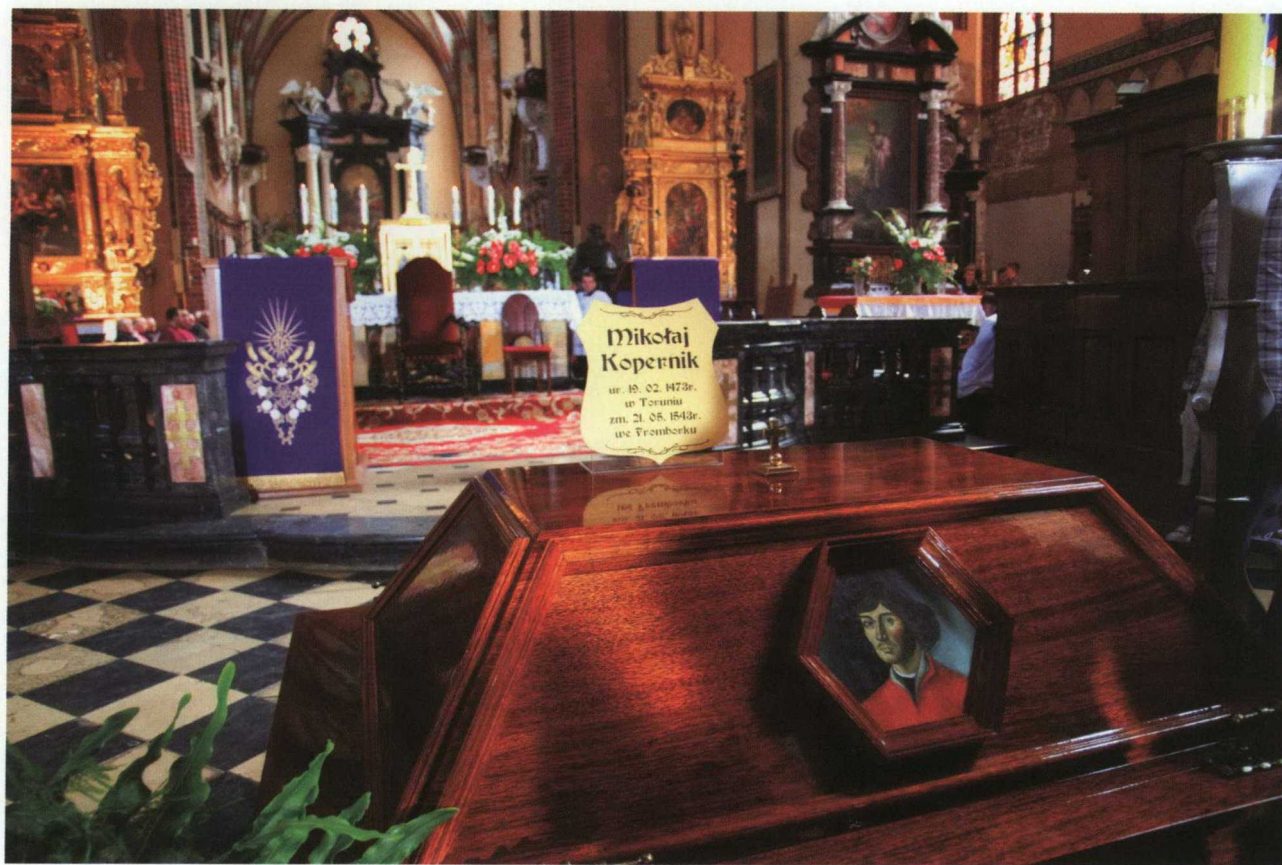


David Castor

Swedish researchers had the idea to analyze one of the items that had been looted during the Polish-Swedish wars: a calendar from Copernicus' library, now held in an Uppsala museum



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Thanks to the efforts of Polish and Swedish researchers, Copernicus received a second burial after 467 years

around 25 years, and its pages bear notes made by the astronomer. The researchers were able to find and secure nine hairs nestled deep between the pages. This brought a major breakthrough: a genetic profile was obtained for four of those hairs, and this material was used in comparative analysis. The genetic profile of two of the hairs matched that of the remains discovered in Frombork.

### Almost 100% certain

Researchers have previously used genetic analysis to identify the remains of Petrarch and the family of Tsar Nicholas II. Our research used the analysis of hypervariable fragments of mtDNA, which provide highly accurate identification of historical figures. The mitochondrial genome is present in thousands of copies in all our cells. This type of DNA, routinely used in forensics and identification of missing persons, has a very useful feature: it does not undergo recombination, and this fact guarantees high precision of analysis. The best reference base of mtDNA sequencing is EMPOP, which holds 3830 sequences from western Eurasia; four were revealed to be identical to that of the remains we studied. This means that a sequence matching that of the cathedral remains can be found in 1 in 500 unrelated people. However, we decided to broaden the interpretation in our studies. Prof. Tomasz Grzybowski from the Institute of Molecular and Forensic

Genetics at Collegium Medicum at the Nicolaus Copernicus University used his own database of nearly 32,000 mtDNA sequences (8 times more than those from the EMPOP database) from various populations of western Eurasia. It turns out that if we limit our search to Central and Eastern Europe, a profile matching that of the Frombork cathedral remains occurs in only 1 in every 1000 people.

The DNA analysis used by the Swedish and Polish researchers raises no doubts in international scientific circles, and it is commonly used by justice systems in many countries. Combined with the results of other anthropological, historical, and archaeological analyses, these results allow us to conclude with almost 100% certainty that the remains are indeed those of the great astronomer. Therefore, 467 years after his initial, modest burial, Copernicus was buried once again, this time with much ceremony. ■

### Further reading:

- Bogdanowicz W., Allen M., Branicki W., Lembering M., Gajewska M., Kupiec T. (2009). Genetic identification of putative remains of the famous astronomer Nicolaus Copernicus. *PNAS*. 106 (30), 12279-12282.
- Gingerich O. (2009) The Copernicus grave mystery. *PNAS*. 106 (30), 12215-12216.
- Gąsowski J. (2010) *Spotkanie z Kopernikiem. Kulisy odkrycia*. [Meeting Copernicus: A Story of Discovery]. Toruń: Wydawnictwo Adam Marszałek.