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# On the defectiveness of the argument for the finality of the discovery of the remains of Nicolaus Copernicus.

## Part 2: Results and interpretation of genealogical, historical and genetic research<sup>1</sup>

### Abstract

The article presents a comprehensive critique of the argument in favour of the discovery of the remains of Nicolaus Copernicus. It analyses the arguments based on genealogical, historical and most of all genetic considerations, including the mathematical fundamentals of estimation a random match of mtDNA profiles.

The following assertion results from the presented criticism: Based on the results provided by the team of Jerzy Gąssowski, it is not possible to reasonably claim that the grave of Nicolaus Copernicus was discovered. Therefore, this research should be continued in order to increase the strength of the argument and obtain new evidence.

**Keywords:** Nicolaus Copernicus, Copernicology, likenesses of Copernicus, Copernicus's ethnicity, genealogy, mtDNA, Y-DNA, mtDNA and Y-DNA population bases, methods for estimating the probability of a random match of mtDNA profiles for the general case and the extreme cases, genetic genealogy, ethnogenesis of Slavs and Germans, ethnic origin of the population of Silesia, ethnic origin of the Toruń burghers, methodology of interdisciplinary research.

<sup>1</sup> The following article was peer-reviewed by: Professor Karolina Targosz, Habilitated Doctor in Humanities (Ludwik and Aleksander Birkenmajer Institute for the History of Science, Polish Academy of Sciences) – the historical issues and the iconography of Copernicus; Professor Tadeusz Dobosz, Habilitated Doctor in Medical Sciences – the issues of DNA analyses (Department of Molecular Techniques, Chair of Forensic Medicine, Faculty of Medicine, Medical Academy in Wrocław; a member of the Forensic Genetics Commission of the Polish Society of Forensic Medicine and Criminology); Rev. Zbigniew Liana, PhD (Chair in Natural Philosophy, Philosophical Faculty, The Pontifical University of John Paul II in Kraków) – methodological issues.

This text develops a part of the theses outlined in the paper “The procedure of identification of the remains no. 13/05 as the remains of Copernicus in the light of rationality of reasoning and



## 1. Introduction

“According to the authors of the search for the grave of Nicolaus Copernicus for the discovery of this grave and the remains of this great thinker speak the irrefutable, consistent scientific arguments of varied nature:

1. In-depth reading of historical sources.
2. The results of the archaeological and anthropological-anthroposcopic research.
3. The comparison of the skull 13/05 with the portraits of Copernicus.
4. The comparison of the facial reconstruction from the skull 13/05 with the portraits of the astronomer.
5. The knowledge of the facts regarding the ethnicity of the population of Silesia and Toruń in 13<sup>th</sup>–14<sup>th</sup> century and the parents of Copernicus and Copernicus himself.
6. The knowledge of the history of the manuscripts of Copernicus’s writings and his personal library.
7. The results of the genetic research into the alleged remains of Copernicus and the hairs from the book by Johannes Stöffler (*Calendarium Romanum magnum, Caesariae maiestati dicatum*), which for a quarter of a century was used by the astronomer, including:
  - a) the comparison of the result of the analysis of HERC2 gene (determining eye colour) with the portraits of Copernicus;
  - b) proper understanding of the methods of statistical analysis of genetic data;
  - c) the knowledge of the mtDNA and Y-DNA population databases.

However, in the light of the detailed interdisciplinary analysis carried out by the author of this article, it appears that despite the public-wide acceptance of the argument presented by the authors in favour of the thesis of the ultimate discovery of the remains of Nicolaus Copernicus this argument *is flawed* for many relevant reasons” (Kokowski 2012b, pp. 179–180).

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the rhetoric of persuasion” (delivered at the conference “The secret grave of Nicolaus Copernicus. Dialogue of experts”, Kraków, 22–23 February 2010) and the paper “The search for the grave of Copernicus. Reflections of *Advocati diaboli*” (delivered during the “Copernicus Center Colloquium” # 1, Kraków, 20 March 2009). This text is also a supplement of my previous article entitled “About defectiveness of argument for the ultimate discovery of the remains of Nicolaus Copernicus. Part 1: Results and interpretation of historical, archaeological, anthropological and anthroposcopic research”, published in this volume. The topics discussed here will be developed in more detail in a separate comprehensive interdisciplinary monograph, to which the interested reader is referred now.

## **2. Thematic scope**

In the previous article published in this volume I synthetically explained the deficiencies of the evidence so far presented regarding the first, the third, and the fourth of the above issues. In this article I will focus on the analysis of the issues from the fifth to the tenth on the list.<sup>2</sup>

## **3. The failure of the quest for Copernicus's relatives**

The following constituted very important parts of the programme of the search for the alleged remains of Nicolaus Copernicus:

1. Extensive genealogical research into the relatives of Copernicus in maternal and paternal lineages.
2. The search for the remains of Copernicus's relatives, which – in the absence of any knowledge about the potential location of the graves of other members of the immediate family of Copernicus – was limited only to the search for the tomb of bishop Watzenrode.

The genealogical research into the relatives of Copernicus in maternal and paternal lineages was carried out by a team of researchers, which consisted of Prof. Krzysztof Mikulski, Habilitated Doctor, Joanna Jendrzewska, MA, and Anna Stachowska, MA. It is an undisputed fact that these studies have yielded many important and valuable results. However, thanks to the research so far carried out, the family tree has been determined only to the mid-eighteenth century (cf. Mikulski 2008; Jendrzewska, Stachowska 2008; Mikulski, Jendrzewska, Stachowska 2010).

On the other hand, the search for the tomb of bishop Watzenrode was carried out by the team of archaeologists, which consisted of, among others, Prof. Jerzy Gąssowski, Habilitated Doctor, Beata Jurkiewicz, MA and Dr. Ryszard Cichocki.<sup>3</sup> These works were targeted by the previous analysis of historical sources made by Dr. Jerzy Sikorski (Sikorski 2008).<sup>4</sup> Unfortunately, despite the efforts made, the search did not yield a positive result.

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<sup>2</sup> Cf. Kokowski 2012b, chapter 2. Incidentally, I would like to add that my interest in the subject of the assessment of the value of DNA typing methods conducted stems from my genealogical research. In the context of these studies, natural questions appeared: To what extent, in mathematical sense, are the results of the analyses of the DNA profile valid? How detailed must the analysis of the DNA profile be so that it does not lead to wasting (great!) sums of money?

<sup>3</sup> Cf. Gąssowski 2008b; Cichocki 2008.

<sup>4</sup> Let me add that I formulated myself the working hypothesis that we should look for the grave of bishop Watzenrode in the chancel near the main altar (cf. Kokowski 2005a/2007a; 2005b/2007b –

#### 4. Lack of an independent test of the discovery

Finding the relatives of Nicolaus Copernicus (living or deceased) was an important element of the programme of the search for his burial, because it would lead to gaining genetic material that would be used to test the kinship with the genetic material of Nicolaus Copernicus. This test would simultaneously be a test for the results obtained so far by Gąssowski's team (that is the comparison of the skull 13/05 and the facial reconstruction by D. Zajdel with the portraits of Copernicus).

The failure in finding relatives meant it was impossible to conduct the DNA parentage testing. Thus, at this stage of the research one could not see any possibility of strengthening the argument for the discovery of the tomb of Copernicus. The output of this stalemate situation – in accordance with the assurances made by the authors of the search and a large group of their spokespeople – resulted in collaboration with Swedish researchers.

#### 5. Swedish breakthrough in the research

On the initiative of Władysław Duczko,<sup>5</sup> Habilitated Doctor (an archaeologist and a historian expert in the first millennium of the European history, employed at the University of Uppsala since the 1980s and at the Pułtusk Academy of Humanities since 2004), Jerzy Gąssowski was invited to give an inaugural lecture on the search for the grave of Copernicus during the “Polish Days,” organized in Uppsala by the Polish Institute in 2006. The lecture took place on 13<sup>th</sup> October. One of the listeners was Göran Henriksson, PhD, an astronomer and astro-historian, who for many years collaborated with Władysław Duczko in his archaeological research in Old Uppsala. During this lecture Henriksson came up with the idea of looking for traces of the DNA Copernicus left in several manuscripts of his own letters and extensive book collection, stored since 1626 years as spoils of war in the libraries in Uppsala. Göran Henriksson shared this idea with Władysław Duczko on October 19, 2006, after hearing his lecture on the study of Old Uppsala.

After returning to Poland, Władysław Duczko informed Jerzy Gąssowski about this idea. Soon, Associate Professor Marié Allen, PhD (a geneticist employed in the Department of Genetics and Pathology, Uppsala University) was invited to

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these publications were known to the authors of the quests). And just there the Gąssowski team looked for this tomb in 2006 (cf., for example, Gąssowski 2010a, p. 4, the photograph under the misleading title “Getting DNA by professor Marié Allen”). However, as we know from the article by Thomas Węclawowicz (cf. Węclawowicz 2008, p. 188–191, p. 184 photograph 18, p. 186 photograph 18, p. 187 photograph 19), the search were unsuccessful, since no grave was found there.

<sup>5</sup> Cf. Duczko 2010, p. 32–33.

the collaboration in the search for the traces of Copernicus's DNA (prior to that, she participated in, among others, the identification of the remains of St. Bridget of Sweden – see Nilsson, Possnert, Edlund, Buildings, Kjellström, Allen 2010):

A new thread of explorations occurred suddenly where it was not expected at all. during the 'Polish Days' organised in Uppsala in October 2006, in an inaugurating lecture I presented our achievements in the project searching for an identifying the remains of Nicolaus Copernicus. It is known that in the collections of the university library in Uppsala there are the books of our astronomer that were brought to Sweden as war booty in the year 1626. Ph.D. Göran Henriksson from the Institute of Physics and Astronomy of the University of Uppsala listened to the lecture. He undertook the task of analysing the authenticity (*sic*) of the letter of Nicolaus Copernicus that is a part of the collection of the University (it regards the alleged autograph of the letter of Nicolaus Copernicus to Bernard Wapowski pasted into the second edition of *De revolutionibus* (of 1566), which is held by the library of the University of Uppsala; see: Gąssowski 2008b, p. 34 photo 9 – M. K.). His examinations (*sic*) prove that the handwritten notes made on the margins of the book from Copernicus's collection in Uppsala were actually made by the great astronomer himself (Gąssowski 2008b, p. 35).

As we know from many publications, including the interviews given by M. Allen (2007), J. Gąssowski (2007c), and finally of the article by W. Duczko (2010, p. 33), what was originally planned were the analyses of the DNA traces, such as blood and saliva left in Copernicus's letter to Bernard Wapowski (also called in the literature "Copernicus's letter against Johann Werner"). The letter mentioned – as assured by Dr. Henriksson – was first thought to be the original.<sup>6</sup> According to G. Henriksson, Paul Czartoryski, a historian of science, believed that.<sup>7</sup> However, reportedly, the idea to conduct a DNA test was eventually abandoned due to the consequent necessity to destroy the sample of the letter collected for testing.<sup>8</sup> It turned out that it was a very wise decision... since this research could not determine anything due to the two(interrelated) reasons shown below:

1. The alleged autograph of the letter of Nicolaus Copernicus to Bernard Wapowski can be found in the volume with the catalogue number *Collect. Hjärther H III. 34*, deposited in the library of the Astronomical Observatory in Uppsala. The volume, except the aforementioned letter, includes the second edition of *De revolutionibus* (Basel 1566; not the first edition of 1543!), and the work of Johannes Regiomontanus *De triangulis Planis et sphaericis libri V* (Basel 1561). The letter is written on the ante folio recto

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<sup>6</sup> Cf. Gąssowski 2007a; 2008b, p. 32–35; 2009b, p. 19, and Grabarczyk 2008; Duczko 2010, p. 33; Henriksson 2010a, p. 206; 2010b, p. 213.

<sup>7</sup> Henriksson 2009a; 2009c; 2010a, p. 207; cf. also Korolczuk, Kurski 2008.

<sup>8</sup> Henriksson 2009a, cf. also Duczko 2010, p. 33.

and verso of the entire volume, as well as on the post folio recto and verso, and it ends on the inner side of the second cover. Therefore the letter is only a copy of the lost autograph letter of 3 June 1524. All these facts were reported for the first time by Ludwik Antoni Birkenmajer, who discovered the copy in Uppsala (see 1900, pp. 497–501), and none of the specialists ever questioned this view (cf., for example, Drewnowski 1978, p. 13, illustration 1 after page 32; Rosen, 1985, p. 141; Dobrzycki 2007, p. 7). One can also easily make personally certain of the findings of L. A. Birkenmajer by comparing the handwriting styles of the author of the Uppsala copy of the letter and the handwriting style of Copernicus's autograph of *De revolutionibus* – they are completely different (fig. 1 and 2),<sup>9</sup>

2. There is no empirical evidence (historical source) that Prof. Paweł Czartoryski ever acknowledged the thesis that the above-mentioned manuscript of the letter belonging to the library of the Astronomical Observatory in Uppsala is the original letter of Copernicus to Bernard Wapowski. If he had even claimed that in 1973 in Uppsala – which is attributed to him by Dr. Henriksson in his interviews and lectures, and which he confirmed in the correspondence with me<sup>10</sup> – Prof. Czartoryski would have had to oppose the thesis of Prof. Ludwik Antoni Birkenmajer (Birkenmajer 1900, pp. 497–498). This, however, is highly questionable (considering the research standards of Prof. Paweł Czartoryski, whom I personally knew).

Contrary to the claims of Jerzy Gąssowski,<sup>11</sup> Göran Henriksson is not the discoverer of the fact that there are handwritten notes that our great astronomer wrote himself on the margins of the books from Copernicus's personal library, kept now in Uppsala. This discovery is credited to Leopold Prowe, a German historian, who informed about it in 1853. (I would like to add that in addition to Copernicus's notes in his book collection, there are also notes of other authors, which... obviously complicates the study). Later, other scholars had great merit in this field, among others: Maximilian Curtze, Franz Hipler, Ludwik Antoni Birkenmajer (Jagiellonian University; Polish Academy of Arts and Sciences), Aleksander Birkenmajer (Jagiellonian University; Polish Academy of Arts and Sciences; Institute for History of Science, Polish Academy of Sciences), Jeremi Wasutyński (Polish emigrant independent researcher, Sweden), Jerzy Dobrzycki (Institute for History of Science, Polish Academy of Sciences), Paweł Czartoryski (Institute for History of Science, Polish Academy of Sciences), Grażyna Rosińska (Insti-

<sup>9</sup> I informed about this and related the facts to Doctor G. Henriksson in the email in March 2009 (Kokowski 2009c), and in two papers presented in 2009 and 2010 (Kokowski 2009a, 2010c).

<sup>10</sup> *Ibidem*.

<sup>11</sup> Cf. Gąssowski 2008b, p. 32, 34–35.

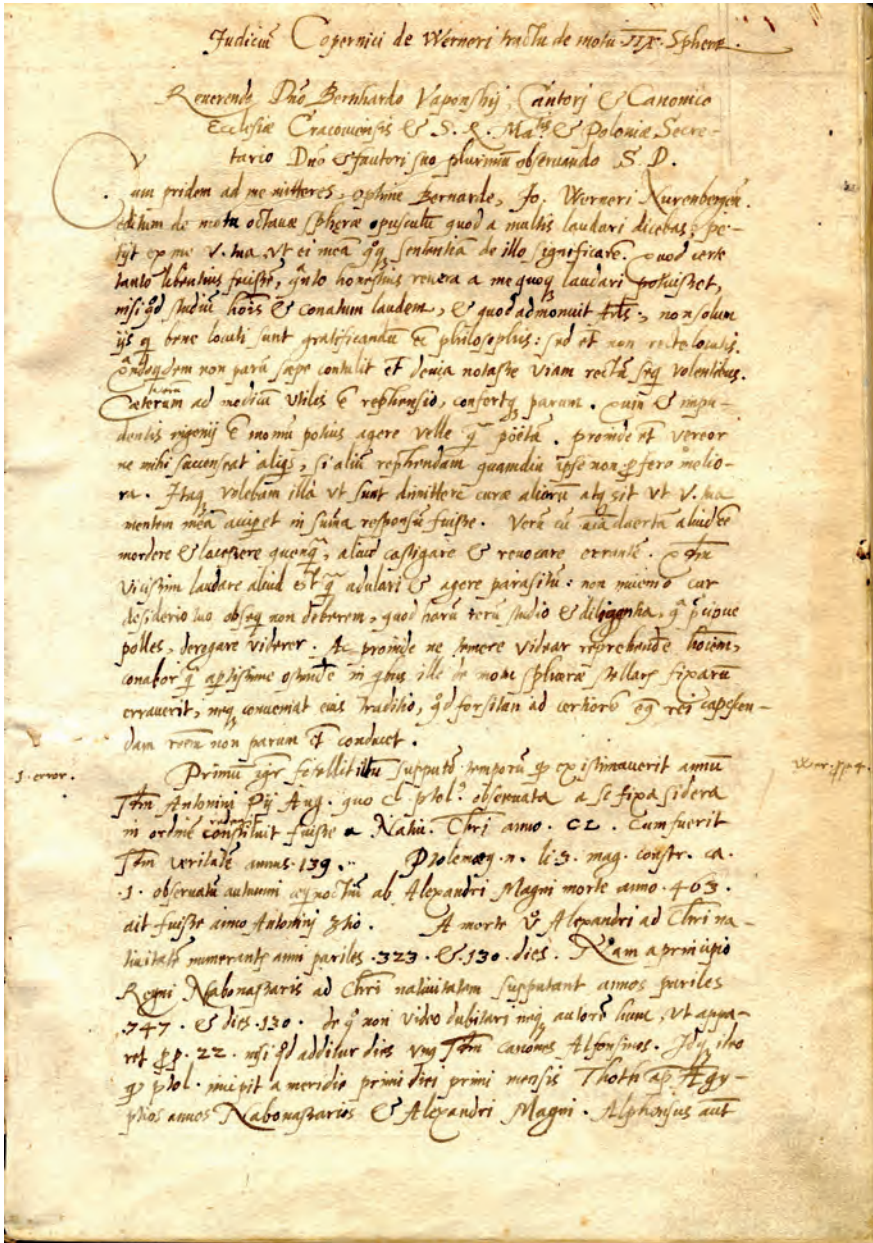


Fig. 1. N. Copernicus, *Letter against Werner*, p. 1 (source: Uppsala, Astronomiska Observatoriet, Collect. Hjärther H III. 34<sup>12</sup>).

<sup>12</sup> I would like to thank Ms. Laily Österlund, Head of the Section Old Prints of Carolina Rediviva Library in Uppsala, for the opportunity to reprint the illustration.

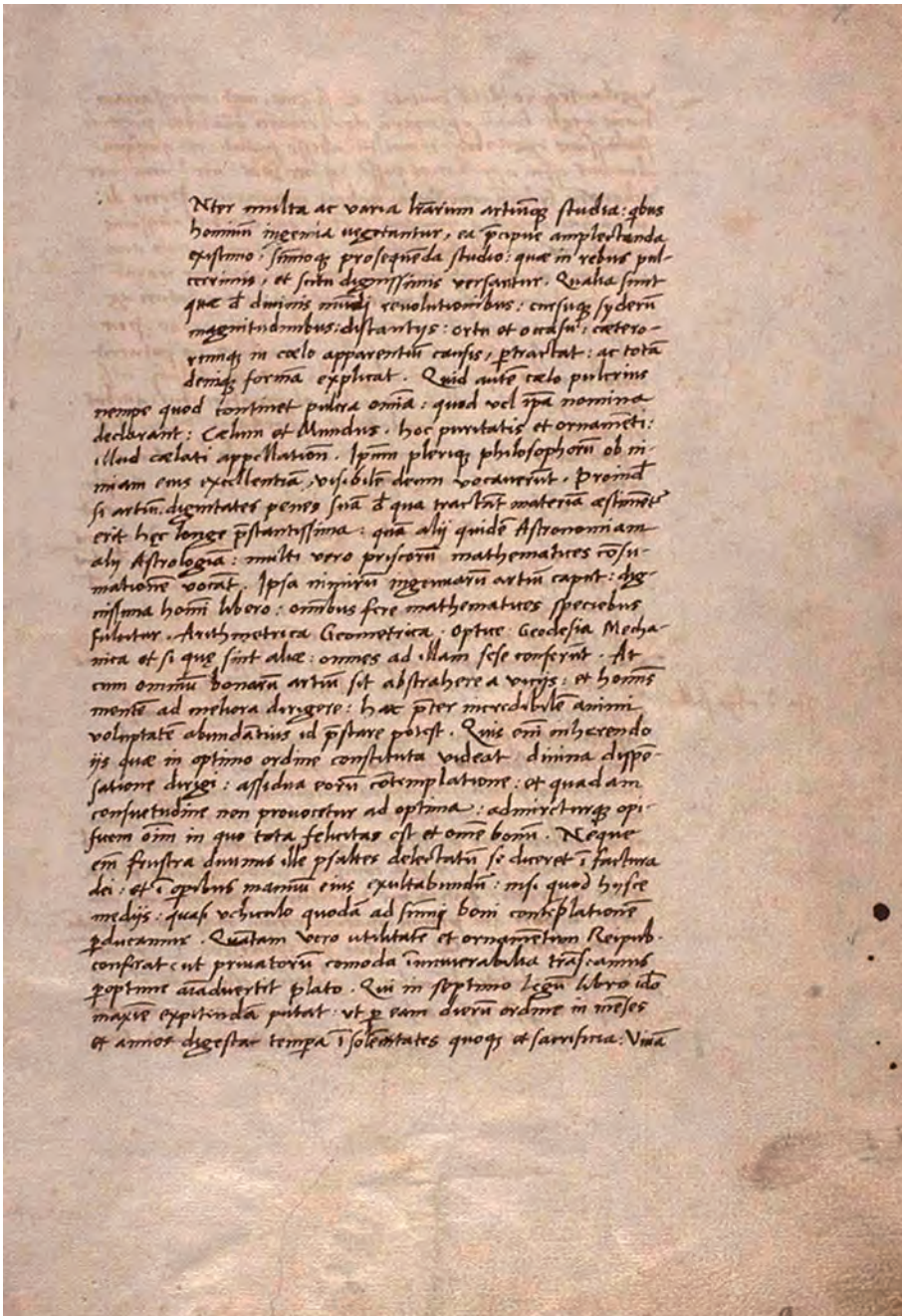


Fig. 2. N. Copernicus, The autograph *De revolutionibus*, bk. I, p. 1r (source: Jagiellonian Library, Manuscripts: *De revolutionibus*, <http://www.bj.uj.edu.pl/bjmanus/revol/images/001r.jpg>).



tute for History of Science, Polish Academy of Sciences) and Owen Gingerich (a collaborator of Dobrzycki, Harvard University).<sup>13</sup>

The above-quoted section of Gąssowski's text is by no means the only one in which the author spoke about the Copernican subject-matter, known to him only in informally. Here is another example taken from an interview he gave to J. Hofman-Wiśniewska in 2008:

Copernicus's personal library located in Sweden had been looked into by no one (*sic*). Not only is it in Latin, it is a very difficult, sixteenth-century Latin. In Poland, there are probably only two specialists who are able to read it. Besides, the astronomical works do not make fascinating reading (*sic*). They stood quietly on the shelf, and probably had not been opened since the time of Copernicus (*sic*). Among these books the personal calendar of the great astronomer (*sic*) was found. Formerly, calendars were downright compendia of knowledge. Copernicus had such a calendar with mathematical tables, which would come in very handy for his everyday use. It is in this calendar that the hairs were found; a few hairs. Each hair was analysed, on the basis of which four hairs were selected that potentially gave (potentially) a (high) probability of (making) a recognition (Gąssowski 2008c, p. 4; translation – M.K.).

In the quoted text there is the unambiguous assertion (very important for the issue of the thesis on finding the remains of Copernicus) that no one had studied the personal library of Copernicus. As I stated above already, this is an erroneous thesis. There were many scholars who dealt with this issue, and a particular interest was shown by German (in the second half of the 19<sup>th</sup> century), Polish (from the end of the 19<sup>th</sup> century to the 1970s) and American researchers (since the 1970s). They were, among others, Leopold Prowe, Franz Hipler, Maximilian Curtze, Ludwik Antoni Birkenmajer (UJ, AU), Aleksander Birkenmajer (JU, AAS, IHS PAS), Jeremi Wasiutyński (after World War II, Polish emigrant independent researcher, Sweden), Jerzy Dobrzycki (IHS PAS), Paweł Czartoryski (IHS PAS), Grażyna Rosińska (IHS PAS), Owen Gingerich (a collaborator of Dobrzycki, Harvard University).

In particular, all the works of Copernicus stored in Swedish libraries (as war booty) since 1626 were carefully examined by Polish scholars in the late 19<sup>th</sup> century, in July and August 1911, and in the 1970s.<sup>14</sup> Moreover, to celebrate the

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<sup>13</sup> Cf., for example, Prowe 1853b; 1873, Hipler 1872; Curtze (ed.) 1875; Curtze (ed.) 1878; Birkenmajer 1900; Barwiński, Birkenmajer, Łoś 1914; Dobrzycki 1973; Czartoryski 1978; Wasiutyński 1963; Rosińska 2002 oraz Gingerich 2002; 2004a; 2004b. On the achievements of Gingerich cf. Maciejewska 2008.

<sup>14</sup> Cf., among others, Birkenmajer 1900; Barwiński, Birkenmajer, Łoś 1914 and Czartoryski 1978.

United Nations' Year of Copernicus, held in 1973, all these works were lent to Poland and it was then when the microfilms of these works were made.<sup>15</sup>

On the other hand, Copernicus's works (and his book collection) *never* aroused in Sweden sufficient interest that would result in establishing there a scholarly tradition of Copernican research. (This explains the elementary mistakes made by G. Henriksson). Hence, it is not true that "Copernicus's personal library located in Sweden had been looked into by no one." I would like to emphasize that this is an important assertion, because the fact that supposedly no one had looked into these books, was to prove that the hairs found in those books *must have had to* belong to Copernicus!

Incidentally, I would like to add that it is impossible to agree with the other thesis of J. Gąssowski cited above that "the astronomical works do not make fascinating reading" (Gąssowski 2008c, p. 4). Though, the following, more precise statement should be considered as the unquestionable truth: "The astronomical works do not make... fascinating reading *for people not interested in astronomy*." For it is a truism to say that there are such people among ordinary mortals, including, among others, Nicolaus Copernicus, who valued this domain of science. Therefore, it will be reasonable to recall in this context the words of Nicolaus Copernicus from the preface to *De revolutionibus* (dedicated to Pope Paul III): "Mathemata mathematicis scribuntur" ("Mathematics is written for mathematicians"), directed against ignorant and arrogant people, such as Lactantius (otherwise a good writer), who had the audacity to scoff at mathematicians (astronomers) and philosophers who asserted that the Earth is a sphere (and not that it is flat)!

Moreover, it is wrong to claim that Copernicus, a Canon of the Warmia Chapter was a priest, a clergyman (that is he had received major holy orders, becoming a deacon or a priest), which is maintained by Jerzy Gąssowski and Beata Jurkiewicz (see Gąssowski 2005b, p. 129; Gąssowski, Jurkiewicz 2005b, p. 19), and a team of researchers involved in the analysis of DNA of the alleged remains of Nicolaus Copernicus (see Bogdanowicz *et al.* 2009, p. 12279). The experts, who have studied this issue, accept the opposite view – he had only minor orders (see Kokowski 2009b, pp. 369–370 fn. 335 – an overview of the discussion of this issue; Gingerich 2009, pp. 12216 and 2010, pp. 29 – a short note).

In the context of this kind of erroneous assertions proclaimed about Copernicus,<sup>16</sup> I want to formulate the following strong thesis. In the above-cited state-

<sup>15</sup> One of the sets of these microfilms can be found in the Jagiellonian Library in Kraków. I used them personally in my own research, among others, during the work on my post-doctoral dissertation (*habilitation thesis*).

<sup>16</sup> I can even provide a much longer list, mentioning, among others, significant deficiencies in the knowledge of portraits of Copernicus – see chap. 7.6 of this article and my earlier publications, e.g. Kokowski 2005a/2007a; 2005b/2007a, 2011b.

ments by Jerzy Gąssowski an *implicitly accepted assumption* clearly manifests itself, namely that a lack of expertise in Copernicus and the historical context does not affect the soundness of the reasoning concerning the identification of the remains of the astronomer.<sup>17</sup> Speaking more generally, according to Jerzy Gąssowski and his team, a specialized knowledge on the topic of Copernicus and the historical context are not *necessary* components of the *research hermeneutics* (that is the total interpretative tools used during the research), which should have been used to solve the puzzle of the identification of the remains of this person.<sup>18</sup>

In this article, on the example of a detailed analysis and interpretation of the results of DNA testing of Copernicus's putative remains, I will show that this seemingly reasonable assumption is incorrect. At the same time, I will claim that the adoption of this implicit assumption determined the overall rhetorical strategy of the publications on the identification of the remains of Copernicus and caused very serious weakening of the evidence presented in favour of the thesis that the remains of Copernicus had been found.

## **6. On the common opinion on the evaluation of the results of DNA analysis of the putative remains of Nicolaus Copernicus**

According to the common opinion (formed by the authors of the research, the sponsors of these studies, journalists, etc.) the DNA analysis of the putative remains of Copernicus together with the interpretation of these results were carried out perfectly, which, among others, is amply suggested in three films: *Tajemnica grobu Kopernika / Copernicus Tomb Mystery* (60 min), written and directed by Michał Juszcakiewicz (Michał Juszcakiewicz Art's Agency, 2008); *Światowe odkrycie archeologów z Pułtuska. Poznana tajemnica grobu Kopernika / A world discovery of archaeologists from Pułtusk. The unveiled mystery of the grave of Copernicus* (6 min 13 s), written and directed by Józef Śniegocki, Paweł Kiela, photography: Robert Śniegocki (A. Gieysztor Higher School of Humanities in Pułtusk, 2008); and *Misterium cranii Nicolai Copernici* (29 min 12 s), written and directed by Marcin Stefaniak (The Kronenberg Foundation at Citi Hadlowy, 2008), and the verdicts of the award committees: *The "Przekrój" Phenomenon of 2008*, of the weekly magazine "Przekrój", *Polish science hits of 2008* of the daily newspaper "Rzeczpospolita" and *The most important events in Polish science in 2008* of the online service "PAP – Nauka w Polsce" (2008b).

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<sup>17</sup> I pointed to it in the previous article (Kokowski 2011b) and in two papers delivered in 2009 and 2010 (Kokowski 2009a, 2010c).

<sup>18</sup> On research hermeneutics see my remarks in: Kokowski 2001, pp. 6–8.

According to this view, everything in these studies was perfect: the presented empirical evidence, the adopted research methodology (including conducting the DNA analyses by three independent teams), the choice of collaborators from different disciplines, the organization of their collaboration (so that they were able to exemplarily solve the problem of interdisciplinary character of the issue being examined) and the arguments in favour of the thesis of the final, definitive discovery of the remains of Copernicus based on the results of the DNA analyses of the putative remains of the astronomer.

## 7. Doubts

There exists a whole group of substantial doubts in regard to the alleged perfection of the DNA testing of the putative remains of Copernicus and the interpretation of these results. I present them in the following sub-sections.

### 7.1. Unsubstantiated character of the theses

From the point of view of a methodologist of empirical sciences, the authors of the DNA testing of the alleged remains of N. Copernicus adopted quite a surprising strategy in their scientific publications. By limiting themselves to merely giving the results of the mtDNA and Y-DNA analyses, they did not present any evidence that they had conducted such analyses, since they did not attach the detailed tables or graphs with measurements, for example, of the relevant chromatograms (also called electropherograms in the literature).<sup>19</sup>

However, there is one significant exception to this rule, which, read literally, negates the thesis proclaimed regarding the determined mtDNA sequences of the hairs. That is to say, in the article of Marié Allen (2008, p. 232) it is claimed that the chromatograms attached on page 233 show a difference (with respect to the so-called revised Cambridge Reference Sequence – rCRS, that is the corrected reference sequence determined originally by the team of Dr. Fred Sanger from the University of Cambridge) in position 16316 (A/G) of the four samples (teeth, three hairs) analysed. However (see above fig. 3), the charts suggest that what is shown here, is rather the difference in position 135 (A/G) – hence the expression visible in the so-called “currently selected option panel” (“agent Box”) “28 frag bases selected at a consensus position 135”, and under the chromatograms for the three samples (tooth, two hair) “Fragment base # 135” (additionally, I want to point out here that there is no “R” sign on the icon of the “Andersen” sample –

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<sup>19</sup> This regards empirical evidence (and probable knowledge) and not logical-epistemological evidence (and absolutely certain knowledge). Cf. also section 13, below.

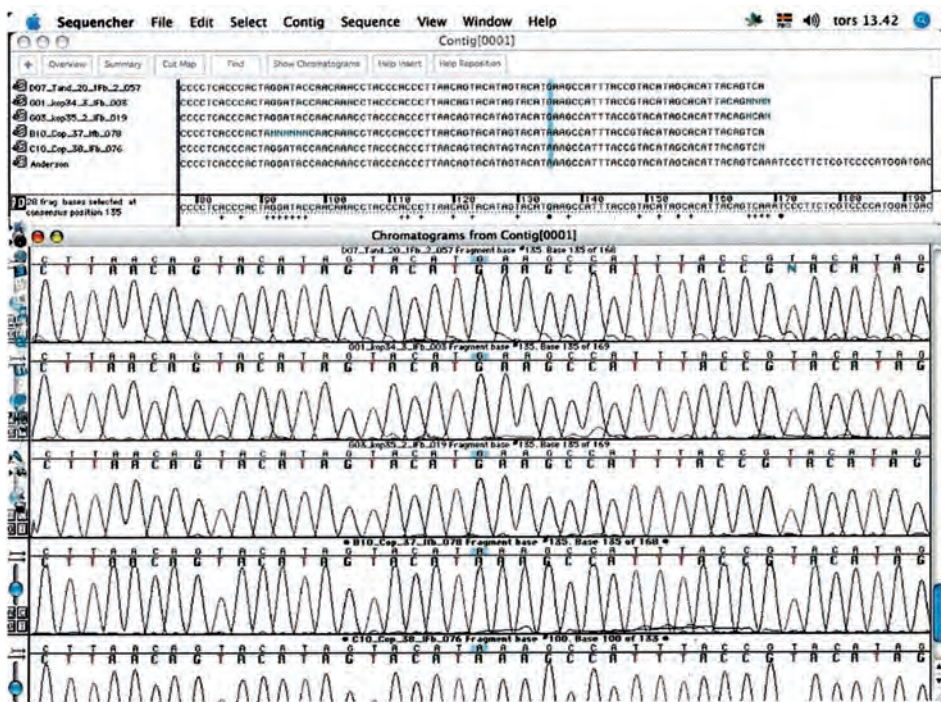


Fig. 3. M. Allen, *The sequences of the chromatograms of four samples of the teeth and the three hairs, showing a difference in position 16316 (A / G) with respect to rCRS* (source: Allen 2008, p. 233).<sup>20</sup>

and this sign means that the “Reference sequence” or “comparative sequence” has been selected correctly).<sup>21</sup>

A similar discrepancy is also visible on the website of the Kronenberg Foundation (2008a) “Photo Gallery”, photo no. 4 (reproduced in fig. 4) and 5 (fig. 5): the chromatograms show the difference in position 135 (A/G), and not in position 16316 (A/G).

What can the indicated differences mean? I provide below four versions of response, *dependent on the different assumed level of knowledge* regarding the results provided by the measuring device used, which in this case was a program for DNA sequence analysis, namely Sequencher®, version 5.0.<sup>22</sup> At the same time, I point out the erroneous theses in the responses provided:

<sup>20</sup> I would like to express my gratitude to the Aleksander Gieysztor Academy of Humanities in Pułtusk for the opportunity to reprint the full version of this illustration.

<sup>21</sup> Cf. Ginsburg 2002; Gene Code Corporation 2007, 2008, 2009; Ginsburg 2011a; 2011b.

<sup>22</sup> Sequence Analysis Software, Gene Codes Corporation, Ann Arbor, MI USA; <http://www.genecodes.com>.

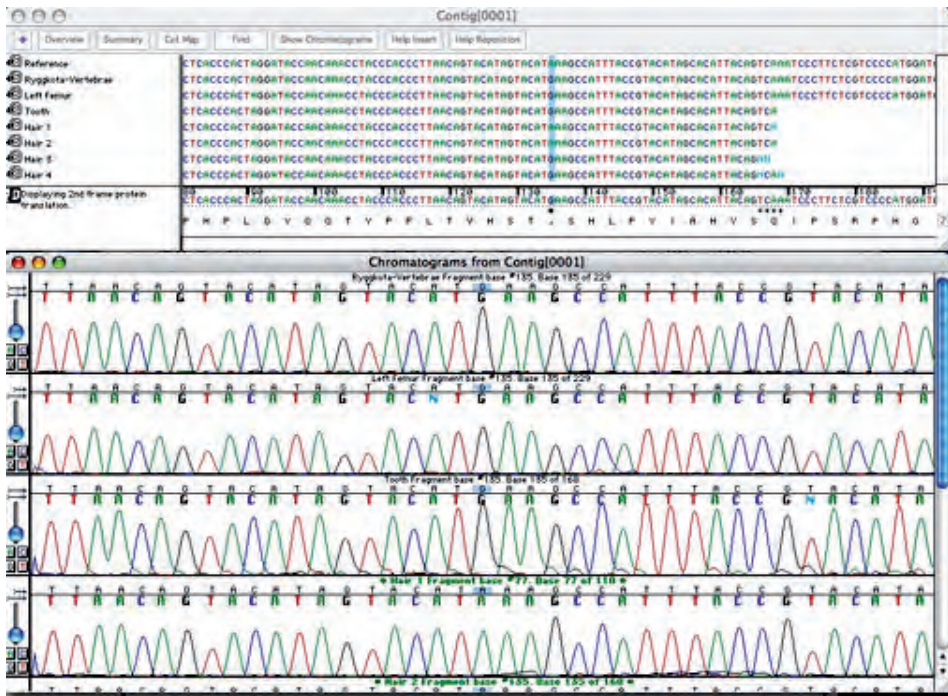


Fig. 4. M. Allen, *Comparative analysis of the DNA from the skull, the teeth, the forearm and the hairs found in the books of Nicolaus Copernicus* (source: Kronenberg Foundation 2008a, “Photo Gallery”, photo no. 4).<sup>23</sup>

*First answer* (which ignores familiarity with the program Sequencher®): The researchers from Uppsala are actually right that they have definitely determined the difference in position 16316 (A/G), and *this can be seen in the chromatograms provided by them (sic)* (see, however, three other answers given below).

*Second answer* (which ignores *detailed* familiarity with the program Sequencher®): Although the charts are saying something else, the researchers from Uppsala are actually right that they have definitely determined the difference in position 16316 (A/G). But in the two only publications available, in which the corresponding graphs are given (Fundacja Kronenberga 2009, picture 4 and 5; Allen 2008, p. 233) (fig. 3–5), *the chromatograms included come from an earlier, preliminary phase of research, when it was still thought that the samples differed in position 135 (A/G) (sic)*.

<sup>23</sup> The image presented here has better resolution than the one posted on the website of the Kronenberg Foundation (see file: <http://www.citibank.pl/poland/homepage/polish/kopernik/images/4.jpg>). I would like to extend special gratitude to the Foundation for making the image available and for the possibility of its publication (see Senk 2012).

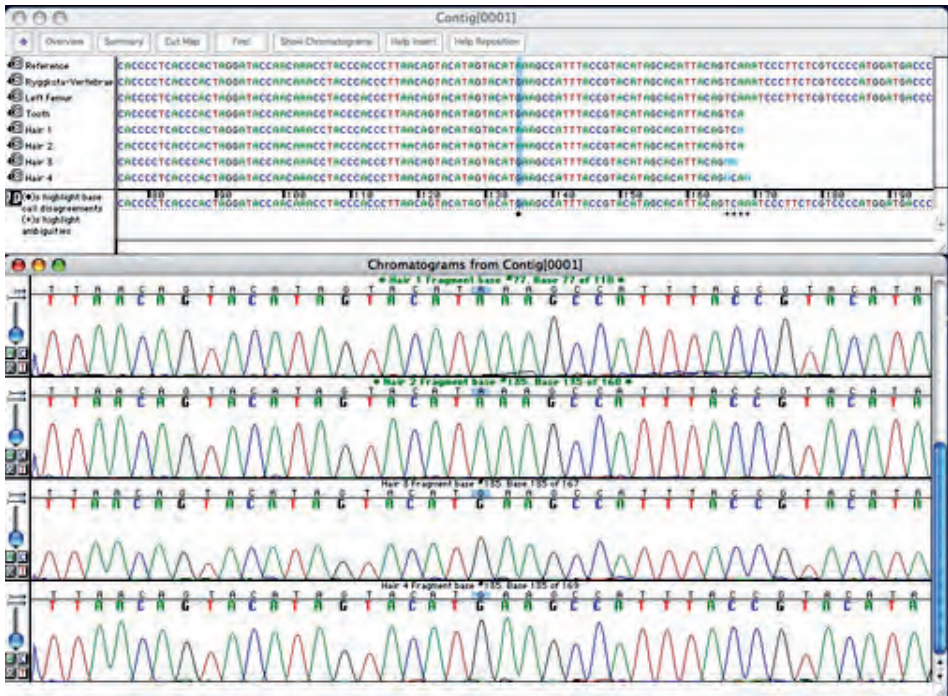


Fig. 5. M. Allen, *Comparative analysis of DNA from four hairs found in the books of Nicolaus Copernicus* (source: Kronenberg Foundation 2008a, “Photo Gallery”, photo no. 5).<sup>24</sup>

*Third answer* (which ignores detailed familiarity with the program Sequencher®): When we literally read the statements of the researchers from Uppsala, *the indicated discrepancies show unambiguously (sic)* that the samples assayed in Sweden and Poland, despite opposing declarations, had incompatible mtDNA sequences! One can make sure of this strong and surprising assertion by comparing the illustrations given above (fig. 3–5) with fig. 6, which shows the sequence of chromatograms taken from the article by Nilsson, Possnert, Edlund, Buildings, Kjellström, Allen (2010) on the analysis of the alleged remains of St. Bridget (1303–1373), to which the author of the DNA testing of the alleged hairs of Copernicus also contributed.

Let us note in this context that *if we accept* that what is shown on fig. 6 is the *unequivocal evidence* for the existence of three *discrepancies* of mtDNA se-

<sup>24</sup> The image presented here has better resolution than the one posted on the website of the Kronenberg Foundation (cf. file: <http://www.citibank.pl/poland/homepage/polish/kopernik/images/5.jpg>). I would like to extend special gratitude to the Foundation for making the image available and for the possibility of its publication (see Senk 2012).



**Fig. 6.** M. Nilsson, G. Possnert, H. Edlund, B. Budowle, A. Kjellström, M. Allen, Chromatograms of the sequences of the skulls A and B, showing three sequence differences (with respect to rCRS sequence) at positions 16294, 16296 and 16304<sup>25</sup> (source: Nilsson, Possnert, Edlund, Budowle, Kjellström, Allen 2010, p. 3, fig. 6).

quence in the case of the skulls A and B (with respect to the sequence rCRS), namely at positions 16294, 16296 and 16304 (and so it is claimed!), then we must also recognize that the samples of the alleged remains of Copernicus, tested by Swedish and Polish researchers, despite opposing declarations, had incompatible mtDNA sequences, because the Swedes (see fig. 3–5) showed the difference in position 135 (A/G), and such was not provided by the Poles!

*Fourth answer* (taking into account the detailed familiarity with the program Sequencher®): the difference in position 135 (A/G) is shown on three chromatograms of the samples of putative of remains of Copernicus provided by Swedish researchers (fig. 3–5). Nevertheless, we cannot henceforth conclude unequivocally that the samples assayed in Sweden and Poland had incompatible mtDNA sequences. However, such a possibility cannot be ruled out.<sup>26</sup> Such statements are closely linked to the issue of appropriate calibration of the procedure of comparison of the sequences of the samples with the reference sequence in the pro-

<sup>25</sup> Attention: the differences in the sequence are marked with a black dot placed directly under the line of the following numbered items of the sequence.

<sup>26</sup> Moreover, the probability of this fact (that the samples assayed in Sweden and Poland had incompatible mtDNA sequences) is very high. That is:

$$1 - 1/(610^4) \approx 1 - 0.000044,$$

where  $1/(610^4)$  – the probability of accidental match; since for the HVS–I region (16024–16365 base pairs) we have 342 available positions, and for the HVS–II region (73–340 base pairs) – 268 available positions, in total 610 available positions; in each position we have 4 possibilities (nucleobases A, C, G, T). (*A comment added in the English version of the article.*)



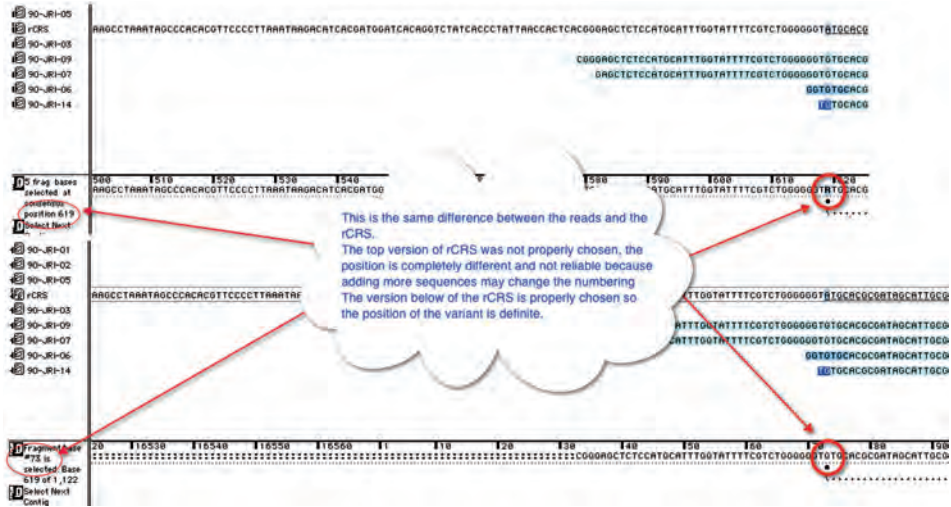


Fig. 7. The properly and improperly selected sample of reference sequence rCRS (source: Ginsburg 2011b).<sup>27</sup>

gram Sequencher®. When this is done properly, the icon of the comparative sequence must contain the “R” symbol. Otherwise, our results of the comparison of the mtDNA sequence with the reference sequence rCRS are not correctly determined.<sup>28</sup> This is clearly illustrated by fig. 7, obtained from Michelle Ginsburg, PhD, the representative of the manufacturer of the program Sequencher®, and an expert of the Gene Codes Corporation responsible for contacts with Europe.

Moreover, to understand the content presented in fig. 3–7 even better, it is also worth:

- α) confronting these illustrations with the illustration taken from the study on the program Sequencher® from Gene Codes Corporation, which compares two example samples marked with symbols 082790 and 90 with the rCRS reference sample: “The Variance Table in Review Mode” sequencing of mtDNA (fig. 8) – cf. Gene Codes Corporation 2011d, p. 5;

<sup>27</sup> I am grateful to Michele Ginsburg, PhD and Gene Codes Corporation for the opportunity to publish this image (cf. Ginsburg 2012).

<sup>28</sup> What occurs here is fully analogous with measuring, for example, the length of a flat object with the help of a ruler. In order to determine the correct length of such an object, we should put the ruler at the point “0”, marked on the scale of the ruler, and to read the length of the object. If we put the ruler at a non-zero value, then we have to take that into account in the measurement of length, subtracting the final value read from the ruler from the initial value. Otherwise, the determined length of the measured object will be of course different and wrong.

β) becoming acquainted with a detailed description of the program Sequencher® – cf. Gene Codes Corporation 2011a–d; determining, on one’s own, the above-mentioned table (fig. 8), by using the free demo version of the program Sequencher®, version 5.0.

Thus, despite the high-profile global media announcements about the great success of Swedish researchers, who – thanks to the analysis of mtDNA of the putative remains of Copernicus (the bones, and especially the hairs) – definitely proved the discovery of the remains and the grave of the astronomer, so far no publication includes credible empirical evidence<sup>29</sup> of this assertion (that is the relevant chromatograms, tables of differences, etc.) – cf. Allen 2008, pp. 232–233; Kronenberg Foundation 2008a, “Photo Gallery”, photos 4–5; Bogdanovich *et al.* 2009.

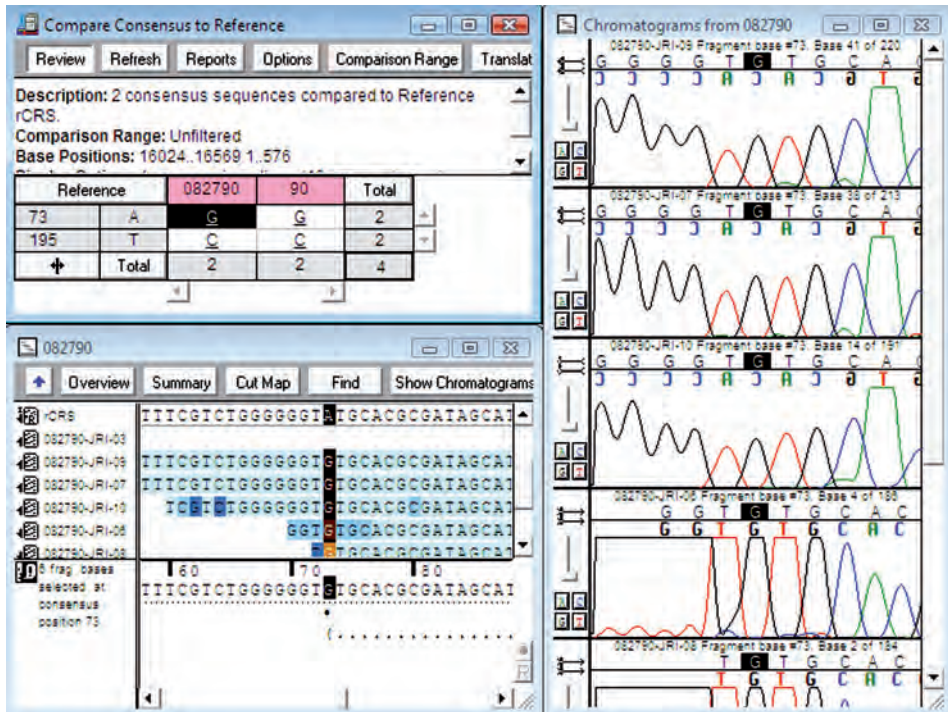


Fig. 8. The Variance Table in Review mode – among others: chromatograms of the sample 082790 at position 73 (source: *Mitochondrial DNA Typing*, Gene Codes Corporation 2011d, p. 5).<sup>30</sup>

<sup>29</sup> Cf. above fn. 20.

<sup>30</sup> I am grateful to Gene Codes Corporation for the possibility to publish the image (cf. Ginsburg 2012).

## **7.2. Do two hairs from Stöffler's book have the same mtDNA sequence as the bone samples 13/05?**

According to the consistent report of the proponents of the thesis in favour of the discovery of the grave of Copernicus, it is certain that two hairs from Stöffler's book have the same mtDNA sequence as the 13/05 bone samples. However, in 2008 the very author of this research presented a different view on the matter:

The other difference from rCRS in HVI (16129) that was seen in the remains was not covered by the shorter fragment amplified from the hairs. *Although the samples match in the sequences obtained now, differences may be found in other parts of the HVI region.* Further analyses will be attempted to try to cover this region of HVI as well. *However, as things stand, the chance of random match is about one in two hundred fifty. In conclusion, while this analysis cannot be regarded as definitive proof that the remains recovered from Frombork Cathedral belong to the astronomer Copernicus, it adds an important piece to puzzle of his final resting place* (Allen 2008, p. 232; italic – M.K.).<sup>31</sup>

The author made this claim because the Swedish team was unable to determine the position 16129 of the region HVI for hair samples. This raises a reasonable doubt as to whether this determination was made at a later time. I was assured by the head of the team (Allen 2009c), however, that this had indeed been done before the final publication of the team of geneticists: Bogdanowicz *et al.* 2009. Nevertheless, no documentation proving this thesis is known to me (what I mean here, among others, is a presentation of appropriate chromatograms, also called electropherograms – compare considerations in sect. 7.1).

## **7.3. Did Swedish researchers provide irrefutable evidence for the discovery of the remains of Nicolaus Copernicus?**

According to the consistent report of the proponents of the thesis in favour of the discovery of the grave of Copernicus it is certain that a team led by Marié Allen provided such definite evidence on the basis of mtDNA analyses of the hairs found in *Calendarium Romanum magnum* by Johannes Stöffler, which for many years was used by Nicolaus Copernicus.

However, in my opinion, no publication gives evidence to this thesis, that is relevant documentation for such a thesis is not provided – compare considerations in sect. 7.1 and 7.2.

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<sup>31</sup> This thread was taken up by me for the first time in Kokowski 2009a.

#### 7.4. The issue of the independence of the work of the teams and the issue of the independent confirmation of the results

According to the information published by Wojciech Kostrzewa in “Dziennik Polski” on 21 November 2008, received during the discussion with Prof. Aleksander Głazek, Habilitated Doctor, Prof. Wiesław Bogdanowicz, Habilitated Doctor, and Wojciech Branicki, PhD, it follows unanimously that the team of Swedish researchers had already known the results of the studies of skeletal remains carried out in Kraków and Warsaw, before they started their own research. In other words, these teams cooperated with each other. It strikes – in my opinion – at the very concept of independence of the confirmation of the results. Moreover, unlike Swedish researchers, Polish researchers (both from Krakow and Warsaw) did not perform hair analyses at all. It also strikes at the standard requirement for DNA studies, i.e. the confirmation of the results of DNA analysis by at least two independently operating laboratories.

The scientists from Sweden joined the research much later, when 10 hairs that could belong to the astronomer had been found in Uppsala in the book by Johannes Stoeffler, which Copernicus used for many years. Four of them were examined. It transpired that two of them contained mitochondrial DNA of the same characteristics as in the remains from Frombork. *The hairs were not studied by the Polish scientists, because, as Dr. Branicki stresses, they are very small fragments and are difficult to divide. So, their (Swedish) research was not verified by another centre, as it happened in the case of the bones.* In 2007, the Institute of Forensic Research in Kraków was visited by Prof. Marié Allen of the University of Uppsala, who became acquainted with the results of the genetic analyses of the bones. She received one tooth and a fragment of a bone from Prof. Gąssowski to repeat the results of Polish analyses. *In her correspondence with the FIR she admitted that she had confirmed the results of mitochondrial DNA examination, whereas her analyses of other markers tested in Kraków were unsuccessful. ‘So, we obtained more complete genetic data than Uppsala,’ says Dr. Branicki* (Branicki 2008b, p. A3; translation and italics – M.K.).

‘We collaborated with the Swedes in this matter. Over a year ago, our experts did genetic tests of the skeleton,’ explains Aleksander Głazek, director of Jan Sehn Institute of Forensic Research in Kraków. He adds that they had agreed with the Swedes for a joint announcement of the results of the research. (...) It is to the Swedes’ credit that they found ten hairs in the calendar of the astronomer located in Uppsala. The Swedish researchers determined that two hairs had the same DNA features as the bones from Frombork. *‘The researchers from Uppsala themselves studied the bones and isolated the genetic profiles, but earlier they had known the results of the work of the experts from Kraków and Warsaw,’* observes a representative of the Institute of Forensic Research from Kraków (Głazek 2008; translation and italic – M.K.).

### **7.5. Inconsistency of the results of the mtDNA analyses**

The authors of the DNA analyses of the putative remains of Nicolaus Copernicus are not in agreement with each other as to an issue by no means trivial, namely how many people there are in the EMPOP database,<sup>32</sup> who had the mtDNA haplotype they had determined. As many as five, including four explicit and one implicit, different answers to this question had been formulated:

1. Five (of which four live in Germany and one in Denmark) – Kupiec (“PAP – Nauka w Polsce” 2008a).
2. Six (five from the German population, and one from the Danish population) – Branicki, Kupiec 2008, p. 220, 222.
3. Two (one from the German population, one from the Danish population) – Bogdanowicz 2008, p. 206.
4. Four (three from Germany and one from Denmark), which corresponds to a random match 1:483 – Bogdanowicz *et al.* 2009, p. 1.
5. Nine or twenty five – Allen 2008, p. 232 (the numbers are the result of the analysis of the assumed value of a random match of samples 1:250 and the mathematical model of estimation of random match of sequences assumed by M. Allen which is identical to the model adopted in the final publication: Bogdanowicz *et al.* 2009; Allen 2009c; 2009d).

The discrepancies of this kind raise serious doubt whether the authors are speaking about the same finally determined sequence of mtDNA: 263G, 315.1C, 16129A, 16316G, or maybe about other sequences determined by them (despite the explicit declaration on having determined one sequence).

In the publications of the team, another piece of key information is not found: in what ranges the researchers made the review of the EMPOP database; whether it was the same range, or a different one, which could explain the disparate results of such searches for the same sequence.

### **7.6. Inconsistency of two theses: on the light-coloured eyes of Copernicus (resulting from the DNA analysis), and the dark-coloured eyes (resulting from the anthropological typology)**

According to K. Piasecki (2005a), Copernicus was to have dark eye colour, which would be compatible with the mixed Mediterranean and Nordic anthropological type of the skull<sup>33</sup> (this position was shared fully by Zajdel 2007). This was,

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<sup>32</sup> Cf. EMPOP 2010.

<sup>33</sup> “A mixed Mediterranean and Nordic type. On the basis of the face we can determine hair colour and eye colour. Copernicus, when he was younger, had dark hair like you,” he says. “Eyes

however, denied by the authors of the DNA research of the alleged remains of Copernicus, who – having established *the C/C genotype of rs12913832 SNP*, located in the gene HERC2 – propagated the thesis on the bright blue colour of Copernicus’s eyes with 83.5% certainty and with 13.5% probability the thesis on the bright green colour; they, however, ruled out dark colour (hazel – 3% probability, and brown – 0%) – Branicki 2008b; Bogdanowicz *et al.* 2009; Branicki, Kupiec 2010. Furthermore, the authors of the DNA research of the alleged remains of Copernicus did not refer at all to the earlier thesis of K. Piasecki on the dark coloured eyes of Copernicus, and the theses mentioned contradict one another. It is important inasmuch as that the thesis of Piasecki regarding the eye colour was “materialized” by D. Zajdel during his creation of the facial reconstruction from the skull 13/05, which was to be one of the pieces of evidence for the discovery of the grave with, supposedly, 97% probability.

## 8. Unambiguous errors

In the allegedly perfectly carried out DNA research of the putative remains of Nicolaus Copernicus, an entire group of unambiguous errors were committed. I present them below.

### 8.1. Estimation of a random match of the determined mtDNA profile

With reference to the literature of the subject,<sup>34</sup> the authors of the DNA analyses of the putative remains of Copernicus chose the so-called *counting method* for estimation of a random match of the mtDNA sequences – Bogdanowicz *et al.* 2009, p. 2; Allen 2009c, 2009d; Kupiec, Branicki 2010 – which in mathematical statistics is called the simple asymptotic method or the Wald method. It is based on the so called asymptotic formula or on the Wilson formula. In accordance with this model, they made two assumptions:

also like you, mixed, but certainly they were neither bright nor dark. And the nose, long and narrow, also like your (...).

‘You are slightly similar to him... When he was younger, he also had dark hair, eyes similar to yours, a long face, maybe a little longer than yours. And a long, narrow nose (...),’ Prof. Karol Piasecki is watching me intently. On the table before him lay the images of the reconstructed face of the Great Astronomer” (Piasecki 2005a).

“Joanna Paszkowska: ‘And when you learned that the skull was attributed to Copernicus, did you only then create the eye colour or the hair type? Or the idea had come earlier?’

Chief Commissioner D. Zajdel, MA: The idea came earlier. Besides, the hair colour, the hair shape closely follows the anthropological analysis” (Paszkowska 2007).

<sup>34</sup> Cf. Evett, Weir 1998, p. 56–59, p. 142; Holland, Parsons 1999, p. 32.

1. The lower and upper values of the haplotype frequency can be approximated with the following formula:

$$p'_{\mp} = p \mp z_{1-\frac{\alpha}{2}} \sqrt{\frac{p(1-p)}{n}},$$

where:

$$p = \frac{m}{n},$$

- $p$  – the frequency of a specific haplotype for the given metapopulation according to the population database;
- $m$  – the number of a particular haplotype in the given metapopulation according to the population database (that is the number of samples of the same chosen haplotype);
- $n$  – the total number of haplotypes in the given metapopulation in the population database (the size of the metapopulation);
- $z_{1-\alpha/2}$  – the quantile of order  $1-\alpha/2$  of the standard normal distribution for the given confidence level of 100  $(1-\alpha)\%$ .

2a. For the evaluation of the frequency of the determined haplotype it is sufficient to adopt a 95% confidence level of calculations.

2b. This corresponds to the value of  $z_{1-\alpha/2}=1.96$  (it is worth adding here immediately that the actual value of the  $z_{1-\alpha/2}$ , rounded to six decimal places, is 1.959964 not 1.96).

With those assumptions (for  $z_{1-\alpha/2}=1.96$ ), the authors determined the maximum frequency (proportion) of the determined haplotype (for the case when for forensic data there were 3830 samples of the West Eurasian metapopulation in the EMPOP database, including four samples with a determined haplotype) and the maximum value of a random match ( $Przg_{\max}$ ) of this profile at 95% confidence level. They obtained the following values:

$$p_{\max} \approx 0.2067\% = 0.002067,$$

$$p_{\max} = 1 : Przg_{\max},$$

$$Przg_{\max} \approx 1:0.002067 \approx 483,$$

$$p_{\max} = 1 : 483.$$

However, for the adopted model, the same data and the same accuracy of calculations (six significant digits after the decimal point), we obtain a slightly different value for the maximum value of a random match of this profile:

$$\text{Przg}_{\max'} = \text{Entier} (1 : 0.002067) = \text{Entier} (483.792936) = 484,$$

$$p_{\max''} = 1 : \text{Przg}_{\max''} = 1 : 484.$$

Let us note that, for the adopted accuracy of the calculations, the result of the calculation is not affected whether we accept the value of  $z_{1-\alpha/2} = 1.959964$  or its approximation 1.96. The error mentioned above resulted from the replacement of the number 0.002067 with its approximation 0.002070:

$$\text{Przg}_{\max} = \text{Entier} (1 : 0.002070) = \text{Entier} (483.091787) = 483,$$

$$p_{\max} = 1 : \text{Przg}_{\max} = 1 : 483.$$

*I want to emphasize that I do not attribute much significance to the calculation error indicated here, because it has no effect on the falsification or corroboration of the thesis on the discovery of the remains of Copernicus.*

In this context, I would like, however, to draw attention to another much more serious mathematical error, which was committed by the above-mentioned authors. To understand it, we should take note of the following three issues:

Let us note that at the basis of the approximation of the asymptotic model assumed above lays the assumption that the probability of finding  $k$  samples of a given haplotype in the database consisting of  $n$  all samples with different haplotypes is described by the binomial distribution:

$$P(k) = \binom{n}{k} p^k (1 - p)^{n-k},$$

where:  $p$  – the probability of success.

(To be exact we must note that this happens only when we *randomly* select  $n$ -element sample from an infinitely large general population ( $N = \infty$ ). In the case of a finite general population ( $N \neq \infty$ ), the distribution of such a *random* sample is not governed by the binomial distribution but hypergeometric distribution! In other words, in the considered problem an additional implicit idealized assumption is accepted, i.e. that for practical reasons general population may be treated as infinite).

2. As it is known to those skilled in statistical calculation, for very large values of  $n$  and  $p \approx 0.5$  the binomial distribution can be very well approximated by the normal distribution, while for small values of the probability of success – by Poisson distribution,<sup>35</sup> and for the intermediate values, we must make direct calculations from the binomial distribution.

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<sup>35</sup> This distribution should properly be called Bortkiewicz distribution, because it was Władysław Bortkiewicz (born 7 August 1868 in St. Petersburg, died 15 July 1931 in Berlin) who was



3. Let us note finally that what is used for the evaluation of the value of the frequency of a haplotype in a population on the basis of the data contained in a population database is the so-called interval estimation of population proportion (or the confidence intervals for population proportions) at a given confidence level.<sup>36</sup> When we apply the approximation of the binomial distribution with the normal distribution, we obtain the above-specified formula for the upper and lower value of the estimation of haplotype frequencies at a given confidence level of  $1-\alpha$ .

In this context, the authors of the DNA analyses of the putative remains of Copernicus overlooked a crucial fact that binomial distribution can be approximated with good accuracy by normal distribution only around the value of  $p = 0.5$ ,<sup>37</sup> however, in the case analysed here, this value is only  $p = 4/3830 \approx 0.001$  (Bogdanowicz *et al.* 2009). Hence, because of the small value of this parameter, the so-called *asymptotic formula* must not be used here.<sup>38</sup>

In *partial* defence of the authors of the DNA analyses of the alleged remains of Copernicus, we must add, however, that the error of this kind is systematically

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the first to write extensively on the subject. For clarification, let me add that Bortkiewicz was a mathematician and an economist of Polish origin. He had Russian citizenship, and (maybe) German. He worked as a researcher in Strasbourg, St. Petersburg and Berlin. From 1901 he held the function of Associate Professor of statistics and political economy at the University of Berlin, and from 1920 – Professor. Cf. Bortkiewicz 1898; Good 1986; *Wikipedia* 2010h; Feller 1980, vol. I, p. 138–144 and Evett, Weir 1998, p. 52–53 (this last study is addressed directly to the forensic geneticists).

<sup>36</sup> It should be emphasized that the formulation of the interval estimation is a merit of Jerzy Sława-Neyman (1894–1981), a Polish mathematician, who emigrated to the USA in 1938, but had already achieved weighty results working in Poland – cf. Bartoszyński, Klonecki 1977; Bartoszyński 1980; O'Connor, Robertson 1980; Chiang 2011.

<sup>37</sup> It is a generally known property of this expansion, described in standard studies in the fields of probability calculus and mathematical statistics, also in the studies on mathematical statistics for forensic geneticists, including the monograph by Ian W. Evett and Bruce S. Weir (1998) and the review article by Mitchell M. Holland and Thomas J. Parsons (1999) referred to by the authors of the genetic research of the alleged remains of the astronomer.

“In chapter 3 we showed that the binomial distribution  $B(n,P)$  from the sample proportion  $P'$  is well approximated by the normal distribution  $N(P,P(1-P)/n)$ . This requires a large sample size  $n$  and a population proportion  $P$  that is not too far from 0.5” (Evett, Weir 1998, p. 142).

“We note that the normal approximation of the binomial applies to frequency estimates near 0.5, and the low estimated frequencies of even common mtDNA types approach the range where the normal approximation may be problematic” (Holland, Parsons 1999, p. 32). See also the next footnote.

<sup>38</sup> There exists an additional serious argument for not using the asymptotic formula. It is a known fact that the standard formula for the determination of the confidence interval, based on the premise that we can make expansion of the binomial distribution with the normal distribution, leads to erroneous results even close to the value of 0.5 for selected values of  $n$ . It is linked with the issue of the existence of the effect of the oscillation of the distribution function of such approximation (and thus with the effect of the oscillation of confidence intervals) – see, e.g., Newcombe 1998; Brown, Cai, Dasgupta 2001; 2002; 2005.

committed in genetic-population research, including forensic research. For example, Tomasz Grzybowski and his colleagues did not avoid this error:

In the calculation of the frequency of rare haplotypes on the basis of a searchable database we used 95% confidence interval, with the use of the natural logarithm of frequency, the normal approximation to the binomial distribution and the antilogarithm [1, 14]. To exercise caution, the maximum frequencies of the haplotypes (the upper limit of the confidence interval) were used in the LR calculations (Grzybowski, Malyarchuk, Bednarek, Woźniak, Papuga, Stopińska, Łuczak 2006, p. 193; translation – M.K.).

Following the guidelines in force in the international milieu of forensic geneticists for assessing the frequency of rare haplotypes in the population the 95% confidence interval should be applied here, with the use of the natural logarithm of frequency, the normal approximation to the binomial distribution, and the antilogarithm [3, 17] (Daca, Mielnik-Sikorska, Bednarek, Grzybowski 2010, p. 268; translation – M.K.).<sup>39</sup>

With a view to the above comments, I claim that if we accept with the authors of the mtDNA analyses of the putative remains of Copernicus that: 1) there were 3830 samples of the West Eurasian metapopulation in the forensic data of the database EMPOP, 2) 4 samples with haplotype sequences consistent with the sequence of mtDNA haplotype of the alleged remains of Copernicus were found in the EMPOP database, and 3) we carry out calculations at the 95% confidence level, then (using the calculator of John C. Pezzulo 2009) we obtain from the binomial distribution and the Poisson approximation the approximated values of the random match, respectively:

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<sup>39</sup> Professor Tomasz Grzybowski, Habilitated Doctor, a creator of many important and interesting studies in the field of population genetics and forensic genetics, is also the author of the negative comment on my paper presented during the scientific conference *The Nicolaus Copernicus grave mystery. A dialogue of experts (Kraków, 22–23 February 2010)*, initiated and run by me. According to him (then Associate Professor), “the vast majority of critical remarks on genetics made by Michał Kokowski, PhD (then Associate Professor, Habilitated Doctor – M.K.), the head of the conference, arose as a result of misunderstandings and unskilful usage of the DNA databases” (translation – M.K.).

In my view, however, this assessment was wrong – as I announced in the commentary to the PAP’s report on the conference organized by me (cf. Kokowski 2010f; “PAP – Nauka w Polsce” 2010b, 2010c), promising on this occasion that the readers would be able to find out in the published text. I hereby fulfil that commitment. In this context, I am extremely curious of the current opinion of my conference opponent on the allegedly erroneous understanding of the issues regarding genetic databases, statistical analyses, genetic genealogy, etc. I would be glad if he pointed out any actual errors committed by me (it is obvious to me that I can be wrong on some issues, so I appreciate any rational criticism of my theses). If, however, he could not find them, I would like to read in any of his publications that he had been mistaken in his first, superficial assessment of my paper.

$$p_{\max 0.95D} = 1 : \text{Przg}_{\max 0.95D} = 1 : 370,$$

$$p_{\max 0.95P} = 1 : \text{Przg}_{\max 0.95P} = 1 : 374,$$

while the asymptotic approximation gives an underestimated value:

$$p_{\max 0.95} = 1 : \text{Przg}_{\max 0.95} \approx 1 : 484.$$

When the conventionally chosen confidence level is 99.999%, we receive from the binomial distribution and Poisson's approximation respectively:

$$p_{\max 0.99999D} = 1 : \text{Przg}_{\max 0.99999D} \approx 1 : 179,$$

$$p_{\max 0.99999P} = 1 : \text{Przg}_{\max 0.99999P} \approx 1 : 178,$$

while the asymptotic approximation gives an underestimated value:

$$p_{\max 0.99999} = 1 : \text{Przg}_{\max 0.99999} \approx 1 : 299.$$

When the conventionally chosen confidence level is 99.9999%, we receive from the binomial distribution and the Poisson approximation respectively:

$$p_{\max 0.999999D} = 1 : \text{Przg}_{\max 0.999999D} \approx 1 : 158,$$

$$p_{\max 0.999999P} = 1 : \text{Przg}_{\max 0.999999P} \approx 1 : 159,$$

while the asymptotic approximation gives an underestimated value:

$$p_{\max 0.999999} = 1 : \text{Przg}_{\max 0.999999} \approx 1 : 278.$$

An additional comment is necessary here. Let us note that the choice of a definite level of confidence has a considerable impact on the estimation of the value of the random match of the haplotype sequence of the putative remains of Copernicus with the haplotypes from the EMPOP1 database, i.e. the higher the confidence level, the more accurate estimation of the random match. In the present case (for 4 samples from the 3830 samples from the Eurasian population), for the confidence level of 99.9999% and the data taken from the EMPOP1 database we obtained an estimation of the value of the random match of 1:258. (It is more precise than the estimation given above 1:370, determined for the confidence level of 95%.)

In this context, I would like to stress with all firmness that the practice of determining the random match of the DNA sequence only at the 95% confidence level, common around the world in genetic studies (including forensic genetics!), is simply a waste of the information contained in the databases. In other words,

it is possible to extract a more precise estimation of this match from the available databases without a greater computational difficulty. Of course, the 95% confidence level is sufficient in many practical issues, such as technical measurements, but not very useful when we touch upon such important issues as the court rulings, which determine further lives of the accused, are based on the test of a random match.<sup>40</sup>

Moreover, contrary to the thesis formulated by Ms M. Landau of the weekly “Wprost” (and whose source were ultimately the authors of the DNA research, who had given her an authorized interview, which was evidenced by the fact that this text was distributed at the website of the Museum and Institute of Zoology, PAS),<sup>41</sup> The determined values of the random match are *by no means infinitesimally small*, because, for example:

- For the confidence level of 95% the probability of the random match of 1:370 (not 1:483 as the authors of the research of the alleged remains of Copernicus claimed) is more than 18.4 times higher than the probability of death in a road accident in Poland in 2007 per capita and over 1.6 times higher than the likelihood of injury in a road accident in Poland in 2007 per capita.<sup>42</sup>
- For the confidence level of 99.999% the probability of the random match of 1:179 is more than 38.1 times higher than the probability of death in

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<sup>40</sup> The authors of the statistics textbook of StatSoft company (2006, 2007, pp. 5–6; 2011) show a good understanding of the issue of the conventionality level of confidence, also called the statistical significance – cf. Chap. “Getting Started with Statistics Concepts”, the topics: “What is «Statistical Significance» (p-value)?” and “How to Determine that a Result is «Really» Significant?”

<sup>41</sup> “Such a profile occurs once per 483 cases. The probability that the same mtDNA profile, belonging to two different persons was discovered both in the cathedral and in the book of Copernicus (that is *Calendarium Romanum magnum, Caesareae maiestati dicatum* – M.K.), virtually does not exist” (Landau 2009, p. 51; translation – M.K.).

Let me add here a purely linguistic remark. I believe that the expression “the probability of an event virtually does not exist” is a stylistic error. We should instead use the phrase “the probability of an event is small, very small, little or virtually equal to zero.”

It is worth recalling that the thesis propagated by Ms. Landau was strengthened by the assurances of Prof. Jerzy Gąssowski that the works from the library of Copernicus had not been viewed by anyone, because they had been completely forgotten (cf. the statement of Jerzy Gąssowski, quoted above in chapter 4). As I already mentioned, this thesis is false: many scholars studied Copernicus’s books held in Sweden since 1626 as the spoils of war (see above, chapter 5, fn.12).

<sup>42</sup> According to the estimates of Główny Urząd Statystyczny (Central Statistical Office in Poland) at the end of 2007, Poland had 38 126 000 inhabitants, and according to the data of the Polish Police (cf. Portal Policja 2010), 5,583 people were killed and 63 224 were injured in 49 536 accidents in Poland in 2007.

a road accident in Poland in 2007 per capita and more than 3.3 times higher than the likelihood of injury in a road accident in Poland in 2007 per capita.

- For the confidence level of 99.9999% the probability of an accidental conformity of 1:158 is more than 43.2 times higher than the probability of death in a road accident in Poland in 2007 per capita and more than 3.8 times higher than the likelihood of injury in a road accident in Poland in 2007 per capita.

Hence, on the basis of the probability values of the random match given above, one cannot conclude that these probabilities are virtually equal to zero, and thus exclude the possibility of a random match of the mtDNA sequence of the putative remains of Copernicus and the mtDNA of other persons who used the library of Copernicus.

## **8.2. The estimation of the random match of the determined mtDNA profile and the samples in the EMPOP1 database for forensic and literature data**

The EMPOP database, in addition to forensic data, also includes literature data. The latter, however, were ignored by the authors of the DNA analyses of the alleged remains of Copernicus. When we take all these data into account, it appears that the first version of the EMPOP database (referred to as EMPOP1) with forensic and literature data, contained in total 4476 samples of the Eurasian populations, including 5 samples (not only 4) with a haplotype sequence matching the sequence of the haplotype of the mtDNA of the putative remains of Copernicus, with the additional (fifth) sample coming from Kościerzyna (Poland)!

In this part of the paper I will focus on the analysis of the purely quantitative aspect of this issue (I will discuss the aspect of this being a Polish sample in the latter part of this article, i.e. in section 8.4).

When we carry out the calculations for the 95% confidence level, then we obtain (approximately) the same value of the random match from the binomial distribution and the Poisson's approximation, respectively:

$$p_{\max 0.95D}^{\text{bin}} = 1 : \text{Przg}_{\max 0.95D}^{\text{bin}} = 1 : 384,$$

$$p_{\max 0.95P}^{\text{bin}} = 1 : \text{Przg}_{\max 0.95P}^{\text{bin}} = 1 : 384,$$

while the asymptotic approximation gives an underestimated value:

$$p_{\max 0.95}^{\text{bin}} = 1 : \text{Przg}_{\max 0.95}^{\text{bin}} \approx 1 : 477.$$

When the conventionally chosen confidence level is 99.999%, we receive the approximated values of the random match from the binomial distribution and the Poisson approximation, respectively:

$$p_{\max 0.99999 D}''' = 1 : \text{Przg}_{\max 0.99999 D}''' \approx 1 : 192,$$

$$p_{\max 0.99999 P}''' = 1 : \text{Przg}_{\max 0.99999 P}''' \approx 1 : 191,$$

while the asymptotic approximation gives an underestimated value:

$$p_{\max 0.99999}''' = 1 : \text{Przg}_{\max 0.99999}''' \approx 1 : 301.$$

When the conventionally chosen confidence level is 99.9999%, we obtain the approximate values of the random match from the binomial distribution and the Poisson approximation, respectively:

$$p_{\max 0.999999 D}''' = 1 : \text{Przg}_{\max 0.999999 D}''' \approx 1 : 169,$$

$$p_{\max 0.999999 P}''' = 1 : \text{Przg}_{\max 0.999999 P}''' \approx 1 : 170,$$

while the asymptotic approximation gives an underestimated value:

$$p_{\max 0.999999}''' = 1 : \text{Przg}_{\max 0.999999}''' \approx 1 : 281.$$

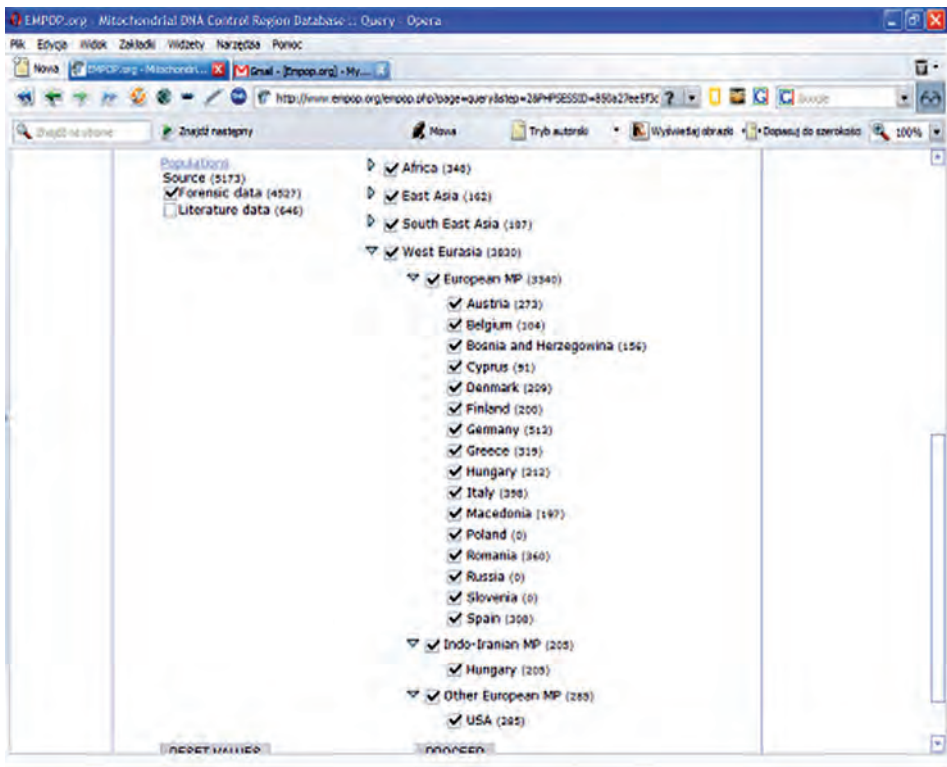
Analogously, as in the case under consideration above, the determined values of the random match are not at all infinitesimally small, because for the confidence level of 95% the probability of random match 1:384 is more than 18.7 times higher than the probability of death in a road accident in Poland in 2007 per capita and more than 1.5 times greater than the likelihood of injury in a road accident in Poland in 2007. For the confidence level of 99.999% the probability of the random match of 1:192 is more than 35.5 times higher than the probability of death in a road accident in Poland in 2007 and more than 3.1 times higher than the likelihood of injury in a road accident in Poland in 2007; and for the confidence level of 99.9999% the probability of random match of 1:169 is more than 40.4 times higher than the probability of death in a road accident in Poland in 2007 and more than 3.5 times greater than the likelihood of injury in a road accident in Poland in 2007.

Hence, based on the considerations carried out here, I want to draw an analogous conclusion as in section 8.1. Based on the above values of the probability of a random match, one cannot conclude that these probabilities are virtually equal to zero, and thus to rule out the possibility of a random match of the mtDNA sequences of the putative remains of Copernicus and of other people who had used the personal library of Copernicus.

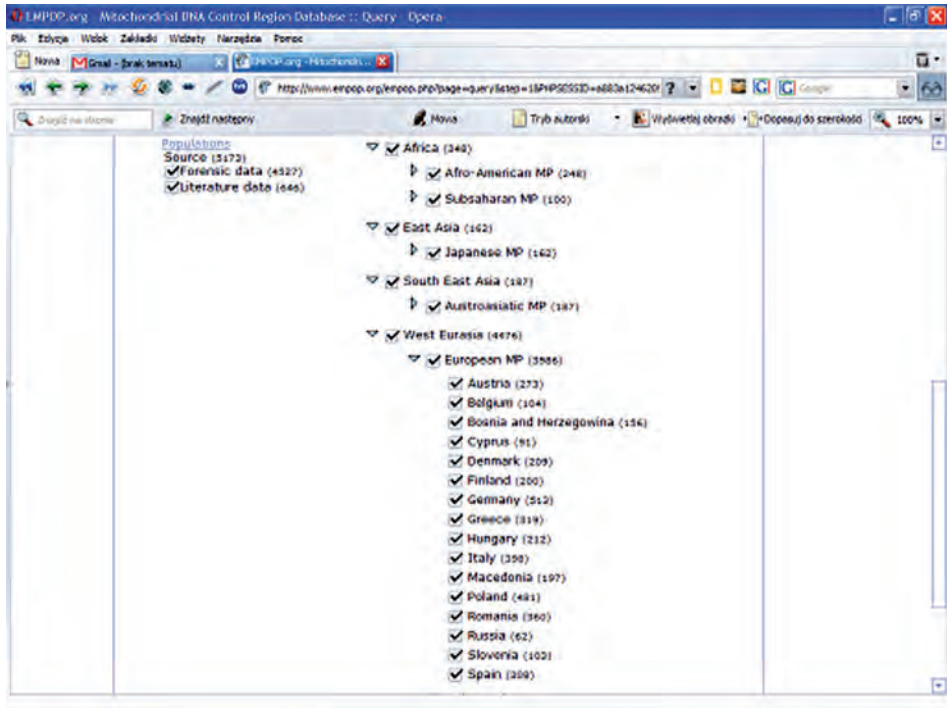
### 8.3. Selective knowledge of the mtDNA population databases and incomplete knowledge in the field of genetic genealogy

The search in the EMPOP mtDNA database (17) showed that the mtDNA profile found in St. Cross Altar skeletal remains occurred in 4 of 3,830 West Eurasian haplotypes present in the database. The matching profiles were previously seen in individuals derived from Germany (1 from Rostock and 2 from Ulm) and Denmark (Copenhagen). No identical haplotype was found in other population groups (of total of 4,527 haplotypes in the database). The result of the EMPOP database is interesting from the perspective of Copernicus' maternal lineage. His maternal ancestors may have originated from Silesia, and can thus be of German descent (Bogdanowicz *et al.* 2009, p. 2–3).

As I already mentioned, the authors of the DNA research of the putative remains of Nicolaus Copernicus accepted the EMPOP mtDNA database as the



**Fig. 9.** EMPOP1 database – forensic data (screenshot). *We can see that for the forensic data the EMPOP1 database contained 3830 samples for the Eurasian population, including Denmark – 209, Germany – 513, Poland – 0.*



**Fig. 10.** EMPOP1 database – forensic and literature data (screenshot). We can see that for the forensic and literature data the EMPOP1 database contains 4476 samples for the Eurasian population, including Denmark – 209, Germany – 513, Poland – 481. There was no room in the screenshot for the data from the Indo-Iranian metapopulation (Hungary – 205) and other European metapopulations (USA – 285; see above fig. 9).

reference population mtDNA database. At the same time, they used only forensic data of this database, ignoring (without giving any reason) literature data. However, they made an even more serious mistake arguing that in the so-called *forensic EMPOP1 database* (that is the mtDNA database collecting the samples that were tested in court cases) there are no samples from Poland with the haplotype they had determined, but there are such samples from Germany (three) and Denmark (one). On claiming that these authors *did not provide the key information* that the forensic EMPOP1 database did not contain any samples from Poland – see fig. 9! Consequently, by definition, one could not find samples from Poland in this database, regardless of the profile they had. This means that the forensic EMPOP database was useless with regards to reliable inferences about the possible distribution of samples with a determined haplotype in Poland (I will resume this topic later in this article).



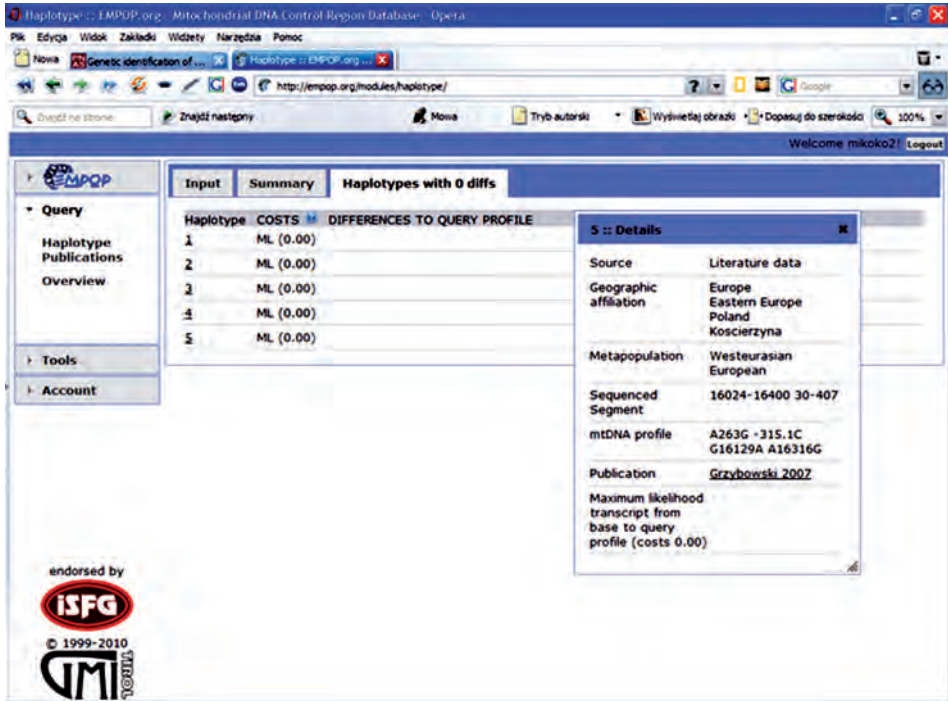


Fig. 11. EMPOP2 database – the sample from Kościerzyna, Poland (this sample had already been stored in the EMPOP1 database) (screenshot).

Let me add yet another piece of puzzling information. The authors of these studies did not mention that in the so-called *literature EMPOP1 database* (that is in the database including samples cited in the scientific literature), there were and are samples from Poland (in the EMPOP1 version: 481 samples out of all merely 646 samples of the European population), including one sample from Kościerzyna matching the haplotype determined for the putative remains of N. Copernicus – see. fig. 10 and 11 (in the case of the second image I have a screenshot from the second version of the EMPOP database (EMPOP2), but the sample from Kościerzyna had been already stored in the EMPOP1 database). The authors also overlooked that in another population database of mtDNA, namely the MitoSearch DNA Database,<sup>43</sup> an open public website of the Family Tree DNA company (dealing with genetic research for genealogical purposes), up to 16 samples of the haplotype determined by them can be found, including two from Poland but none from Germany (I will resume this topic later in this article). Moreover, they did not pay attention to the fact of the small number of samples in the fo-

<sup>43</sup> Cf. MitoSearch DNA Database 2010.

rensic and the literature databases of the EMPOP1 (both regarding the size of the European metapopulation and the sizes of individual national metapopulations), which requires circumspection in formulating statistically meaningful conclusions on the basis of the data included in this database, which particularly refers to the analysis of rare and unique haplotypes (I will resume this topic later in this article, see also the considerations set out above in sections 8.1 and 8.2).

#### **8.4. Selective knowledge of the Y–DNA population databases and incomplete knowledge in the field of genetic genealogy**

In the case of the paternal lineage, the search of the YHRD Y chromosome population database did not reveal the haplotype found in the examined human remains among the 2,595 complete haplotypes comprising the Eurasian metapopulation and among all of the 10,243 complete haplotypes included in the database originating from all over the world. The YHRD database size varies significantly based on the number and character of loci that are included in the search profile. By limiting their number to the core set called the minimal haplotype (most often analyzed Y–STR loci) the searchable data in the YHRD database were significantly extended, giving the total number of 63,369 haplotypes. In this larger dataset, a minimal Y–chromosomal haplotype, derived from the putative Copernicus remains, was present 47 times, 44 in a European metapopulation consisting of 31,762 minimal Y–chromosome haplotypes. The same haplotype has been found in individuals from many countries, including Austria, Germany, Poland, and the Czech Republic. It is interesting to note that Copernicus’ paternal ancestors may also have originated from Silesia (Bogdanowicz *et al.* 2009, p. 2).

The authors of the DNA research of the alleged remains of Nicolaus Copernicus did not avoid an essential error in the interpretation of the Y–DNA haplotype they had determined for these remains, that is the seventeen STR positions. Using the data from the YHRD (Y Chromosome Haplotype Reference Database<sup>44</sup>) for the interpretation of these results, the authors limited their interest only to an examination of the European distribution of the samples of the so-called minimal set for the Y–chromosomal haplotype (that is a combination of nine positions: DYS19, DYS385(1+2), DYS389 I/II, DYS390, DYS391, DYS392, DYS393) in the haplotype determined by them. It had seventeen determined positions (beside those, already listed, nine positions, there were also positions: DYS437, DYS438, DYS439, DYS448, DYS456, DYS458, Y–GATA–C4 (= DYS635) and Y GATA H4). By adopting this assumption, the authors of the DNA research of the alleged remains of Copernicus determined that such a nine-positional haplotype appeared 47 times in the YHRD database, including 44 in the European metapopulation, among others, in Austria, Germany, Poland and the Czech Republic. In this context, the research-

<sup>44</sup> Cf. the YHRD – Y Chromosome Haplotype Reference Database 2010.

ers re-announced the information that also Copernicus's family from his paternal lineage could have come from Silesia (I will return to this thread later in the article).

However, the examination of the spread of only the minimal Y-DNA haplotype of the alleged remains is a mistake, because from genetic genealogy we know very well that the minimal haplotype is poorly suited for the analysis of the issue of the spread of a selected group of the European metapopulation due to its low selectivity. Therefore, to increase the accuracy of the findings in the issue under discussion, we should increase the number of the analyzed haplotype positions, without restricting our attention only to the European metapopulation. When this is done in a systematic way (by gradually increasing the number of considered positions), we receive the following results:

- For 9 positions of the minimal haplotype of the alleged remains of Copernicus, the YHRD database contains 60 samples (including 47 in the European metapopulation),<sup>45</sup> most from Germany – 12 samples, 6 from the USA (European Americans), 4 from the USA (Spanish Americans), 3 from Poland and from many other countries in Northern Europe, Western Europe and Central Europe, and Argentina, Brazil and Peru.
- For 11 positions – 16 samples, including 12 in the European metapopulation: 4 – the USA (European Americans), 1 – the USA (Spanish Americans), 1 – Manaus (Brazil, mixed population), 1 – Macapá (Brazil, mixed population), 1 – Southern Poland, 1 – Hradec Kralove (Czech Republic), 1 – Wrocław (Poland), 1 – Stuttgart (Germany), 1 – Gotland (Sweden), 1 – Northern Portugal, 1 – Peru, 1 – Madrid (Spain), 1 – Belgium (Flanders).
- For 12 positions – 9 samples: 2 – the USA (European Americans), 1 – the USA (Spanish Americans), 1 – Macapá (Brazil, mixed population), 1 – Southern Poland, 1 – Hradec Kralove (Czech Republic), 1 – Wrocław (Poland), 1 – Peru, 1 – Belgium (Flanders).
- For 13 positions – 6 samples: 2 – the USA (European Americans), 1 – the USA (Spanish Americans), 1 – Macapá (Brazil, mixed population), 1 – Peru, 1 – Southern Poland, 1 – Wrocław (Poland).
- For 14 and 15 positions – 4 samples: 1 – the USA (European Americans), 1 – the USA (Spanish Americans), 1 – Macapá (Brazil, mixed population), 1 – Southern Poland.
- For 16 and 17 positions – there is no sample with the haplotype determined for the alleged remains of Copernicus.

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<sup>45</sup> It is worth noticing that these data differ from those given by the authors of the research into the alleged remains of Copernicus. They mentioned 47 samples in the YHRD database, including 44 from the European metapopulation. The difference is due to the fact that I used this database later than the authors mentioned, namely on 29 August 2009. In the meantime, subsequent samples were added to the database.

Hence, on the basis of a systematic survey of the YHRD database, we can reasonably conclude that the Europeans (but not necessarily relatives of Copernicus!) – with the haplotype whose core is identical to the subset of the Y–DNA haplotype of the putative remains of Copernicus – emigrated to North America and South America. (This is hardly a surprising conclusion – after all, it is known from historical sources that many Europeans, including also Poles, did so.) If we accept the additional strong assumption that the families coming from Europe, whose members’ Y–DNA samples are contained in the YHRD database, are indigenous families (that is families that did not change the area of residence, which would obviously have to be independently proved), it turns out that the above data taken from the YHRD database (samples from Wrocław – Silesia and Małopolska) are consistent with the thesis based on the historical records that Copernicus’s family came from Silesia and Małopolska.

I want to emphasize, however, that an objective mathematical measure of this match is the estimation of the so-called most likely TMRCA (Time to the Most Recent Common Ancestor) in the male lineage. For the recorded above 15-position match (of the 17-position haplotype of the alleged remains of Copernicus) the TMRCA is: 98 generations (that is  $98 \cdot 31 = 3038$  years ago) for probability of 97.5%; 85.5 generations (2650.5 years ago) for probability of 95.0%; 72.5 generations (2247.5 years ago) for probability of 90.1%; 58 generations (1798 years ago) for probability of 80.0%; 53.5 generations (1658.5 years ago) for probability of 75.4%, etc.<sup>46</sup>

Let us note next that the Sorenson Molecular Genealogy Foundation (SMGF), Y-Chromosome Database (2010) gives 1 sample with a full match in the 17 positions of the Y–DNA haplotype determined for the alleged remains of Nicolaus Copernicus, and this haplotype belongs to the Wallace family from the United States (living there since the second half of the 18<sup>th</sup> century). It follows from the analysis of the TMRCA that this family could have had a common ancestor with Copernicus in the male lineage before 47 generations (that is 1457 years ago) with the probability of 97.5%, before 38 generations (1178 years ago) with the probability of 94.9%, before 29.5 generations (914.5 years ago) with the probability of 90.0%, before 21 generations (651 years ago) with the probability of 80.6%, before 18 generations (558 years ago) with the probability of 75.5%, etc.<sup>47</sup>

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<sup>46</sup> In order to make these calculations I used the TMRC calculator designed by J. Douglas McDonald (2006), with the mutation rate of 0.0023, and the average generation of 31 years (such value is applied in the Sorenson Molecular Genealogy Foundation (SMGF), Y–Chromosome Database 2010). The results given overwrite the values presented in the Polish version of the article. (*A comment added in the English version of the article.*)

<sup>47</sup> Cf. above footnote. I want to add that the set of 17 loci of the Y–DNA haplotype is insufficient for the needs of genetic genealogy. Currently sets of 33, 37, 46, 67, or, most recently, even 101

### **8.5. Ignorance of the history of the portraits of Copernicus and the inferences about eye colour of Copernicus**

The authors of the DNA research into the alleged remains of Copernicus (Branicki and Kupiec) – having determined *the genotype C/C of rs12913832 SNP*, located in the gene *HERC2* – propagated the thesis about the light blue eye colour of Copernicus with 83.5% probability, and the light green colour with 13.5% probability. However, they ruled out the dark colours (hazel – with 3% probability and brown – with 0%) – Branicki 2008b; Branicki, Kupiec 2009; Bogdanowicz *et al.* 2009; Branicki, Kupiec, 2010. On this basis, these researchers claimed that the following portraits of Copernicus should be considered credible: the portrait by Domenico Ghirlandaio of 1505 (or 1508) and the portrait modelled on it, namely the portrait by John Chapman of 1802; each of these portraits presented a light eye colour of the astronomer. They questioned, however, in this respect, the verity of other portraits, which showed a dark eye colour. According to the authors of the final article on the DNA analyses of the alleged remains of the astronomer (Bogdanowicz *et al.* 2009, p. 3), one of the possible explanations of this fact was that the early portraits were made with the use of the technique of chalcography,<sup>48</sup> which does not render eye colour correctly. This was to have effect, in their opinion, on establishing the tradition of painting Copernicus with dark eyes.

Propagating the above theses, the authors had assumed an initial premise that portraits by Domenico Ghirlandaio of 1505 (or 1508) and John Chapman of 1802 were authentic and reliable (the reliability of the latter portrait was dependent on the credibility of the former one, because it was modelled on it). However, they were not right regarding the assumed authenticity and credibility of the former portrait and the credibility of the latter one. Namely, the former portrait was not created during the life of Copernicus at all, i.e. in 1505 or 1508, but long after his death, soon after the publication (Florence, 1962) of the work of Galileo Galilei *Dialogo sopra i due sistemi del mondo massimi tolemaico e Copernic (Dialogue Concerning the Two Chief World Systems: Ptolemaic and Copernican)*.

This is evidenced by three facts: 1) in the years 1505–1508 the heliocentric theory of Copernicus had not yet been formulated, 2) the simplified version, cor-

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Y–DNA markers are in use. Due to this increasing number of markers, the match of the compared haplotypes in many loci means that the TMRCAs are significantly shorter.

<sup>48</sup> “Chalcography (gr. *chalkós* ‘copper’ + *gráphein* ‘to write’) printing, a method of preparation and implementation of intaglio printing by engraving a pattern on a copper plate and printing it after the application of paint” (*Słownik wyrazów obcych*. Scientific Editor: Prof. Irena Kamińska-Szmaj. Authors: Mirosław Jarosz *et al.* Wrocław: Wydawnictwo Europa, 2001, p. 109; translation – M.K.).

rected by Galileo Galilei, of the Copernican theory became widely known only after the publication of the work mentioned, 3) it is precisely in that work of Galileo Galilei that the emblem “tellurium” (i.e. the symbol of the solar system) was used for the first time. Hence, these two portraits cannot be considered reliable sources of information about the eye colour of Copernicus.

Furthermore, claiming that the use of the chalcography technique had effect on establishing the tradition of painting Copernicus with dark eyes, the authors of this conjecture in their deliberations completely neglected the fact that, according to historical records, there were images of Copernicus painted during his lifetime, which shaped the subsequent images based on these portraits.

### **8.6. Attribution to J. Adamczewski of the thesis on the German character of Silesia and that Copernicus’s maternal grandmother came from the Reuss (Russe), not the Modlibóg family**

The result of the EMPOP database search is interesting from the perspective of Copernicus’ maternal lineage. His maternal ancestors may have originated from Silesia, and can thus be of German descent. Copernicus’ grandmother, Catherina, was first married to Heinrich Peckau, who was a member of the council of Thorun. After Heinrich’s death, Catherina was married to a trader and famous enemy of the Teutonic Knights – Lucas Watzenrode. Together they had 3 children, Christina, Lucas, and Nicolaus Copernicus’ mother, Barbara [Adamczewski J. (1972), *Nicolaus Copernicus and His Epoch* (Interpress, Warszawa) (in Polish)] (Bogdanowicz *et al.* 2009, p. 3).

The reference to the work by Jan Adamczewski suggests that it is in this historical and biographical study where the information on the German origin of Copernicus in his maternal lineage appears. But this is not true: J. Adamczewski (1972) accepted the old thesis of Polish Copernicologists, which was propagated, among others, by Krzyżanowski (1843, reprinted: Polkowski (ed.), 1873–1875, vol. II, p. 113; 1843b, 1843c, reprinted Polkowski (ed.), 1873–1875, vol. II, p. 134); Lach-Szyrma (1844, p. 367), Polkowski (1873, pp. 3–75) and L.A. Birkenmajer (1924, pp. 245–247). It said that the maternal grandmother of Copernicus was Catherine “de gente Modlibog,” i.e. née Modlibóg, coming from a family connected by marriages with rich bourgeois families of Toruń, Kraków, Elbląg, Gdańsk and known, noble families, such as Działyński, Kościelecki, Konopacki, Czapski and Gosiewski (see Adamczewski 1972, p. 22).

This thesis, in turn, referred to the information on the genealogy of the Watzenrode-Copernicus family provided by Gottfried Reinhold Centner (1762, p. 406; 1763, p. 46), according to whom Copernicus’s maternal grandmother was “Catharina Rüdigerin Modlibog gente,” and, therefore, she was the wife of an un-

specified Rüdiger and her maiden name had a uniquely Polish sound – Modlibóg (“to pray to God”).

In addition, Adamczewski also claimed – in full accordance with Krzyżanowski, Polkowski and L.A. Birkenmajer – that from the 13<sup>th</sup> to the 15<sup>th</sup> century Silesia was inhabited by both Polish and German populations, and provided information about the origin of the Copernicus family:

The Copernicus family originated from the Silesian village Koperniki, located in the area of Nysa and Otmuchów. Since the end of the 12<sup>th</sup> century Koperniki belonged to the estate of the Bishopric of Wrocław, and were located within the area of the Kingdom of Poland. The village, founded before 1272, was inhabited mainly by Polish population, as indeed the whole Otmuchów and Nysa district (Adamczewski 1972, p. 7).

Adamczewski also repeated – in full accordance with L.A. Birkenmajer (1924, pp. 1–48) – the information about the origin of the Watzenrode family from Silesia and their emigration to Chełmno district in about 1360. He did not mention, however, the additional hypothesis of L.A. Birkenmajer, explaining the reason behind this move. According to it, the Watzenrodes left Silesia, when in 1356 the last free Silesian Duchies of Jawor, Ziębica and Świdnica (they had lived so far in the latter two) lost political contact with the Kingdom of Poland and were incorporated into the Bohemian Crown (being in union with Germany and Hungary).

Propagating the thesis described above “that, among others, Copernicus’s maternal grandmother came from the family of Reuss (Russe) and her first husband was to be Heinrich Peckau” (contrary to Adamczewski’s thesis), the authors of the publications on the DNA analyses of the putative remains of Copernicus should have relied on the publication of another author. It was Karol Górski who had written that (1968, pp. 8–10, 1973, pp. 32–33, 215; 1973b, pp. 6–7), and who had accepted the findings of Leopold Prowe (1853; 1883, vol. I, pp. 68–69 and fn.\* and vol. II, pp. 452–453) and George Bender (1881, p. 71). However, unlike the authors of the publications on the DNA analyses of the putative remains of Copernicus, Karol Górski did not conceal the fact that Silesia was inhabited by both the Germans and the Poles.

I would like to add yet another important complement. According to the recent studies by Krzysztof Mikulski (1997a; 2008), both variants of the origin of Copernicus’s maternal grandmother should be rejected in the light of the detailed analysis of historical sources. In the first publication Mikulski postulated that Copernicus grandmother came from the Lodel family (Mikulski 1997a, p. 251). In the second publication, he denied such a possibility: he held that “it is difficult to establish her maiden name” (Mikulski 2008, p. 50), and as *quite probable* he adopted the thesis that the maternal grandmother of Copernicus came from the

family of Kordelitz, belonging to the patriciate of Toruń (Mikulski 2008, pp. 62, 64). As we can see, the issue of the origin of the maternal grandmother of Copernicus has not been unequivocally resolved yet.

To be precise, it is worth recalling that Toruń belonged to the Hanseatic League. The patriciate of the city used the German language in its administrative, judicial and economic matters, and in 13<sup>th</sup>–16<sup>th</sup> century very few of its members had Polish-sounding names (cf. Gumowski 1970; Jasinski 1999, pp. 138–139; Tandecki 1999, pp. 203–206; Mikulski 1997b; Bishop 1992, pp. 80–86). However, such facts about Toruń, do not prove the German character of Silesia.

### **8.7. Ignorance of the history of the ethnic geography of Silesia and the lack of knowledge about the history of the debate on the ethnic origin of Copernicus**

What results from the above statements of the researchers of the DNA of the alleged remains of Copernicus (Bogdanowicz *et al.* 2009, p. 3) is a proposition that Silesia was dominated by the German population already at the time the family of Waczinrod / Waczelrodt / Waczenrod / Watzenrod / Watzenrode<sup>49</sup> lived in Silesia (that is at least since the mid-thirteenth century to the mid-fourteenth century) or the lifetime of the astronomer (that is at the turn of the fifteenth and sixteenth centuries). This proposition, however, stems from the ignorance of the issues under consideration.

I would like to recall the basic historical findings: it is not elsewhere, but in the Lower Silesia or in the Middle Silesia as it used to be called, in the Cistercian monastery in Henryków in 1270 that the first Polish-known phrase was recorded: “Daj, ac ja pobruszę, a ty pocziwaj”<sup>50</sup> (“Let me grind, and you rest”), and it is not elsewhere, but in the Lower Silesia or the Middle Silesia as it used to be called, in Wrocław, in a Latin church register, in 1475 the first printed Polish words of the prayers “Our Father”, “Hail Mary” and “I believe” were published.

The Polish character of Silesia, from the 10<sup>th</sup> to 16<sup>th</sup> century, is evidenced by historical research<sup>51</sup> and the etymological studies of geographical names;<sup>52</sup> this also applies to the Otmuchów and Nysa districts, where the family of Copernicus

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<sup>49</sup> On the subject of a number of different spellings of the name, cf. Birkenmajer 1924, pp. 5–21.

<sup>50</sup> Cf. *Wikipedia* 2011 and Piotr (an abbot of the Monastery of St. Mary the Virgin in Henryków) 1268–1273, p. XXIII.

<sup>51</sup> Cf. A. Galas, A. Galas 2001; Czaplinski, Kaszuba, Wąs, Żerelik 2002; *Wikipedia* 2010e.

<sup>52</sup> Cf., for example, Rospond, Borka, Sochacka (eds.) 1970–2007, vol. 1–13.



originated from, and the Świdnica district, where the family of Watzenrod came from.<sup>53</sup> What is more, despite the fact that in 1741 Silesia came under the rule of Prussia,<sup>54</sup> and was subjected to organized Germanisation (such as, among others, the *Kulturkampf*),<sup>55</sup> the Polish population remained here. Its existence – especially in Opolski Silesia and Upper Silesia, even in the 18<sup>th</sup>, 19<sup>th</sup> and 20<sup>th</sup> century (until 1945) – is evidenced unequivocally in the studies of even German scientists, including:

- α) “Karte der Sprachgenzen in Ober- u. Mittelschlesien 1790 u. 1890” (“Map of linguistic boundaries of Upper and Middle Silesia in 1790 and 1890”), included in the work of Joseph Partsch, a German professor of geography of the University of Wrocław, *Schlesien: eine Landeskunde für das deutsche Volk*, vol. 1: *Das ganze Land* (Breslau: Ferdinand Hirt, Königliche Universitäts- und Verlags – Buchhandlung, 1896), between p. 364 and 365 (fig. 12).
- β) “Sprachen Karte von Mittel- und Oberschlesien 1905” (“Language Map of Middle and Upper Silesia in 1905”) by Richard Andree, included in: *Andrees Handatlas* (6th ed. Leipzig 1914) (fig. 13).
- γ) A monograph (with many maps) by dr Paul Weber, *Die Polen in Oberschlesien. Eine statistische Untersuchung...* (Berlin: Verlag von Julius Springer, 1914).
- δ) There are also Polish authors of such studies – cf. for example Kuroński 1939; Hajduk, Popiołek 1939; Lehr, Osmańczyk 1972; Osmańczyk 1985; 1989a; 1989b; Gawryszewski 1995; Borowicz 2004; Kaczmarek 2006; *Wikipedia* 2010c; 2010i.

To illustrate this problem I enclose the following two maps: “The stages of Germanisation of Silesia” by Z. Kaczmarczyk from 1953 (fig. 14) and “The map of the Polish minority in the Third Reich in 1934” (fig. 15). The latter should be supplemented with additional information about the number of members of the Union of Poles in Germany (under the sign of Rodło),<sup>56</sup> established in 1922 (fig. 14).

According to the post-war findings on the basis of the surviving archives, in the middle of 1924 the Union of Poles in Germany had about 32 000 members. In the Silesian District I there were 104 sections with more than 5100 members, that is 16.5% of

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<sup>53</sup> Cf. Rospond 1973, pp. 57–80, 140–145.

<sup>54</sup> Silesia lost unity with the Kingdom of Poland in the mid-fourteenth century, when it became a part of the Crown of the Kingdom of Bohemia. Since then, the process of Germanisation increased gradually, and was even intensified, when after the death of Ludwik Jagiello in 1526, along with the entire Crown of the Kingdom of Bohemia, it came under the power of the Habsburg dynasty (cf. A. Galas, A. Galas 2001; Czaplinski, Kaszuba, Wąs, Żerelik 2002).

<sup>55</sup> Cf. Trzeciakowski 1970; 1990.

<sup>56</sup> On the activities of the Union of Poles in Germany, cf. e.g. Hajduk, Popiołek 1939; Lehr, Osmańczyk 1972; Osmańczyk 1985; 1989a; 1989b; *Wikipedia* 2010i.



Fig. 12. "Karte der Sprachgrenzen in Ober- u. Mittelschlesien 1790 u. 1890" (source: Partsch 1896, after p. 364; in the electronic version: p. 0381).

the total number of members; in District II, that is in Berlin and the Polabian Lands – about 6200, that is almost 20% of the total, in Westphalia–Rhine District III in 160 sections – about 13 000, that is almost 45% of the total, in the East Prussian District IV – around 4000, that is close to 12.5% and, finally, on the Kashubian-Lubusz border of the District V – around 2700, that is almost 6% of the total. In subsequent

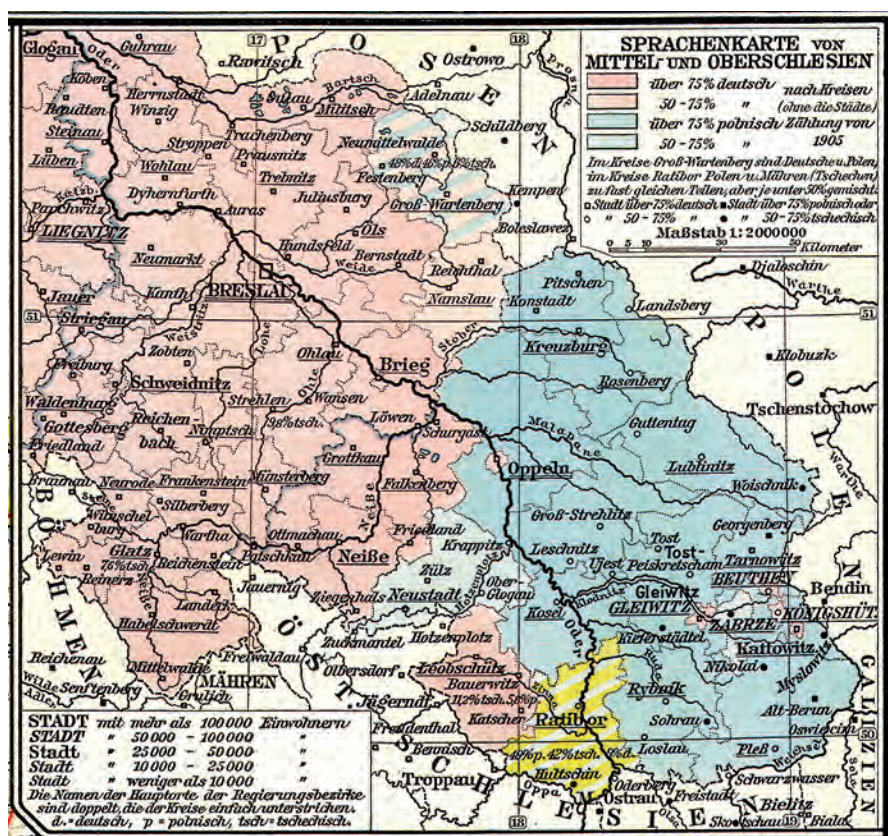


Fig. 13. R. Andree, "Sprachen Karte von Mittel- und Oberschlesien 1905" (source: Andree 1914; <http://www.atlassen.info/atlassen/velhagen/andha06/piclarge/andha1914k051b.jpg>).

years, until 1930 the number of members nearly doubled, exceeding 60 000, however the proportions hardly changed, and all in all in favour of the Land of the Oder. The years of the economic crisis and the open terror 1931 – 1933 resulted in a decrease of several thousands, which slowed briefly in 1934–1935. The next years of the pressure of the total Nazi machine caused a decrease in the number of active members of the Union, but in 1938–1939 it was estimated as not less than in the summer of 1924 (Osmańczyk 1989a, p. 22–23).

It is worth remembering in this context that the Union of Poles in Germany acted so dynamically that on 6 March 1938 it could organize the 1<sup>st</sup> Congress of this Union in the very centre of Berlin, at the largest – at that time – theatre hall of the city (for five thousand people), Theater des Volkes (The People's Theatre). It was attended by the representatives of all the five districts: 1) Śląsk Opolski (Op-

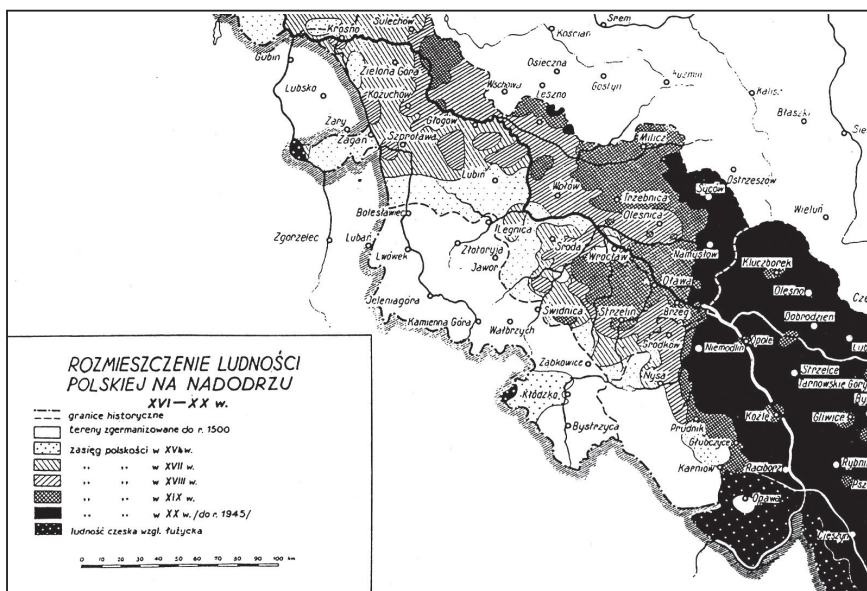


Fig. 14. “The stages of Germanisation of Silesia according to Z. Kaczmarczyk” (source: Kaczmarczyk 1953, p. 24; Borowicz 2004, p. 32, fig. 3).



Fig. 15. “The map of the Polish minority in the Third Reich in 1934” (source: “Tygodnik Ilustrowany” of 12 August 1934, reprinted in: Osmańczyk 1985, p. 21).

pelner Schlesien), 2) Berlin – the Polabian districts (Brandenburg, Saxony, Lower Silesia, and Pomerania), 3) Westphalia and Rhineland, 4) the Frontier March of Posen-West Prussia and Kashubia, 5) East Prussia.<sup>57</sup>

Hence, even in Nazi Germany, it was not doubted that large clusters of Poles lived in different parts of the country, including Silesia. The awareness of this fact made that, with reference to the Prussian-German nationalist tradition of the 18<sup>th</sup> – 20<sup>th</sup> century, actions aiming at total intimidation and Germanisation of this Polish population were strengthened, which was something this population particularly dramatically experienced during the World War II.

Thus, formulating the proposition of the German character of Silesia without mentioning in this context even briefly that also Poles (and Czechs) lived in Silesia, the authors of the genetic studies of the alleged remains of Copernicus demonstrated a lack both of the political sensitivity in understanding Polish-German relationships and of the knowledge of the difficult history of Polish-German relationships,<sup>58</sup> including the history of the debate on the ethnic origin of Copernicus.<sup>59</sup>

### **8.8. Erroneous inferences about the ethnic origin of Copernicus and his parents**

The authors of the DNA studies of the putative remains of Nicolaus Copernicus undertook the thread of ethnic origin of Copernicus and his parents, among others, in the following publications: Kupiec 2008; Branicki, Kupiec 2008; Bogdanowicz 2008 and Bogdanowicz *et al.* 2009. From the analyses of mtDNA and Y-DNA sequences of these remains, a conclusion resulted on the German origin of Nicolaus Copernicus. The authors of these studies themselves explicitly formulated this thesis in relation to the origin of his mother (Kupiec 2008; Branicki, Kupiec 2008; Bogdanowicz 2008 oraz Bogdanowicz *et al.* 2009):

‘We started with the study of the mitochondrial DNA inherited in the female lineage, which allows for a comparison with up to modern living relatives of the maternal lineage. After checking in the European population database, it turned out that five individuals have the same mitochondrial type, including four people living in Ger-

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<sup>57</sup> Cf. Lehr, Osmańczyk 1972; Ambasada Polski w Berlinie 2005.

<sup>58</sup> By claiming it all, I would also like to note clearly two issues: I highly appreciate the German culture and I am a strong supporter of a genuine Polish-German reconciliation based on mutual equality and historical truth, and in particular on the respect for the idea of a small homeland (*Heimat*) or a private homeland (cf. Fundacja Kultury 2000; *Lublin: Pamięć Miejsca* 2010; *Wikipedia* 2010d; Ossowski 1984, p. 26).

<sup>59</sup> I extensively describe the history of the debate on the ethnic origin of Copernicus in: Korkowski 2009b, p. 115–136, 402–431.

many, which would confirm the maternal lineage of Copernicus, whose mother was German. During the study we also determined the Y chromosome, possessed only by men,' – said Tomasz Kupiec of the Institute of Forensic Research to PAP (Kupiec 2008, in Polish).

The search in the EMPOP mtDNA database showed that the mtDNA profile found in St. Cross Altar skeletal remains occurred in 4 of 3,830 West Eurasian haplotypes present in the database. The matching profile were previously seen in individuals derived from Germany (1 from Rostock and 2 from Ulm) and Denmark (Copenhagen). No identical haplotype was found in other population groups (of total of 4,527 haplotypes in the database).

The result of the EMPOP database is interesting from the perspective of Copernicus' maternal lineage. His maternal ancestors may have originated from Silesia, and can thus be of German descent (Bogdanowicz *et al.* 2009, p. 2–3).

On the other hand, these authors implicitly formulated the thesis of the German origin of the paternal lineage of Copernicus (Branicki, Kupiec 2008; Bogdanowicz 2008 and Bogdanowicz *et al.* 2009):

In the case of the paternal lineage, the search of the YHRD Y chromosome population database did not reveal the haplotype found in the examined human remains among the 2,595 complete haplotypes comprising the Eurasian metapopulation and among all of the 10,243 complete haplotypes included in the database originating from all over the world. The YHRD database size varies significantly based on the number and character of loci that are included in the search profile. By limiting their number to the core set called the minimal haplotype (most often analyzed Y–STR loci) the searchable data in the YHRD database were significantly extended, giving the total number of 63,369 haplotypes. In this larger dataset, a minimal Y–chromosomal haplotype, derived from the putative Copernicus remains, was present 47 times, 44 times in a European metapopulation consisting of 31,762 minimal Y–chromosome haplotypes. The same haplotype has been found in individuals from many countries, including Austria, Germany, Poland, and the Czech Republic. *It is interesting to note that Copernicus' paternal ancestors may also have originated from Silesia* (emphasis added) (Bogdanowicz *et al.* 2009, p. 2).

Given that in the previously quoted paragraph of the said article (Bogdanowicz *et al.* 2009, p. 3), the authors argued that Silesian origin of Copernicus's mother's family (that is the family of Watzenrode) suggests their German descent, it should also be stated – in order to be consistent – that the male ancestor of Copernicus coming from Silesia would be ethnically German. However, such thesis was not openly propagated by them in their publications. Nevertheless, such a conclusion presents itself, particularly in the context of the determination

made by Wojciech Branicki and Tomasz Kupiec that Copernicus was a carrier of the gene called HERC2 (Branicki 2008b; Branicki, Kupiec 2009; Bogdanowicz *et al.* 2009; Branicki, Kupiec 2010). This gene determines the blue color of eyes and fair complexion – and such appearance had been connected for a long time with the “master race”: “racially pure Aryans”.

Such conclusion was drawn by a Polish journalist of the “Dziennik.pl” newspaper (“Dziennik.pl” 2009) on the basis of the findings of the HERC2 gene,<sup>60</sup> and by the members of two German forums: “Skadi Forum” (2009) (the largest Germanic online forum of more than 40 000 members)<sup>61</sup> and “The Apricity Forum” (2009), based on the entire ethnogenetic argumentation.

A natural question arises now: what is the value of this inference about the German origin of Copernicus, on the basis of the mtDNA and Y-DNA analyses of his alleged remains? I think this inference is based on the following premises:

3. the implicit assumption that a match of a particular DNA profile of the sample of the “donor” (including archaeological samples) with the profile of the samples included already in the population DNA database (coming always from a particular country) can provide evidence for the determination of the ethnic origin of the “donor”;
4. the thesis about the German character of Silesia, where the families of Kopernik and Watzenrode came from;
5. the information on the occurrence of DNA sequences of the samples in the mtDNA and Y-DNA population databases.

I would like to state then, that the inference presented above is void because of the assumption of erroneous and selective premises.

The (a) premise ignores the issue of the family history of the person from whom the DNA sample was taken, including the effect of migration in comparatively recent and very remote times. These effects lead to mixing of the gene pool. For example, let us hypothetically suppose that, at some point in his-

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<sup>60</sup> The Polish journalist kept his presence of mind, criticizing such a view. “The surprising results of the analysis of DNA samples, which were taken from the bones found in 2005 in Frombork are, of course, no evidence of the Germanness of the famous scientist. Despite this, they may, however, become an argument for the most extreme proponents of this thesis. Because the dispute on the nationality of the astronomer has been going on at least since the 1930s. But not only the Nazis wanted to make a German out of Nicolaus Copernicus. Guenter Verheugen, Deputy Head of the European Commission, also said that the astronomer »had German parents from Prussia«” (“Dziennik.pl” 2009, in Polish).

<sup>61</sup> “Copernicus’ haplotype places him almost certainly in haplogroup R1b. While this haplogroup has a very wide distribution, it is the case that it is one of the haplogroups which differentiate Germans from Poles. So, while this is insufficient to ascertain the ethnic origin of Copernicus’ patrilineage, it certainly suggests a higher probability for it being of ethnic German rather than Polish origin” (“Skadi Forum” 2009).

tory there was a tribe which had so far been “purely Germanic” (with “a purely Germanic” mtDNA), who kidnapped into slavery Slav women with a “purely Slavic” mtDNA. As you might imagine, this led to the birth of members of the Germanic tribe of “purely Slavic” mtDNA (because mtDNA is inherited from the mother).

The (b) premise is inconsistent with the historical knowledge (on which I already wrote enough in Sect. 8.7 above).

The (c) premise is contrary to the knowledge about the mtDNA and Y-DNA databases, the resolutions on the ethnogenesis of Slavs and Germans and the historical and historical genetic knowledge about the origin of the Torun burghers.

As I explained previously (in Section 8.4), a detailed overview of the mtDNA population database EMPOP proves that the authors took into account only a part of this database, namely the forensic data, and left out the literature data. It is true that for the forensic data there is no sample from Poland on the sequence determined by the authors, but there are three from Germany and one from Denmark. However, this fact does not at all constitute evidence that Copernicus’s mother could have come from the German ethnic group since this database did not contain (and still – as of 2013 – does not contain) Polish forensic samples. When we additionally take the literature data into account, it appears that one sample (out of all 646 samples from the literature data) comes from Poland (Kościerzyna), which refutes the authors’ thesis that the genetic studies have proved the Germanness of Copernicus’s mother. In other words, a mere attentive review of the EMPOP database falsifies the authors’ thesis that this database can be used to demonstrate the German origin of Copernicus in his maternal lineage!<sup>62</sup>

In the above argumentation I *accepted the implicit assumption* of the authors of the DNA research of the alleged remains of Copernicus that the presence or the absence of the samples in the database with current data can provide unambiguous evidence for the ethnic origin of the DNA traces of the person under study. However, this assumption is erroneous. In reality, the situation is much more complex. It is not enough just to have the information from which country a given sample

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<sup>62</sup> Following this reasoning, we might also take into account here the (deprecated) thesis of Polish researchers in Nicolaus Copernicus’s life (discussed in subsection 8.6) that the maternal grandmother of Copernicus was Catherine Modlibog (e.g., Polkowski 1873, pp. 73–75; Birkenmajer 1923, pp. 98–99; 1924, pp. 1–54, 142–151, 241–251; Rospond 1973, pp. 146–147), and such a name hints at Slavic origin of this person. Hence, accepting the assumptions (a) – (c) of the authors of the DNA analyses, we might, essentially, draw a no less reasonable conclusion: on the strength of the mechanisms of inheritance, the DNA results prove genetically Slavic roots (after Catherine Modlibog) of four people (three from Germany, one of Denmark), whose mtDNA samples are listed in the EMPOP database. Cf. also Kokowski 2009b, pp. 135–136, 430–431.



comes. We also need to know the ethnic history of the family of the person this sample came from.

Let me give an unequivocal illustration of this problem on the example of the MitoSearch DNA Database – a public service of the Family Tree DNA company involved in genetic testing for genealogical purposes. It turns out that for the sixteen samples in the database matching the haplotype of the alleged remains of Nicolaus Copernicus, no sample comes from the indigenous areas of Germany, and two come from current Polish territory. The first of these samples belongs to an American citizen who came from Rosalie Suchla née Halama (1846–1906), coming from Opolski Silesia, from the village of Poppelau (that is Popielowo near Opole). That Rosalie came from a Polish-speaking family, and in 1882 (that is, at the times when Silesia was under the rule of Prussia) emigrated to the USA, where she settled in Independence (Wisconsin); she did not speak English.<sup>63</sup> And the second sample belongs to an American citizen who comes from Florentyna Chmielewska (1887(?)–1945), born probably in the vicinity of Płock (the capital of Mazovia, 80 km from Lidzbark Warmiński, 147 km from Olsztyn and 84 km from Toruń). In 1900 in the USA Florentyna married Wincenty Franciszek Bączek / Banczek (the name was changed in the USA to Frank Vincent Bonczek), in a Polish Church of St. Stanislaus in Newark (New Jersey).<sup>64</sup>

Did I just thereby prove that the two currently living American citizens (and their female ancestors) are Copernicus's relatives? Not at all, because the common female ancestor of Copernicus and all those currently living people (and their female ancestors) who share the same mtDNA sequence as Copernicus and come from many different countries (England, Denmark, Ireland, Finland, France, German, Polish and the USA), can have lived several thousand years ago.<sup>65</sup> In order to prove blood relationship of these people we should carry out a huge research project to build complete family trees of such families from the times of Copernicus to the present day. It is unlikely (albeit logically possible) that such a task could be completely executed in any particular case. As we know from the research of the family tree of the relatives of Copernicus in the female lineage, *due to the lack of source data* the researchers only managed to reproduce this tree from Catharine Watzenrode, the grandmother of the astronomer (ca. 1400 – ca. 1462), to the relatives living in the middle of the 18<sup>th</sup> century (see Mikulski 2008; Jendrzewska, Stachowska 2008). Premise (c) neglects the

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<sup>63</sup> Cf. Nogosek 1982; J.W. Day 2009; J. Day 2010; Kokowski 2010d.

<sup>64</sup> Cf. Mayka 2009b; Tamara 2001; 2006; 2007; 2009; 2010; 2011. I must emphasize, however, that after carrying out the analysis of archival documents available to me, I have some doubts about the accuracy of the information about the place and date of birth of aforementioned Florentyna.

<sup>65</sup> Lawrence Mayka, the volunteer administrator of the Polish Project of the Family Tree DNA, is aware of this problem – cf. Mayka 2009a; 2009b.

knowledge of the ethnogenesis of Slavs and Germans, based on the results of the linguistic research, the genetic studies (of the history) of migration of tribes (Y-DNA analyses) and the archaeological research of the past 60 years – cf. for example *Eupedia* 2011a (and the numerous literature references there), “Historia – forum historyczne Histmag.org” 2011 (and the numerous literature references there) and Pietrzak 2011. According to these results, it is certain that the Slavic languages derive from the Indo-European languages. The Slavic languages are used by the populations coming from the population of the Indo-European tribes, in which the dominant haplogroup is haplogroup R1a. This does not mean at all that other haplogroups, for example R1b, I1 or I2, are not present there. It is also known that the Germanic languages developed relatively late, that is around (or after) 500 BC, as a result of mixing of proto-Celtic and proto-Slavic languages, which were spoken by populations with different haplotypes – mainly R1b, I1, and R1a. This mixing results in the fact the mere finding a haplotype R1b sample does not necessarily prove its Germanic origin, just like finding a haplotype R1a sample does not prove its Slavic origin.

The premise (c) also neglects the knowledge of the empirically confirmed fact of the similarity between the genetic structures of Slavs and Germans, and the similarity of morphological characteristics of human populations living in Central Europe in the period from the Bronze Age to modern times (this also applies to the Western Slavs and Germans in the Middle Ages and modern times) (see Malyarchuk 2001, Grzybowski *et al.* 2002; Piontek, Iwanek, Segeda 2008, specially pp. 67–83). In consequence, the Western Slavs and the Germans may have the same haplogroups.

Premise (c) also ignores the historical knowledge and the historical genetic knowledge of the origin of the burghers of Toruń. The earliest historical information on the subject can be found in the sources from the second half of the 13<sup>th</sup> century: the newcomers from Silesia and Lausitz and all Poland, including the nearby Kujawy, Wielkopolska and the Chełmno district, are listed in them; the fourteenth-century sources mention the influx of a large population group from Westphalia (cf. Jasiński 1999, pp.138–139 ; Tandecki 1999, pp. 203–206; Mikulski 1997b; Biskup 1992, pp. 80–86). It results from the historical genetic research that in these regions, with the exception of Westphalia, the haplogroup R1a has prevailed for 2,000 years – cf. *Eupedia* 2011a (and the literature references there). In consequence, a discovery of the sample with haplotype R1b would suggest that if the sample is of Germanic origin, the person from whom this sample was taken, should have come from a family originating from Westphalia. This, however, is by no means settled by historical sources.

### **8.9. The problem of the reliability of DNA analyses of the remains from the grave 13/05 as the definite criteria for identification of the remains of Nicolaus Copernicus and the issues of kinship, ethnicity and sampling saturation in DNA population databases**

*According to popular ideas*, a match of the DNA tests (mtDNA and Y-DNA) of compared samples of given individuals is *the definite proof for*: (a) the identicalness of the DNA profile of the biological material and (b) the family blood relationship between these individuals, and even (c) their ethnicity. However, this is not true for a very simple reason, namely the existence of a possible random match of *partial DNA profiles* of the samples analysed (the effect is well-known in the so-called genetic genealogy) as a result of mixing genes of one or many populations, which I mentioned in Chapter 8.8. In other words, it is possible to find a *partial match* between the DNA profiles of people who are not related at all and have different ethnic origin.

As I showed above (in chapter 8.1 and 8.2), when we determine the random match of the mtDNA sequence for rare and unique samples (*in the mathematical meaning of these terms*), instead of the normal approximation of the binomial distribution we should use the Poisson approximation of the binomial distribution or directly the binomial distribution.

Nevertheless, in cases of rare and unique DNA profiles, we should always be very careful in unambiguous interpretations of the results obtained. It results from the fact that the *currently* existing population databases are not fully representative, which is due to: 1) the relatively small number of samples in these databases (only a few or several thousands of samples from all over the world, though about 6.8 billion people live on our planet, of which about 724 million live in Europe); 2) the lack of the so-called saturation of the population DNA databases, both national and international; and 3) the poor structure of the sample sets in such databases – for example, the databases do not include samples from certain areas of countries or even form entire countries. (We should remain particularly critical when we use population databases to draw conclusions regarding somebody's ethnic origin – compare above Chapters 8.4 and 8.8).<sup>66</sup> I mentioned this issue in the paper delivered at the conference in Kraków in 2010 (see Kokowski 2010c), which, however, met with an overwhelming criticism of Tomasz Grzybowski, a DNA research expert,<sup>67</sup> who was present at this conference.

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<sup>66</sup> I formulated this issue for the first time in: Kokowski 2009b, pp. 135–136, 430–431.

<sup>67</sup> Cf. fn. 38. I would like to add that this author in his own paper presented during the conference (cf. Grzybowski 2010) made the thesis of *almost achieving sampling saturation* in the Polish population mtDNA database regarding the nucleotide diversity and number of polymorphic positions and the lack of sampling saturation in this database regarding the number of different haplotypes.

It transpires, however, that the theses made by me during the Kraków conference are correct, which is easy to demonstrate on the specific example of the EMPOP database, greatly acclaimed by researchers. The set of samples in the EMPOP database is not a representative sample of the Western metapopulation. The reason is elementary: the forensic data in EMPOP (which was used by the researchers of the alleged remains of Copernicus) did not include samples from many European countries, including Belarus, the Czech Republic, Estonia, the Netherlands, Ireland, Latvia, Malta, Norway, Poland (!), Portugal, Russia, Serbia, Slovakia, Slovenia, Switzerland, Sweden, Turkey or the United Kingdom (see fig. 3; a similar remark, but – I want to emphasize – with some differences!, also refers to the literature data in EMPOP – see fig. 4).

In addition, it is easy to construct a qualitative and quantitative test of the correctness of my thesis on the *statistical* unrepresentativeness of population databases, which is caused by the effect of the lack of sampling saturation, on the example of the so-called Western metapopulation.

For this purpose, I have chosen the data taken from the article by Pereira, Cunha, Amorim (2004), who analysed the problem of sampling saturation of Portuguese mtDNA haplotypes in the national database, as the model for the sampling saturation of mtDNA haplotypes for HV1, HV2, and HV1+HV2 regions for all countries.

The aforementioned researchers have found that in the case of Portugal in order to achieve sampling saturation in the national database, 1000 samples is sufficient in the case of HV1, 900 in the case of HV2, and 1300 in the case of HV1 + HV2. (I take the idealized assumption that national metapopulations are as homogeneous as the Portuguese metapopulation<sup>68</sup>). Then, based on the data regarding the number of samples in the EMPOP database (in the opinion of specialists, this database is considered as a master database of European mtDNA) and the Portuguese data (because these data were not included in the EMPOP database – see fig. 11 and fig. 12), I have calculated two magnitudes: *the Sampling Saturation Rate in the mtDNA Population Database for the Country Given (CSC)* and *the Normalized Sampling Saturation Rate in the mtDNA Population Database for the Country Given (NCSC)*, in accordance with the following definitions:

1. *The Sampling Saturation Rate in the mtDNA Population Database* (respectively: HV1, HV2, HV1+HV2) *for the Country Given (SSRC)* is the ratio of the number of the mtDNA samples (respectively: HV1, HV2,

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<sup>68</sup> This is consistent with the thesis accepted that the frequencies of the mtDNA haplogroups in different European metapopulations take similar values – cf. for example Torroni *et al.* 1996; Salas *et al.* 1998; Pereira, Prata, Amorim 2000; Mogentale-Profizi *et al.* 2001; Grzybowski *et al.* 2007; Eupedia. *European travel and history* 2011b.

HV1+HV2) from the given country (with the exception of Portugal) included in the EMPOP database to the total population of the country.

2. *The Normalized Sampling Saturation Rate in the mtDNA Population Database* (respectively: HV1, HV2, HV1+HV2) *for the Country Given (NS-SRC)* is the ratio of *the Sampling Saturation Rate in the mtDNA Population Database* (respectively: HV1, HV2, HV1+HV2) *for the Country Given* to *the Sampling Saturation Rate in the mtDNA Population Database* (respectively: HV1, HV2, HV1+HV2) *for Portugal* (these values are determined from the data given in article: Pereira, Cunha, Amorim 2004); by definition in the case of Portugal the NSSR is 1 for HV1, HV2, HV1+HV2 regions.

**Tab. 1.** The Sampling Saturation Rate in the population of mtDNA and the Normalized Sampling Saturation Rate of mtDNA for the European metapopulation (Europe) for the data from EMPOP (version 1a), the data on the population from Wikipedia 2010f, on the metapopulation of Portugal from: Pereira, Cunha, Amorim 2004.

Country	European MP (Europe) Forensic data – Literature data	Population	SSR * 100 000	SSR/NSSR		
				HV1	HV2	HV1+HV2
Austria	273 S	8 210 281	3,325	0,356	0,396	0,274
Belgium	104 S	10 414 336	0,999	0,107	0,119	0,082
Bosnia and Herzegovina	156 S	4 613 414	3,381	0,362	0,402	0,278
Cyprus	91 S	796 740	11,422	1,223	1,359	0,941
Denmark	209 S	5 500 510	3,800	0,407	0,452	0,313
Finland	200 S	5 250 275	3,809	0,408	0,453	0,314
Germany	513 S	82329758	0,623	0,067	0,074	0,051
Greece	319 S	10 737 428	2,971	0,318	0,353	0,245
Hungary (European mp.)	212 S	9 905 596	2,140	0,229	0,255	0,176
Italy	398 S	58 126 212	0,685	0,073	0,081	0,056
Latvia	–	2 231 503	–	–	–	–
Macedonia	197 S	2 066 718	9,532	1,021	1,134	0,785
Spain	308 S	40 525 002	0,760	0,081	0,090	0,063
Poland	481 L	38 482 919	1,250	0,134	0,149	0,103

**Tab. 1.** (continued)

Country	European MP (Europe) Forensic data – Literature data	Population	SSR * 100 000	SSR/NSSR		
				HV1	HV2	HV1+ HV2
Romania	360 S	22 215 421	1,620	0,173	0,193	0,133
Russia	62 L	140 041 247	0,044	0,005	0,005	0,004
Slovenia	103 L	2 005 692	5,135	0,550	0,611	0,423
Sweden	–	9 059 651	–	–	–	–
Portugal	1000	10 707 924	9,339	1	–	–
Portugal	900	10 707 924	8,405	–	1	–
Portugal	1300	10 707 924	12,141	–	–	1

**Tab. 2.** The Sampling Saturation Rate of the population of mtDNA and the Normalized Sampling Saturation Rate of mtDNA for European metapopulation (Europe) for the data from EMPOP (version 2.1), the data on population from *Wikipedia* 2010f, on the metapopulation of Portugal from Pereira Cunha, Amorim, 2004. (The data in this table differ from the data in Table 1 in the following countries: Denmark, Hungary, Latvia, Macedonia, Poland, Russia, and Sweden, as a result of expanding the database with new samples).

Country	European MP (Europe) Forensic data – Literature data	Population	SSR * 100 000	SSR/NSR		
				HV1	HV2	HV1+ HV2
Austria	273 S	8 210 281	3,325	0,356	0,396	0,274
Belgium	104 S	10 414 336	0,999	0,107	0,119	0,082
Bosnia and Herzegovina	156 S	4 613 414	3,381	0,362	0,402	0,278
Cyprus	91 S	796 740	11,422	1,223	1,359	0,941
Denmark	206 S	5 500 510	3,745	0,401	0,446	0,308
Finland	200 S	5 250 275	3,809	0,408	0,453	0,314
Germany	513 S	82 329 758	0,623	0,067	0,074	0,051
Greece	319 S	10 737 428	2,971	0,318	0,353	0,245
Hungary (European mp.)	594 S	9 905 596	5,997	0,642	0,714	0,494

Tab. 2. (continued)

Italy	398 S	58 126 212	0,685	0,073	0,081	0,056
Latvia	131 L	2 231 503	5,870	0,629	0,698	0,483
Macedonia	200 S	2 066 718	9,677	1,036	1,151	0,797
Poland	894 L	38 482 919	2,323	0,249	0,276	0,191
Romania	360 S	22 215 421	1,620	0,173	0,193	0,133
Russia	290 S+L	140 041 247	0,207	0,022	0,025	0,017
Slovenia	103 L	2 005 692	5,135	0,550	0,611	0,423
Spain	308 S	40 525 002	0,760	0,081	0,090	0,063
Sweden	335 S	9 059 651	3,698	0,396	0,440	0,305
Portugal	1000	10 707 924	9,339	1	–	–
Portugal	900	10 707 924	8,405	–	1	–
Portugal	1300	10 707 924	12,141	–	–	1

From the tables presented it results clearly that, against the background of the Portuguese database, the national sub-databases of the EMPOP database, with the exception of Cyprus sub-database (HV1, HV2) and Macedonian sub-database (HV1, HV2), have not yet reached saturation. This remark applies of course to the ideal case: a homogeneous population structure of individual countries. All the more so it applies to minority groups in these countries! I suppose, however, that the Cyprus sub-database and the Macedonian sub-database have not reached the point of saturation, since it is known that both Cyprus and Macedonia are not ethnically nor genetically homogeneous: Cyprus is populated mainly by Greeks (77% of the total population), the second group are ethnic Turks (18% of the population), the remaining 5% of the population are Armenians, Englishmen, Jews and refugees from Lebanon (cf. *Wikipedia* 2010a, 2010b); Macedonia is populated by different ethnic groups, mainly Macedonians (66% of the population) and Albanians (25%), and Turks (3.9%), Romani people (2.6%), Serbs (1.8%) and other nationalities (0.7%); the ethnic Macedonians themselves are descendants of, among others, Slavs and Greeks (cf. *Wikipedia* 2010g).

All of this convinces me of the *statistical* unreliability of the existing mtDNA population databases, and I refer this thesis particularly to the rare and unique samples in a *statistical sense*, i.e. when the Poisson distribution should be used as an approximation to the binomial distribution. I would like to add that the usage of the Poisson distribution as an approximation is of course correct; my doubts regard only the reliability of the initial parameters (the frequency value of the

samples in the database) and the calculations, made on the basis of such databases (this is an empirical problem associated with the lack of sampling saturation). What resulted from the considerations presented here but unambiguously formulated already in the paper given at the Kraków conference (Kokowski 2009a, 2010c), is the unequivocal postulate that the specialists of the mtDNA population databases should empirically test the thesis made by me. What is interesting, it transpires that this has already happened! My conference opponent, i.e. Tomasz Grzybowski (together with collaborators), had abandoned his primary idea of the *almost achieved saturation* in the mtDNA population databases he had announced during that conference. He did that in his following article entitled *Oce-  
na stopnia wysycenia bazy danych mitochondrialnego DNA dla populacji Polski (Saturation of the Polish mitochondrial DNA database)*, “Archiwum Medycyny Sądowej i Kryminologii” 2010, vol. LX, pp. 263–269, which was published after the Kraków conference. Let us quote a key part of this publication:

From the above analyses it can be concluded that the Polish population database of mitochondrial DNA profiles, just like other discussed databases with European or global range, has not reached the point of saturation for all possible mtDNA haplotypes yet (sic). This database in its current form may be used for genetic and forensic purposes, but with caution in regards to estimating the frequency of rare and unique haplotypes (sic). According to the guidelines in force in the international milieu of forensic geneticists, in order to assess the frequency of rare haplotypes in the population 95% confidence interval (sic) should be applied here, with the use of the natural logarithm of frequency, the normal approximation to the binomial distribution (sic) and antilogarithm (...). In the assessment of the frequency of the haplotypes the connected databases for different ethnic groups of Central Europe can also be used, since it has been demonstrated that the population of this part of the Old Continent bears no visible features of stratification at the level of the mtDNA control region (...) (Daca, Mielnik-Sikorska, Bednarek, Grzybowski 2010, p. 268; translation – M.K.).

Thus, we see that the authors mentioned make now the thesis about *the lack of sampling saturation in the mtDNA population databases which I formulated earlier*, and which was negated by Tomasz Grzybowski during the Kraków conference. (The authors of this publication present solid empirical evidence for my thesis, which confirms the qualitative and quantitative evidence given in the Tab. 1 and Tab. 2). At the same time, the same authors, “according to the guidelines in force in the international milieu of forensic geneticists” (sic), repeat the thesis of the applicability of the normal approximation to the binomial distribution to the model of a random match for rare or unique haplotypes. However, this is an unequivocal error, which I have explained extensively in this article (see chap. 8.1, 8.2): in such cases, as an approximation for the binomial distribution the Poisson distribution should be applied.



Reflecting more deeply on the issue of statistical reliability of population databases, I have come to differentiate now between two concepts: *the numerical sampling saturation* and *the frequency sampling saturation*. By *numerical sampling saturation* I understand the effect that after including other groups of samples into the database, no fundamentally new types of samples (in this case mtDNA haplotypes) appear in the database. On the other hand, I understand *the numerical sampling saturation* as a subtler effect: i.e. when after including other groups of samples into the database, the frequencies of appearance of certain sample types in the database do not change, in principle. For obvious reasons, this second type of sampling saturation is much more difficult to achieve, which is related to the *a priori* unknown geographical distribution of samples (our ignorance on this point can only be removed by a detailed empirical study combined with a great expansion of the population databases).

In the context of the considerations carried out in previous sections, it is also clear that the general issues indicated above are fully reflected in the particular case of the evaluation of the DNA analyses of *the remains from the grave 13/05*, which – I think – does not need any further explanation here.

### **8.10. Comments on the anachronistic notions of “nationality” and “ethnicity” in Copernicus’s days**

As it is well known, the multinational Kingdom of Poland for centuries boasted liberties, both religious and economic (that is relatively, at the time, low taxes). These liberties were a strong incentive for many Europeans (for example ethnic Germans, Scandinavians, Dutchmen) to settle in this country. The issue of the descent of these new citizens, of their “nationality” and “ethnicity” did not play a significant role at the time, and so was it in Copernicus’s time. Such a role was however played by the consciousness of being a subject of a certain royal power. The aforementioned concepts of “nationality” and “ethnicity” are the product of only the 18<sup>th</sup> and 19<sup>th</sup> centuries. They became the foundation for the terms of “nation” and “national consciousness”, created then.

Nicolaus Copernicus and his family, both from his paternal and maternal lineages, living in Prussia, one of the provinces of the multinational Kingdom of Poland, identified themselves with the interests of the kingdom, of which they were citizens, as well as with the interests of their province. Therefore, due to the fact that modern Poland is the political successor of this national tradition, it is entirely legitimate to talk about the Polish scientist Nicolaus Copernicus.<sup>69</sup> This is all the

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<sup>69</sup> The editors of the online edition of the British tabloid “Daily Mail” did not remember about this fact. In the first version of the article on the addition of three new elements to the periodic table

more justified, as it is known from historical research that, in addition to Latin, Greek and German, Copernicus also knew the Polish language, as is evidenced, for example, by the faultless records of Polish names in the *Locationes mansorum desertorum* (*Allocations of the Deserted Acres in Warmia in the Years 1516–1521*) edited by Marian Biskup (cf. Copernicus 1970/1983, 2007). It is however anachronism to speak of Copernicus as a Pole or a German in the ethnic sense.<sup>70</sup>

At this point I wish to emphasize that in the current political context of the European Union Nicolaus Copernicus may be regarded as one of the leading figures of the European cultural integration understood in all possible (i.e. scientific, philosophical, political, educational, economic, social, and linguistic...) contexts and aspects.<sup>71</sup> It is quite obvious that the condition of acceptability of this interpretation is its relevancy: the reliance on reliable (historical and current) sources, the openness to dialogue and the avoidance of various types of anachronism.

On the one hand, let us remember that from the perspective of the exact sciences the value of Copernicus's achievements does not depend on whether he was a Pole or a German in an ethnic sense (in the meaning given to that term in the 19<sup>th</sup> and 20<sup>th</sup> centuries), or even someone else (for example, a local Prussian patriot, a "universalist" – a citizen of Europe). On the other hand, we must not overlook another very important perspective: the thorny Polish-German relationships and their significance in the history of the debate on the ethnic origin of Copernicus. The study of this intricate issue calls for keeping the highest scientific standards.

### **9. The defectiveness of the authoritative argument in the reasoning in favour of the acceptance of the discovery of the grave of Nicolaus Copernicus**

As we know from rhetorics, the art of persuasion, one of the tools used in the procedure of argumentation (for or against any thesis) is *argumentum ad verecundiam*, that is the argument appealing to respectability, the argument from authority. It means that to justify the thesis made by us we refer to authority: a person

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by the International Union of Pure and Applied Physics (IPUAP), published on 4 November 2011 in this journal, they said that one of these elements, numbered 112, i.e. "Copernicium," was named after the "name of a PRUSSIAN astronomer" ("Daily Mail" 2011). The error was removed on 8 November 2011 following the reaction of readers and the influence of other texts that had appeared in the media, including "Gazeta.pl" 2011a.

<sup>70</sup> I discuss this issue extensively in: Kokowski 2009b, pp. 115–136, 402–431.

<sup>71</sup> I made this thesis for the first time in the paper delivered in a symbolic place of the European Union, that is in Maastricht, during the 1<sup>st</sup> International Conference of the European Society for the History of Science, "Science in Europe – Europe in Science" (Maastricht, 4–6 November 2004) – cf. Kokowski 2004a.

or a whole environment who already accepted our thesis. This argument was used by the team of Jerzy Gąssowski in two ways: both to confirm the theses propounded by them and also to defend the theses criticized by the opponents. The argument has the following structure (*I provide it here in my own synthetic formulation*): “You are criticizing our research, in particular, the genetic studies, however: (a) we published an article (Bogdanowicz *et al.* 2009) on the subject in the PNAS (“Proceedings of the National Academy of Sciences of the United States of America”),<sup>72</sup> a prestigious journal from the Master Journal List (called in Poland *the Philadelphia list*<sup>73</sup>), (b) our findings were accepted by a world-renowned Professor, Owen Gingerich also in the journal mentioned (Gingerich 2009).”

Such an argument (*in a different, but semantically equivalent verbal form*) was reported in, among others, Bogdanowicz *et al.* 2009 (cf. Jezierski 2010, p. 178), Gąssowski 2010b, p. 26; Gąssowski 2010c, pp. 121–123 (this argument was also voiced during the Kraków conference by the advocates of the discovery of the grave of Nicolaus Copernicus, present at this conference). Nevertheless, I think that this argument is defective, because the article mentioned (Bogdano-

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<sup>72</sup> This article was edited by Dr. Alan Walker, professor of anthropology and biology at the Department of Anthropology at Penn State Pennsylvania State University, University Park, PA (Walker 2011), and reviewed by Dr. Ronald Van Den Bussche, professor of zoology at the Life Sciences East Oklahoma State University, the manager of the Van Den Bussche Laboratory of Molecular Systematics and Conservation Genetics and, among others, the holder of the scholarship of Fulbright Commission in Museum and Institute of Zoology of PAS in Warsaw in 2005 (Fulbright Senior Specialist Fellowship) (Van Den Bussche 2011a; 2011b), and Dr. John H. Rappole, a zoologist and ecologist, a researcher at the Smithsonian National Zoological Park, Smithsonian Conservation Institute, Conservation Ecology Center specializing in the ecology and evolution of birds and their importance for the conservation of the species (Rappole 2011).

<sup>73</sup> The Master Journal List, also known in Poland as the Philadelphia List is developed and regularly updated by the Institute for Scientific Information (Philadelphia, USA). The Polish name was introduced by Kajetan Andrzej Wróblewski (Wróblewski 1999), which, among others, is, of several terms, the chairman of the Scientific Council of the Institute for the History of Science, Polish Academy of Sciences and is currently the Vice-President of the Polish Academy of Arts and Sciences.

According to the list of scientific journals of 2009 arranged by the Polish Ministry of Science and Higher Education, an institute employing the author of each article published in the “Proceedings of the National Academy of Sciences of the United States of America” received 24 points. For comparison, for each article published in the world’s top specialist journal on the history of Polish science, namely “Kwartalnik Historii Nauki i Techniki” (“Quarterly Journal of the History of Science and Technology”), only 6 points were given (cf. Ministerstwo Nauki i Szkolnictwa Wyższego 2009, p. 107, no. 6877 and p. 137, no. 578). According to the analogous list of 2010, it was as follows: 32 points for an article published in “PNAS” and 9 points for an article published in “KHNiT” (cf. Ministerstwo Nauki i Szkolnictwa Wyższego 2010, p. 216, no. 7207 and, respectively, p. 281 no. 738). On the ministerial list of 2012 these points were, respectively, 45 and 10 (cf. Ministerstwo Nauki i Szkolnictwa Wyższego 2012a, p. 216, no. 8474; 2012c, p. 59, no. 2268). This scoring is an expression of an apparent discrimination of the history of Polish science – paradoxically – by an institution of the Polish government!

wicz *et al.* 2009) contains numerous shortcomings and errors indicated above, which were overlooked by even the most successful and famous commentators of that article.

I entirely agree with the team of Jerzy Gąsowski that the famous professor Owen Gingerich (see Gingerich 2011b) in his article (Gingerich 2009) unambiguously implied that he accepted the scientific value of the DNA analyses of the alleged remains of Copernicus:

When in 2005 Polish archaeologists led by Jerzy Gąsowski found fragments of a skeleton tentatively identified as the remains of the 16<sup>th</sup>-century astronomer Nicolaus Copernicus, some doubts remained. Now, in this issue of PNAS (...), these issues are resolved with high confidence through DNA analysis (Gingerich 2009, p. 12215).<sup>74</sup>

He also formulated three relevant critical remarks: 1) Copernicus was not a priest after all, 2) we can see on Copernicus's portraits that he had dark eyes and 3) one of the hairs from the *Calendarium Romanum magnum...* can belong to Professor Gingerich himself, because he studied this work (Gingerich 2009, p. 12216; 2010, pp. 29–30). He, however, did not in any way refer to the German thread. It is worth recalling that he had done so in his earlier publications, among others: Gingerich 2004a/2004b; 2004c; 2004d:

[Piotr Majewski:] Polish and German researchers still have a dispute over the nationality of Copernicus: was he Polish or German? What is your opinion?

[Owen Gingerich:] This dispute has a long history. I have found in many German publications a statement that Copernicus was a German astronomer. Those scholars derive their arguments from the indisputably established fact that the scholar spoke German. There was nothing extraordinary about it, because at the time the German language had the role of an international language, especially in the centres of the Hanseatic League. It was the language of trade relations, and let us remember that

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<sup>74</sup> He consistently repeated this view in his subsequent publications: Gingerich 2010a, p. 29; 2010b, p. 230; 2011a, p. 48. As a side note, I would like to add that in the last two articles Gingerich provides fictitious information saying that Copernicus was supposedly nearly elected the bishop of Warmia in 1537, but he refused because he wanted to follow his vocation, that is writing *De revolutionibus* (Gingerich 2010b, p. 225; 2011a, p. 43).

The historical facts are as follows: on 1 July 1537 Bishop Maurice Ferber dies. Therefore, the Warmia Chapter appoints from among themselves four candidates for the bishop post in the following order: Johannes Dantiscus, Bishop of Chełmno, Jan Zimmermann, Custodian, Doctor Nicolaus Copernicus and Achacy von Trenck. Sigismund I, King of Poland, approves this list and in the letter of 4 September 1537, prepared in Lwów, he puts forward the proposal that the first person on the list, Dantiscus, should be chosen Bishop of Warmia, which is then unanimously accepted by the Warmia Chapter in Frombork on 20 September 1537 (Biskup 1973a & 1973b records no.: 364–368, 370–371, 373–374). With regards to *De revolutionibus*, in 1537 most of this work had already been written (cf. Birkenmajer 1900, p. 350–388; Veselovskij / Weselowski 1965).

Copernicus came from a family of merchants living in Toruń, which belonged to the Hansa. However, there is no clear evidence that he used Polish (*sic*; this is misinformation; cf. above chapter 8.10 – M.K.). He used Latin in writing, which was the official language and one used in correspondence. Also scientific works were created in Latin. I do not think, therefore, that the language was the decisive criterion in assessing the nationality of Copernicus. What is more suitable is the place of birth. Since Copernicus was born in Toruń, which belonged to Poland – under law he became a subject of the Polish King. He studied in the royal city of Kraków, and in his activities he often emphasized his devotion to the Polish King. In my opinion, this loyalty proves conclusively that he felt himself Polish. Since, however, the era of the European nation-states had not begun at the time, I would call Copernicus “a European citizen” devoted to the affairs of Poland (Gingerich 2004c).

[Jakub Ostalowski:] There was a dispute between Poles and Germans over whose Copernicus is: theirs or ours. What is your opinion on this?

[Owen Gingerich:] It seems to me that in my book (i.e. Gingerich 2004a/2004b – M.K.). I clearly argued in favour of one party of the dispute: Poland. There was a time when the Germans claimed that the family name of the astronomer is the Germanic Coppernigk or Koppernig. However, the Padua document is signed “Nicolaus Copernic”, but the scholar happened to sign his works sometimes as Coppernicus (*sic*)<sup>75</sup> (Gingerich 2004d; translation – M.K.).<sup>76</sup>

## **10. The fundamental defect – the insufficient sensitivity to the problems of interdisciplinary research**

As I showed in the earlier sections of this article, the authors engaged in the research into the identification of the putative remains of Nicolaus Copernicus left a variety of (material and formal) flaws and errors in these studies. These arose from two main reasons:

1. The lack of specialized knowledge of several disciplines, such as the iconography of Copernicus, the history of Copernicus’s life, the history and ethnic geography of Silesia, the genetic genealogy and the statistical calculus, and the selective knowledge of the mtDNA i Y–DNA population databases.

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<sup>75</sup> I would like to note that the two-character -pp- was the traditional spelling of the names of the family of Copernicus who had arrived from Silesia. A detailed explanation of this issue is given by Stanisław Rospond (Rospond 1973, p. 99–118).

<sup>76</sup> I would like to add that I know Professor Gingerich personally and I really appreciate his input in the field of the history of science, especially in the Copernican studies – cf. many positive references to his publications, among others, in Kokowski 2001, 2004b, 2009b. This does not mean, however, that I cannot see the minor errors committed by him in this field – cf. Kokowski 2006; 2008a.

2. The insufficient sensitivity of the authors of these studies to the problems of interdisciplinary research. Since the authors mentioned did not feel a strong need to conduct *integrated interdisciplinary research*, they did not feel the necessity to collaborate closely with methodologists of interdisciplinary research, experts in Copernicus's portraits, experts in genetic genealogy, specialists of statistical calculus, experts in the history and ethnic geography of Silesia, etc.

## 11. The key conclusion

The above considerations falsify:

- 1) *the implicit research assumption* made by the team of Jerzy Gąssowski during the search for the relevant genetic material and the interpretation of the genetic analyses (see above, chapter 5), according to which a lack of expert knowledge of Copernicus and the historical context does not affect the correctness of the reasoning concerning the identification of the remains of the astronomer;
- 2) *the fundamental, explicit thesis of the research*, according to which the genetic studies of the putative remains of Copernicus were conducted perfectly, from the scientific point of view.

Having this in mind, I claim that despite the broad social acceptance of the thesis of the definite discovery of the grave of Nicolaus Copernicus, the irrefutable scientific evidence based on DNA analysis has not been provided yet. (This does not mean that I claim that there are no Copernicus's remains in his alleged grave. They may be there, but they need not be).

## 12. Further research perspectives

Since there is so far no convincing empirical evidence in favour of the discovery of the grave of Nicolaus Copernicus, it is worth looking for further possible methods and tests to confirm the results, for example: re-examining the putative remains of Copernicus, using more sophisticated empirical methods, such as e.g. measuring the concentration of the  $^{14}\text{C}$  isotope by applying the technique of accelerator mass spectrometry;<sup>77</sup> additionally, in the light of the recent advances in molecular biology, it would be worth considering a plan to execute the full genome sequencing of these remains; conducting a very careful empirical comparison of

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<sup>77</sup> Cf. Walanus, Kokowski 2012 (in this volume, pp. 157–166).

the alleged skull with the oldest portraits of Copernicus;<sup>78</sup> repeating the procedure of facial reconstruction from the skull 13/05 and thoroughly comparing the outcomes with the existing portraits of Copernicus;<sup>79</sup> examining the hairs from the entire book collection of Copernicus (according to the information received from Marié Allen in March 2009, Johannes Stöffler's *Calendarium Romanum magnum* and *Euclid's Elements* (1482) were researched in this respect);<sup>80</sup> examining the hairs in the autograph of *De revolutionibus*;<sup>81</sup> looking for the grave of Bishop Wattenrode or other relatives of Nicolaus Copernicus (it is invariably a very important research topic).

In order to be able to judge better the credibility of the above tests – for methodological reasons – we should admit several independent professional teams to such research. It would be advantageous if, in addition to the teams already involved in this type of research, new teams, which have not had such an opportunity before, were allowed to participate. The work of such research groups should be subject to an inspection of a group of experts, who already before the start of the study would develop a way of analysing and interpreting the results. No pressure should be exerted on the researchers involved in conducting such projects – they would not have to find in the objects studied any traces of the DNA matching the profile of the samples of the alleged remains of Copernicus. The groups of such researchers could establish contacts with the press only until after the research has been concluded and reliable interpretation of the results received has been performed.

### 13. Methodological comments

At the basis of the type of tests sketched above there must be a developed methodological awareness of interdisciplinary research and extended expertise in many disciplines. In this context, two well-known theses of the methodology of empirical science should be recalled here:

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<sup>78</sup> I postulated it already in 2005 – cf. Kokowski 2005b/2007a.

<sup>79</sup> *Ibidem*, cf. also Kokowski 2008b.

<sup>80</sup> I passed on to Associate Professor Marié Allen specific suggestions that she should devote particular attention to examining several other books which for many years had been used by Copernicus – cf. Allen 2009a; 2009b; Kokowski 2009c; 2009d; 2009e.

<sup>81</sup> I would like to remind in this context that I am the author of this idea (the researchers involved in the analysis of DNA of the alleged remains of Copernicus did not know that the autograph of *De revolutionibus* is stored in Kraków) – cf. Kostrzewa 2008d; 2008e. Bearing in mind the information presented in this article, it should be, however, remembered that it is very difficult to carry out mtDNA examinations of archaeological hair samples, and then perform a reliable interpretation of the results received.

1. The conformity of correctly carried out tests (that is an “overlap” of confirmations) can only lend credence to the obtained results, or probabilize them. This is caused by the fact that the confirmatory tests never provide conclusive evidence due to the existence of formal constraints (of methodological nature, since, for example, one cannot prove the principle of induction) and material constraints (of the applied research methods).
2. It is also known that, so far, no mathematical measure of this probability has been developed on the grounds of the methodology of empirical sciences.<sup>82</sup>

#### **14. The urgent need to change the atmosphere in the media around the search for the grave of Nicolaus Copernicus**

Because of the complexity of the interdisciplinary issues regarding the search for the grave of Nicolaus Copernicus and the identification of his remains, there is an urgent need to change the style of reporting such research in the media. In other words, it is necessary to avoid an atmosphere of haste, or premature publishing of any hypothesis that has not been fully developed, or the use of propaganda methods and techniques for creating a positive image, etc.. A tone of factual and rational scientific discourse and popular science discourse should be maintained. In this context, let me point out that I addressed this issue already in December 2005, in my second publication on the search for the grave of Copernicus (cf. Kokowski 2005b/2007a, the chapter entitled “Etos uczonego, strategia popularyzowania osiągnięć naukowych a niebezpieczeństwa popularyzacji” (“The ethos of the scholar, the strategy of popularizing scientific achievements and the dangers of popularization”)).<sup>83</sup>

Moreover, the style of expression of ill-considered statements, such as the fabricated characteristic of: me, the reasons for my interest in the subject of the

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<sup>82</sup> Cf. for example Popper 1977; Hempel 1968; Nekrašas 1992.

<sup>83</sup> My appeal, however, met with quite an unexpected reaction, since Jerzy Gąssowski found my critique of the style of spreading premature information on the research results – in his interpretation – to be slanderous in nature (cf. Gąssowski 2005d & 2010c, p. 58–59).

What is interesting in this story from the methodological perspective is that the considerations of Jerzy Gąssowski on the subject under discussion are not consistent. The author does consistently deny in public both the value of my criticism and of my person (cf. Gąssowski 2005d & 2010c), and at the same time (Gąssowski 2010c, pp. 93–94, 98–107) complains about numerous serious trials and tribulations in the final phase of the research in 2008, caused by... the premature dissemination in the media of some important information on the search for the grave of Nicolaus Copernicus and the identification of his remains. Hence, it transpires that Jerzy Gąssowski is now a supporter of my own thesis about the danger of premature popularization of the results of research still in progress, which I already articulated in December 2005!



grave of Copernicus and the theses proclaimed by me, as well as the peculiar “report” of Jerzy Gąssowski from the scientific conference “The Nicolaus Copernicus grave mystery. A dialog of experts” (Kraków, 22–23 February 2010), in which he did not take part out of his own choice. The style of Jerzy Gąssowski’s reasonings is perfectly captured in the following quote:

The Kraków conference was a sum of a concentrated attack (*sic* – M.K.) on our achievements. “Stöfler’s work was used by the other, numerous canons”, “the research was sloppy”, “it is a coincidence that a hair of some canon got entangled in the book, and this canon was recognized as Copernicus”, “the reconstruction of Under-inspector Dariusz Zajdel is unbelievable”, “why was the analysis of radioactive carbon not performed?”, “the grave of canon Gąsiorowski refutes the idea that every canon was buried at his own altar”. It is impossible to mention here all the allegations, indicating the ignorance and bad will of debaters who did not allow matter-of-fact explanations (*sic* – M.K.). The meeting was chaired and “moderated” (*sic* – M.K.) by Habilitated Doctor Michał Kokowski. He strived not to allow those who were trying to provide explanations to the allegations to speak (*sic* – M.K.) (Gąssowski 2010c, p. 121).<sup>84</sup>

I must admit that if I had not been one of the organizers of the Kraków conference, and if I had not participated in it, if I had not known in detail a number of research publications on the grave of Copernicus and much additional unofficial information, having read the book of Jerzy Gąssowski I would have been willing to think that *all Polish researchers*, who dare to identify any gaps in the argumentation in favour of the discovery of the grave of Nicolaus Copernicus, are perfidious and jealous people and pseudo-scientists, and also the co-creators of the toxic public atmosphere in Poland (the so-called Polish hell). Hence, I am not surprised that this message was so read by Rev. Jan Rosłań (2011) and other even more titled prelates who are not engaged in Copernican research have no source knowledge in this matter.

I also think that Jerzy Gąssowski commits a serious mistake when he undertakes the assessment my knowledge in the field of *Copernican interdisciplinary scientific research*, and especially when he counts me among the ignoramuses in this matter. Let me give a simple justification of this thesis: he himself has never dealt in a systematic way with such research. In contrast, I have been long involved with the Institute of History of Science PAS and the Commission of History of Science PAAS, which have the world’s longest continuous tradition of such research.<sup>85</sup> “In addition, (alas) I am, so far, the only researcher in Poland,

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<sup>84</sup> Cf. also Gąssowski 2005d & 2010c, pp. 58–59.

<sup>85</sup> The following facts express the continuity of this research at both these institutions: Who was actively involved in the Academy of Arts and Sciences was Ludwik Antoni Birkenmajer (1855–1929), the author of numerous publications on Nicolaus Copernicus, the most important of which

who earned his doctorate (1998) and habilitation (2005) in such subject-matter. Moreover, in 2010 I was also awarded the Nicolaus Copernicus scientific prize of Kraków City Council for the monograph, which is an introduction to the Copernican studies, entitled *Różne oblicza Mikołaja Kopernika. Spotkania z historią interpretacji* (*Different faces of Nicolaus Copernicus. Meetings with the history of interpretation*; published in 2009, 676 pp.).

I also kindly ask Jerzy Gąssowski to rein in his prodigious polemical talent and cease to formulate and disseminate in the media of erroneous speculations about the Kraków conference and myself, including:

1. To formulate the thesis that, allegedly, inviting Professor Owen Gingerich to participate in this conference “was (...) to make plausible the overthrow of the results of our discoveries and research” (Gąssowski 2010c, p. 120; translation – M.K.).
2. To equate the Kraków conference to “a parliamentary inquiry commission” (understood by him as a synonym for a witch-hunt and an unfair court of law), which was to have been the reason not to participate in the Kraków conference for several researchers from Jerzy Gąssowski’s team, and especially for him himself (Gąssowski 2010c, p. 120).
3. To ascribe to me the role of an animator of the toxic public atmosphere in Poland, who during the Kraków conference, among others, “strived not to allow those who were trying to provide explanations to the (unfair – M.K.) allegations to speak” (Gąssowski 2010c, p. 121; translation – M.K.).<sup>86</sup>

Three issues amaze me in this context. Firstly, regarding the fact that Jerzy Gąssowski has openly opposed the idea of conducting *an open scientific debate*, and thus trying to give himself and his followers the exclusive right to rule on the interdisciplinary issues of the grave of Nicolaus Copernicus. Secondly, although

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were published by this Academy (cf. Kokowski (ed.) 2002). It was in my home institute where Aleksander Birkenmajer (1890–1967), the son of Ludwik Antoni worked. From 1954 until his death he developed there Copernican research and raised a group of followers, including, among others, the previously mentioned Jerzy Dobrzycki and Paweł Czartoryski. They intensified the Copernican research in my home institute, resulting in founding the Department of Copernican Research and the release of numerous publications in this field. In reference to this tradition, since 17 May 2011, my home institute has been called the Ludwik and Aleksander Birkenmajer Institute for the History of Science of the Polish Academy of Sciences.

<sup>86</sup> Let me add that Jerzy Gąssowski overlooked in his book (cf. Gąssowski 2010c, pp. 58–59) a non-trivial fact in this context, namely that as an expert of the Polish Academy of Arts and Sciences, I had taken part in the final stage of editorial works on the formulation of the text of the *Frombork Declaration* (the idea of which had been born in Pułtusk), had improved its several shortcomings, and on behalf of this Academy I had signed the final text of the Declaration during the ceremony in Frombork on 3 November 2005, during which we were notified about the discovery of the grave of Nicolaus Copernicus (cf. Kokowski 2012b, fn. 2).

the issue of interdisciplinary Copernican research is poorly known to him, he has the courage to publicly scold various experts in such research for an alleged lack of scientific solidity. Thirdly, although he did not participate in the Kraków conference, he formulates very serious allegations, including accusations *ad personam*, which, however, stand in stark contrast to the very programme and the contents of the conference deliberations – see Kokowski (ed.), 2010a.

I think that by doing it all Jerzy Gąssowski abandons scientific discourse and proves at the same time that he is not aware of the existence of the world's longest tradition of scientific Copernican investigations in Poland, which imposes on every disciple of such studies very high standards of research! (Unfortunately, I detected clear symptoms of these problems already in 2005 – cf. Kokowski 2005a; 2005b/2007a).

Let me take this opportunity to make one general reflection. In the contemporary world, including Poland, there is a noticeable decline in scientific ethos, a symptom of which is the ever more frequent replacement in scientific debates of the concept of *quality of scientific publications* with the concept of *dissemination of publications*. As it does not serve science at all, it is high time we openly opposed this increasingly intensifying dangerous mannerism.

## **15. The fundamental merit of Jerzy Gąssowski's research team**

Despite the multilateral criticism of the methodology of Jerzy Gąssowski's research team and the results achieved by them and the interpretation thereof, presented in this article and in my previous studies, I never had and I still do not have doubts that it is possible to indicate a significant merit of these investigations. Basically, they have attracted back the attention of the general public in Poland to the personage of Nicolaus Copernicus. Thanks to this, it turned out with great clarity that the knowledge of one of the most important thinkers of the turn of the 15<sup>th</sup> and 16<sup>th</sup> century is in Polish society very superficial, even among its educated part. This points to the urgent need of intensification of scientific research into the history of science in Poland, and especially of organizational changes at Polish universities, where chairs for the history of science should be founded, whose task would be to conduct full-time and part-time studies of the first, second and third level in the history of science. This entails the necessity to include the history of science in the list of scientific disciplines in Poland. In order to achieve the best effects of this kind of reform of higher education, this discipline should be developed in a close contact with, on the one hand, particular disciplines (exact sciences, etc.), and on the other hand, philosophy of science and the sociology of scientific knowledge.

## 16. Summary

I have presented in this article a comprehensive critique of the results of the DNA analyses of the putative remains of Copernicus and of their interpretation. I want to emphasize that it of original character as far as the subject literature is concerned (I have had no predecessors in this field). The considerations presented here refer to my earlier publications and papers on this topic, developing and sometimes clarifying earlier findings. The value of these considerations is not limited to the analysis of the specific case of Copernicus and has a much wider significance.

I have pointed out in the article numerous inconsistencies, gaps and flaws in the arguments made by the team of authors involved in the identification research of the alleged remains of Nicolaus Copernicus, which make the issue of the identification of the grave 13/05 and the remains coming from this grave is still open to questions. The analysed deficiencies resulted from the overly limited knowledge of the authors of these studies regarding:

1. Copernican historiography, including the history of his letters and his collection of books, his images and their history, the ethnic origin of the family of Copernicus, the knowledge of the Copernican cited literature;
2. The methodology of empirical sciences (the issue of estimation of the errors of the facial reconstruction from a skull);
3. Genetic genealogy (the insufficiency of the application of the minimum haplotype sequence, that is a set of 9-elements, to draw definitive conclusions on the issue of the spread of the haplotype);
4. The ethnogenesis of Slavs and Germans;
5. The ethnic origin of the population of Silesia;
6. The historical and historical and genetic knowledge of the origin of the Toruń burghers;
7. The mtDNA population databases (including the EMPOP database) and Y-DNA databases, including the possibility of using this kind of databases to research the ethnic origin of persons;
8. The methods for estimating the probability of a random compliance between mtDNA profiles for statistically rare samples;
9. The methodology of interdisciplinary research.

What is particularly noteworthy in this article are the deliberations on the statistical analysis of a random match of mtDNA profiles (I was the first to announce it in the literature):

1. Pointing to the fundamental mistake of many publications on DNA analysis of rare samples (for estimating a random match of profiles, the bino-

- mial distribution should be approximated with the Poisson distribution, and not – as it being done – the normal distribution);
2. Pointing to the conventional nature of the confidence level of calculations (of which is often not realized by practitioners) and emphasizing the necessity to determine the random match of the DNA profiles with a very high level of confidence (that is 99.999% and 99.9999%, not only 95%), which particularly regards DNA research for forensic purposes!;
  3. Correcting the value of the random match of the mtDNA profile of the alleged remains of Nicolaus Copernicus based on the data from the EMPOP database for a 95% confidence level, and – for the first time in the literature – setting the values of the random match for 99.999% and 99.9999% confidence levels;
  4. Demonstrating the unrepresentativeness of the EMPOP mtDNA database (due to the lack of samples from many countries);
  5. Pointing to the qualitative-quantitative evidence of a lack of sampling saturation in the mtDNA EMPOP database.

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