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ENDRE NEPARÁCZKI

CURRENT AND EXPECTED RESULTS OF GENETIC RESEARCH ON THE ÁRPÁD DYNASTY

Introduction

Two undoubtedly outstanding figures of early Hungarian history are Álmos and his son, Prince Árpád, whose name is associated with the conquest of the Carpathian Basin and the establishment of Hungarian central power. However, thanks to their successful policies, they not only laid the foundations of the later Christian Kingdom of Hungary, but their names also mark the beginning of the first Hungarian royal dynasty, the Árpád dynasty (or, as Simon Kézai called it, the Turul clan), which ruled for nearly 300 years. Their role was therefore of paramount importance in shaping the Hungarian identity that can already be found in written medieval Hungarian sources. They appear in Anonymus' *Gesta Hungarorum*: "The Hungarian people, terrifying in their brave military ventures, as we intimated above, are descended from the Scythians, referred to as *Dentü-Mogyer* in their own language. Their land was so full of the multitude of peoples born there that it could neither feed them nor accommodate them, as we already noted. Thus the seven princes, who to this day are called *hétmagyar* [the Seven Hungarians], no longer tolerating the inadequate size of the land, took counsel to leave their native country and occupy territory which they could populate, and to this end they did not shy away from armed warfare. Then they chose the land of Pannonia, which was said to belong to King Attila, the descendant of Prince Álmos, the father of Árpád [emphasis added by the

author]. The seven princes then came to a joint and final decision that they could only complete the journey they had begun by choosing for themselves a prince and a commander. Thus by the free will and common consent of the seven men, they chose Álmos, son of Ügyek, and the descendants of his clan, as prince and ruler for themselves and for the sons of their sons, down to the last generation. This is because the son of Ügyek, Prince Álmos, and his descendants proved to be of nobler birth and more fit for war. The seven princes were all of noble birth, warlike and steadfast. Then they unanimously said to Prince Álmos: "From this day on, we elect you our prince and commander. Wherever destiny leads you, we will follow." Then the men confirmed their oath to Prince Álmos: they poured their blood into a vessel, as was the custom of the pagans. Though they were pagans, they kept their oath of allegiance until their death, as follows:" (Translated into Hungarian by László Veszprémy)[1] and also in the chronicle tradition: "Having thus presented the origin of the Huns, their fortunate and unfortunate battles, and the number of times they changed their land, let us now see when they returned again to Pannonia; who were the captains of those who returned, and how many were their armed men. [...] Now, of these captains, Árpád of the Turul clan, son of Álmos, grandson of Előd, great-grandson of Ügyek, was richer than the rest, and his army was stronger. So this Árpád, with his army, was the first to penetrate the Ruthenian mountains, and the first to make camp by the Ung river, for his clan – compared to the other tribes of Scythia – enjoys the privilege of leading the army, and of being the last to retreat. After crossing the Danube and arriving in Pannonia, Árpád himself pitched his tents on the site where the city of Fehérvár was to be built. This place became the first lodging of the leader Árpád." (Translated into Hungarian by János Bollók).[2]

Another important and recurring element in both sets of sources is the emphasis on the connection with the Huns. On the one hand, this implies the kinship of the Huns and the Hungarians in two separate threads of history, and on the other hand, it includes the origin of the Árpád dynasty, which, as we read

1 Veszprémy and Bollók 2004, p. 13.
2 Veszprémy and Bollók 2004, pp. 103–104

in several places in Master P.'s work, was traced back to Attila, the Great King of the Huns. However, source-critical studies of the above excerpts and of the source works themselves have revealed a number of uncertainties (e.g. as regards the identity of the author(s), possible sources, particularities of the genre, date of writing and reason for writing[3]). Consequently, the authenticity and assessment of this information are not uniform and are still the subject of theoretical debate.[4] The opinions differ strongly as some schools completely rejected the possibility of a Hun connection and regarded it as a motif borrowed from Western sources,[5] while others accepted it as authentic.[6] In addition, some stances regarded parts or certain forms of the information as authentic.[7] There is no doubt that the interpretation of these sources presents many pitfalls and problems, and that an analysis of written data only is unlikely to lead to any meaningful progress. However, the question of whether there may be a kinship (biological) link between the two populations, and whether the royal dynasty may have had ancestors in the Hun population (or more narrowly among the Huns), based on the sources and the historiographical analysis, opens up the possibility of interdisciplinary studies. This set of problems also provides working hypotheses that can be investigated using methods of other disciplines, including archaeogenetics.

Thanks to dynamic technological developments as well, the study of early Hungarian history[8] and the origins of prominent families[9] has in the last decade been joined by the discipline of archaeogenetics, which focuses on the study of human DNA. In humans, there are three types of inheritance: offspring inherit their body chromosomes from their parents in roughly equal proportions (autosomal inheritance), children inherit mitochondrial DNA exclusively from their mothers (maternal inheritance), and sons inherit

3 Szabados 2020
4 B. Szabó and Sudár 2021
5 Hunfalvy 1876, pp. 299–303; Kristó 1983; Györffy 1993, p. 126
6 Szabados 2014; 2015
7 B. Szabó and Sudár 2021; Veszprémy 2013
8 Csáky et al. 2020; Csősz et al. 2016; Maár et al. 2021; Neparáczki et al. 2017; 2018; 2019; Tömöry et al. 2007
9 Dissing et al. 2007; Keyser et al. 2020; Malmström et al. 2012; Nagy et al. 2020; Olasz et al. 2019; Wang et al. 2021

their Y-chromosomes almost unchanged from their fathers (Y-chromosomal inheritance). Research consists of extracting hereditary information directly from human bone remains under special laboratory conditions. So alongside archaeology and anthropology, archaeogenetics supports an understanding of the past by providing a constantly expanding and direct (primary) database. This is particularly important for understanding early Hungarian history (or Hungarian prehistory), since the number of written sources on the period is extremely low and, as indicated above, their interpretation is often problematic.

During the reign of the Árpád dynasty kings, only men were allowed to rule in the Kingdom of Hungary, and in most cases the throne was inherited by male members of the dynasty according to the custom, i.e. the determination of the Y-chromosomal genetic group (Y-chromosome haplogroup; abbreviated as Y-chr.hg) and its phylogenetic origin are excellent tools for investigating the dynasty's origin.

Székesfehérvár has a special role in the context of the dynasty, as it was traditionally the site of the coronation ceremonies[10] and the burial place of many Hungarian kings. The provostry of the Virgin Mary was founded and built by Stephen I (Saint Stephen) (1000/1001-1038), and was rebuilt and extended several times in later centuries.[11] His son, Prince (Saint) Imre, was the first to be laid to rest in the church, and later Stephen, the king who founded the Hungarian state, was also buried there. According to historical records, seven other kings of the Árpád dynasty (Kálmán, Béla II, Géza II, László II, Stephen IV, Béla III, László III) and one other prince of the Árpád dynasty (Álmos) were buried in the basilica.[12]

During the Turkish occupation, however, the condition of the basilica, one of the most important sacred centres of our country, deteriorated, and by the 19th century was largely destroyed and completely buried.

The church and the graves came to the attention of the public again when, in 1848, royal burial spots containing crowns and gold jewellery were discovered

10 Bartionek 1987.
11 Búzás 2019; Szabó 2010; 2018
12 Engel 1987

in the courtyard of the Bishop's Palace of Székesfehérvár, in the area of the former Basilica of Our Lady of the Assumption, during the construction of a well house. The remains recovered from the graves were transported to Pest after the excavation. The skeletons were identified as King Béla III and his wife, Queen Anne of Antioch, based on historical, archaeological and anthropological research.[13] During the following century and a half, further excavations were carried out (1848, 1862, 1874, 1936-37, 1967-2002), which resulted in the discovery of more than 900 skeletal remains of individuals.[14] Unfortunately, the adversities of past centuries and the difficulties encountered during excavations have led to the mixing up of many of the bones, often preventing their separation even at the level of the individuals. After the excavation and processing of the finds, to avoid further damage and confusion, most of the anthropological material (more than 600 skulls and almost as many skeletal remains, representing the remains of more than 900 individuals) was deposited in the ossuary in Székesfehérvár, established on the site of the former basilica. The skeletons of a few individuals, including those of Béla III and Queen Anne, were deposited in the Church of Our Lady of the Assumption in Buda.[15] Most of the archaeogenetic research carried out so far has been based on the anthropological finds unearthed here.

Results

The archaeogenetic study of the Árpád dynasty began with the analysis of the skeletons of Béla III and Anne of Antioch, as well as of 8 other individuals who were buried in Székesfehérvár and reburied in Budapest.[16] As a result of this genetic research, the Y-chr.hg of the Árpád dynasty, bearing the mark R1a, was determined. In the sample set, a male genetic marker set corresponding to Béla III was also determined from the skeleton marked HU52; thus a previously

13 Szabados 2016
14 Éry 2008
15 Éry 2008
16 Olasz et al. 2019

unknown royal or princely burial of the Árpád dynasty was identified. Unfortunately, the skull of skeleton HU52 was lost following the excavations, and its unequivocal identification requires further research. Genetic data shows that he is two generations removed from Béla III, i.e. he could be the king's grandfather, uncle, nephew or grandson.

In recent years, advances in molecular biology techniques have made it possible to perform much deeper, high-coverage Y-chromosome sequencing even on archaic samples. Using this method, the haplotype of the Y-chromosome of Béla III, and thus of the Árpád dynasty, has been determined with nucleotide accuracy. By detecting these markers it is now easy to determine whether the given sample can be assigned to the haplogroup characteristic of the House of Árpád (R-ARP), i.e. we can identify the rulers and princes of the Árpád dynasty. Furthermore, by genetically studying people alive today, we were also able to model the pathway by which the genetic pattern typical of the male line of the Árpáds might have spread.[17]

To illustrate the organisation of groups that can be formed from the genetic pattern inherited from the male line, so-called lineage trees are most suitable, into which all men living today can be classified. As time progresses, these groups become more and more diversified, like the branches of a tree. The rulers of the Árpád dynasty belonged to the R1a group, which split into two major branches around 3500 BC: one of these shows a European spread, and the other an Asian spread. The members of the Árpád dynasty belong to the latter, Asian sub-branch. As we move up the tree, the branches become thinner and thinner, i.e. we can define increasingly specific groups. The members of the Árpád dynasty are part of the so-called Prescythian branch of the Asian branch of R1a, which developed around 2500 BC. Within this, further examination of the markers leads to the group Y2632, which is most characteristic of the Mongols and Bashkirs living today. However, within this group, the Árpád dynasty split from the Bashkir-specific SUR51 group to form a new group, named ARP after the Árpád dynasty (Figure 1).[18]

17 Nagy et al. 2020
18 Nagy et al. 2020

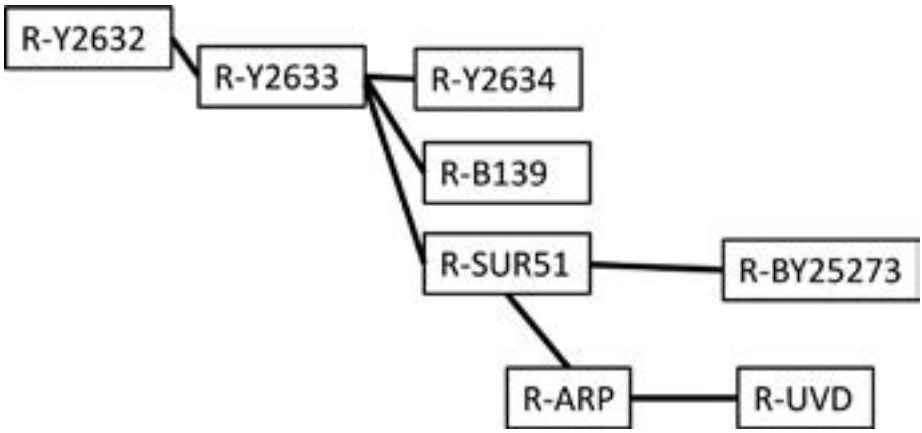

Figure 1. The evolutionary relationship of the R-ARP Y-chromosome haplogroup of the House of Árpád

Projecting the above data onto a map, we find that the R1a-SUR51 group branches off from the R1a-Z2123 group to the Bashkirs of the Volga-Kama region, from which the R1a-ARP group – specific to the Árpád dynasty – branches off again (Figure 2).

Figure 2. Distribution path of R-ARP of the Árpád House compared to recent samples

The distribution pattern of the male branch of the Árpád dynasty is thus compared with the data of people living today (Figure 2). At the same time, the genetic characteristics of an increasing number of archaic samples from Asia have also become known in recent years. These give us the opportunity to compare archaic samples already published, including those of King Béla III. This way, we can make the pathway outlined by the recent samples more accurate, and confirm or refine the estimated time of divergence of each sub-branch.

In 2020, Keyser et al. published a study in which they sequenced samples from the Tamir Ulaan Koshu cemetery, linked to the Asian Huns, using classical archaeogenetic methods. On comparing the results of the archaic finds with archaic samples found in international databases, a haplotype match was described between the examined Asian Hun samples and the Árpád dynasty.[19]

On this basis, and drawing on what we know so far about the genetics of the Asian Huns, if the archaic samples are taken into account the male group known to have contributed to the genetic component of first the Asian Scythians and then the Asian Huns until the Iron Age may have appeared in members of the so-called BMAC culture.[20] This lineage may have reached the Volga-Kama region with the arrival of the European Huns, from where it was demonstrably introduced into the Carpathian Basin with the Árpád dynasty (Figure 3).

Outlook

Data on the first genetically characterised king of the Árpád dynasty has opened up the possibility of examining further bone remains and relics associated with the Árpád dynasty. It should be noted, however, that such attempts had been made before. One example is the interdisciplinary study of the skull relic from the Saint László herm,[21] the archaeogenetic part of which was closed unsuccessfully.

19 Keyser et al. 2020
20 Gnecchi-Ruscone et al. 2021; Jeong et al. 2020
21 Kristóf et al. 2017

Figure 3. Distribution path of specific markers to the House of Árpád, also taking into account archaic data

In 2021, the bioarchaeological investigation of the Árpád dynasty was given new impetus. In the summer of 2021, another interdisciplinary research project was launched, also for the purpose of studying the herma and the skull relic guarded in it. The Archaeogenetic Research Team of the Institute of Hungarian Research and the University of Szeged succeeded in isolating high-quality DNA. The scientific evaluation of the results and the conclusions that can be drawn from them are currently being published.

In 2021, major renovation work was started in the church of Tihany Abbey, as part of which a project was launched entitled *Multidisciplinary Research of the Tihany Royal Crypt*. The research is based on historical data, according to which King András, who died in the Zirc manor house, was buried in the Benedictine monastery of Tihany in 1060, in accordance with his will. Around 1090, his son, Prince David, was also laid to rest here. No scientific or scientific-education data on the status, or the possible success or failure, of the genetic studies had been published by the time this manuscript was completed. According to published press reports, the remains of the bones deposited in the crypt were transported to Budapest, where samples were taken for archaeogenetic analysis and radiocarbon dating. According to preliminary

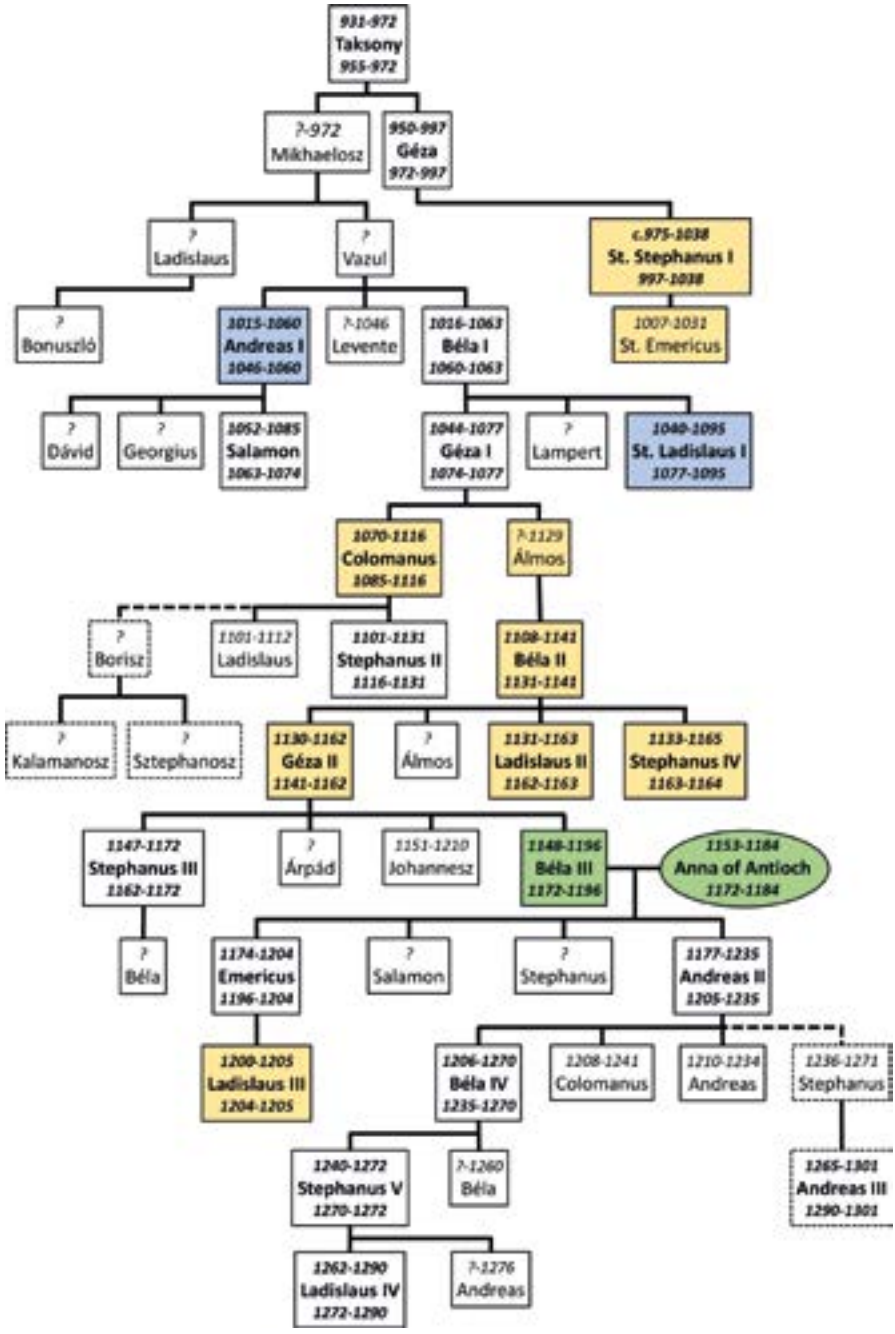

Figure 4. Family tree of the House of Árpád (detail)

data, "at least two bone remains, presumably of adult males, certainly represent the earliest period of the crypt's use, the 11th century."[22]

The Archaeogenetic Research Team of the Institute of Hungarian Research launched a monumental project on the kings of the Árpád dynasty in early 2021, when it began a systematic archaeogenetic study of the ossuary in Székesfehérvár. Sampling and DNA extraction from the skull remains of suitable specimens (rock bone or intact tooth roots) have been and are being carried out in the first phase of the research. The complete genetic material of 204 samples has now been processed, and samples showing a genetic relationship to the kings of the Árpád dynasty have been successfully identified. A further 102 samples are currently being processed and evaluated. A specialist publication containing an evaluation summary of the research phases completed so far will be published this year. The project is rendered more complex by the fact that, according to historical data, the ossuary also contains the anthropological material of several mixed-house rulers. The genetic identification of the associated anthropological finds has still to be conducted, as we do not have the certain points necessary for making a comparison. So parallel with the examination of artifacts in the ossuary, we have started the search and examination of the remains of the Anjou, Jagello and Szapolyai families, in relation to which the Institute of Hungarian Research is engaged in advanced discussions.

22 Szénizotópos 2021.

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