Abhandlung

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The girl with finches: a unique post-medieval burial in Tunel Wielki Cave, southern Poland

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Zusammenfassung: Höhlenbestattungen fehlen in Europa in historischen Zeiten im Allgemeinen. Aus diesem Grund scheint ein nachmittelalterliches Körpergrab eines Kindes mit mindestens einem Vogelkopf im Mund, das in der Tunel-Wielki-Höhle (Südpolen) entdeckt wurde, ein außergewöhnlicher Befund zu sein. Das Ziel dieser Arbeit ist es, eine plausible Interpretation dieser einzigartigen Bestattung auf der Grundlage von Multiproxy-Analysen zu präsentieren, die an Überresten von Menschen und Vögeln durchgeführt wurden, einschließlich genetischer und Isotopenanalysen sowie CT-Scans, Radiokarbondatierungen, anthropologischen und paläontologischen Messungen. Die Ergebnisse zeigen, dass es sich um ein 10–12 Jahre altes Mädchen wahrscheinlich fennoskandischer oder baltischer Abstammung handelt, das in der Neuzeit starb und mit Vogelresten in der Höhle begraben wurde. Die Merkmale der Bestattung in Kombination mit genetischen Analysen und Radiokarbondatierungen sprechen für eine Verbindung des Mädchens mit finno-karelischen Truppen der schwedischen Garnison auf der nahe gelegenen Burg Ojców während der Invasion von König Carl Gustav in Polen zwischen 1655 und 1657.

Schlüsselwörter: Kulturanthropologie; Neuzeitarchäologie; Speleo-Archäologie; Isotopen-Studien; aDNA; Harris-Linien; Höhlen-Grab; Buchfink; Seele Vogel; Karelier.

Abstract: Cave burials are generally absent from historical periods in Europe. Consequently, the discovery of a post-medieval inhumation of a child buried with at least one bird head placed in the mouth in Tunel Wielki Cave (southern Poland) is an exceptional find. The aim of this paper is to discuss this unique burial based on multiproxy analyses conducted on the human and avian remains, including genetic and isotopic analyses as well as CT scans, radiocarbon dating, and anthropological and paleontological assessment. The results reveal the burial was that of a 10–12 year old girl of likely Fennoscandian or Baltic genetic ancestry, who died in the post-medieval period and was buried in the cave with the placement of one, and possibly two, bird heads in the mouth of the deceased. We propose that the girl is associated with Finno-Karelian troops of a Swedish garrison stationed at the adjacent Ojców Castle during King Carl Gustav's invasion of Poland in 1655–1657.

Keywords: cultural anthropology; post-medieval archaeology; cave archaeology; isotopic studies; ancient DNA; Harris lines; cave burial; chaffinch; soul-birds; Karelians.

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Résumé: Les sépultures en grotte sont généralement absentes après le changement d'ère en Europe. C'est pourquoi l'inhumation moderne d'un enfant enterré avec au moins une tête d'oiseau placée dans la bouche, qui a été mise au jour dans la grotte de Tunel Wielki (sud de la Pologne), apparaît comme une découverte exceptionnelle. L'objectif de cet article est de présenter les interprétations possibles à cette sépulture unique. Ces interprétations sont basées sur des analyses pluridisciplinaires menées sur les restes humains et fauniques, dont des analyses génétiques et isotopiques, ainsi que de la tomodensitométrie, des datations au radiocarbone et des mesures anthropologiques et paléontologiques. Les résultats indiquent qu'il s'agit d'une fille d'environ 10 à 12 ans d'ascendance vraisemblablement fennoscandienne ou balte qui est décédée durant la période moderne et a été enterrée dans une grotte avec des restes d'oiseaux. Les caractéristiques de la sépulture, combinées aux analyses génétiques et aux datations au radiocarbone, tendent à créer un lien entre cette enfant et les troupes finno-caréliennes de la garnison suédoise situées dans le proche château d'Ojców durant l'invasion de la Pologne par le roi Charles X Gustav en 1655–1657.

Mots clés: anthropologie culturelle; archéologie post-médiévale; spéléo-archéologie; études isotopiques; ADN ancien; lignes Harris; sépulture dans une grotte; pinson; âme oiseau; Caréliens.

Abstrakt: W Europie czasów historycznych pochówki jaskiniowe właściwie nie występowały. Z tej przyczyny za wyjątkowy uznać należy odkryty w Jaskini Tunel Wielki (południowa Polska) szkieletowy pochówek dziecka z przynajmniej jedną głową (czaszką) ptasią umieszczoną w ustach osoby zmarłej. Celem niniejszego artykułu jest próba wyjaśnienia fenomenu tego wyjątkowego pochówku, oparta o wieloaspektową analizę ludzkich i ptasich szczątków kostnych, uwzględniającą badania genetyczne i izotopowe, tomografię komputerową, datowania radiowęglowe oraz pomiary antropologiczne i paleontologiczne. Wyniki wskazują, że mamy tu do czynienia z pochówkiem 10–12-letniej dziewczynki, najpewniej fińskiego lub bałtyjskiego pochodzenia genetycznego, zmarłej w okresie nowożytnym i pochowanej w jaskini wraz ze szczątkami ptaków. Cechy pochówku w połączeniu z analizami genetycznymi i datowaniem radiowęglowym przemawiają na korzyść hipotezy wiążącej ją z fino-karelskimi wojskami szwedzkiego garnizonu wojskowego stacjonującego w pobliskim zamku w Ojcowie podczas Potopu szwedzkiego w latach 1655–1657.

Słowa kluczowe: antropologia kulturowa; archeologia nowożytna; speleoarcheologia; analizy izotopowe; antyczne DNA; linie Harrisa; pochówek jaskiniowy; zięba; dusza-ptak; Karelowie.

1 Introduction

Caves have been used for funerary purposes almost since the dawn of time, with the perception that they served as final resting places occurring in many periods and cultures. In much previous theoretical and methodological research on caves, the focus has been on their potentially prominent supernatural significance. The concept of a cave as a sacred place may have developed from an idea that these places belonged to a subterranean realm, distinct from the world of the living[1]. There is no doubt that cave burial customs were more frequent in some periods than in others, such as the well-attested sepulchral use of caves in the Neolithic[2]. In the European context, there are strong indications, however, that these customs were abandoned before and during the Middle Ages. This was largely due to the spread of Christianity, which inevitably led to what has been described as a *demystification* of caves[3], and from that time onwards caves were used primarily for refuge, and sometimes for economic or even eremitic purposes[4].

The purpose of this paper is to explore the unique funerary practices related to a juvenile burial of post-medieval date from Tunel Wielki Cave (Sąspów, Cracow district, southern Poland; Fig. 1). This paper will consider the unusual burial circumstances combined with a set of interdisciplinary analyses focussed on establishing the child's genetic, cultural, and social background. It is worth noting that there are only few other cave discoveries of human remains in Europe which produced post-medieval radiocarbon dates[5]. The distinctive features of the burial make it an interesting case study for adopting an interdisciplinary approach to the interpretation of the remains. The case is particularly interesting because any sustainable scenario for what transpired in the cave can only be extrapolated through the interdisciplinary triangulation of: 1) empirical evidence of the archaeological

1 Whitehouse 1992; Ustinova 2009; Orschiedt 2012; Moyes 2014; Tomkins 2014; Dowd 2015; Silvestri *et al.* 2019.
2 See recently: Peterson 2019.
3 Dowd 2015.
4 Peša 2013; Dowd 2015; 2018; Wojenka 2018.
5 See: Dowd 2015; 2016.

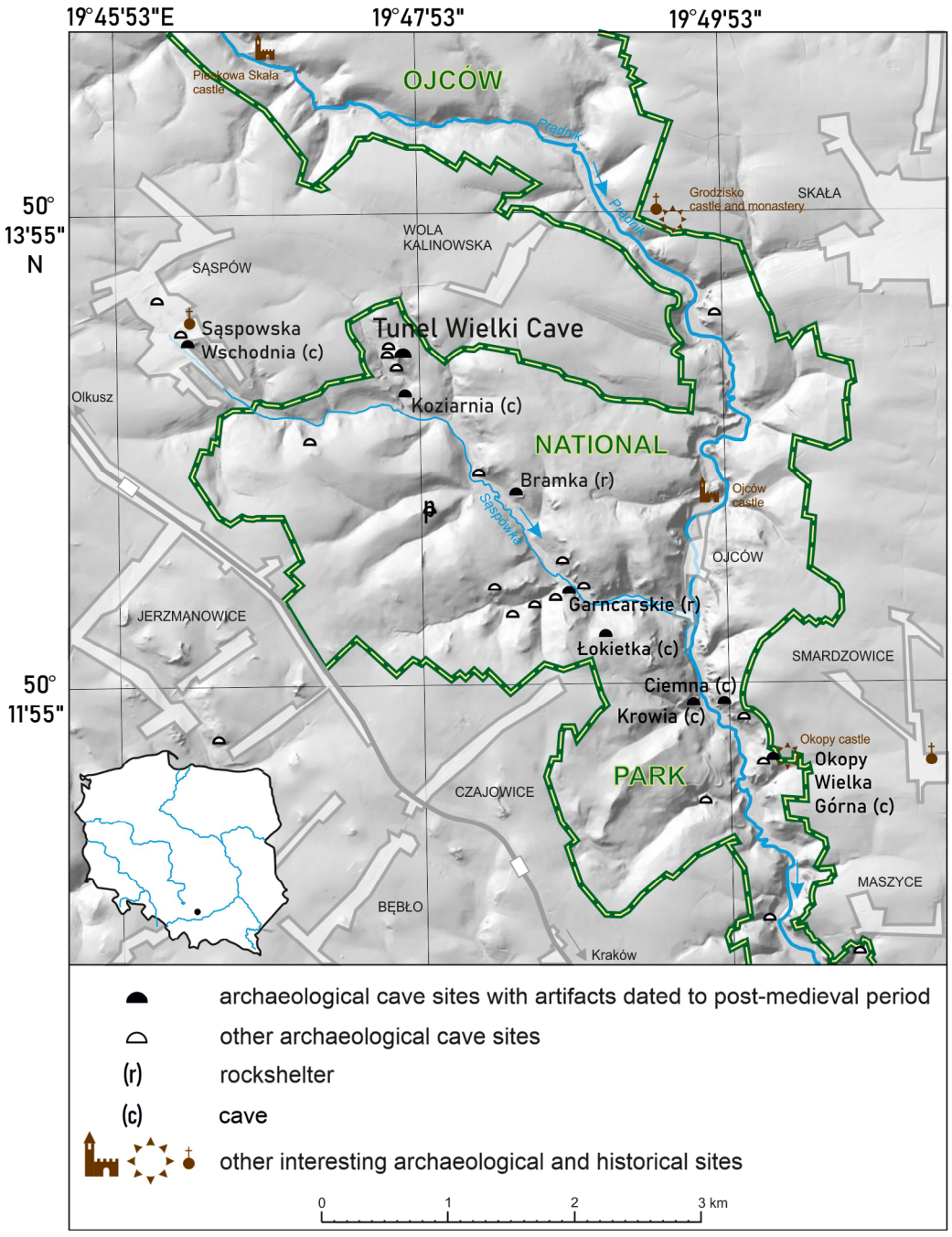

Fig. 1: The location of Tunel Wielki Cave. Map courtesy of M.T. Krajcarz.

record that shows the event's outcome; 2) knowledge of potential contemporary historical events and historical contexts; and 3) knowledge of relevant cultural beliefs and practices. In other words, developing a sound interpretation of the case requires consideration of evidence from outside of the archaeological record and the negotiation of possibilities across perspectives from different disciplines.

2 The site

Tunel Wielki Cave is located in the southern part of the Cracow Upland, approximately 20 km north of Cracow (Fig. 1). The site is situated in Koziarnia Gorge in the Sąspów Valley within the so-called *Sadlane* rocks, of Upper Jurassic age. It is the largest and highest of a cluster of natural caves (Fig. 2). The cave is 22–24 m in length and consists of two chambers connected by an 8 m-long narrow passage which reaches a minimum height of 0.5 m.

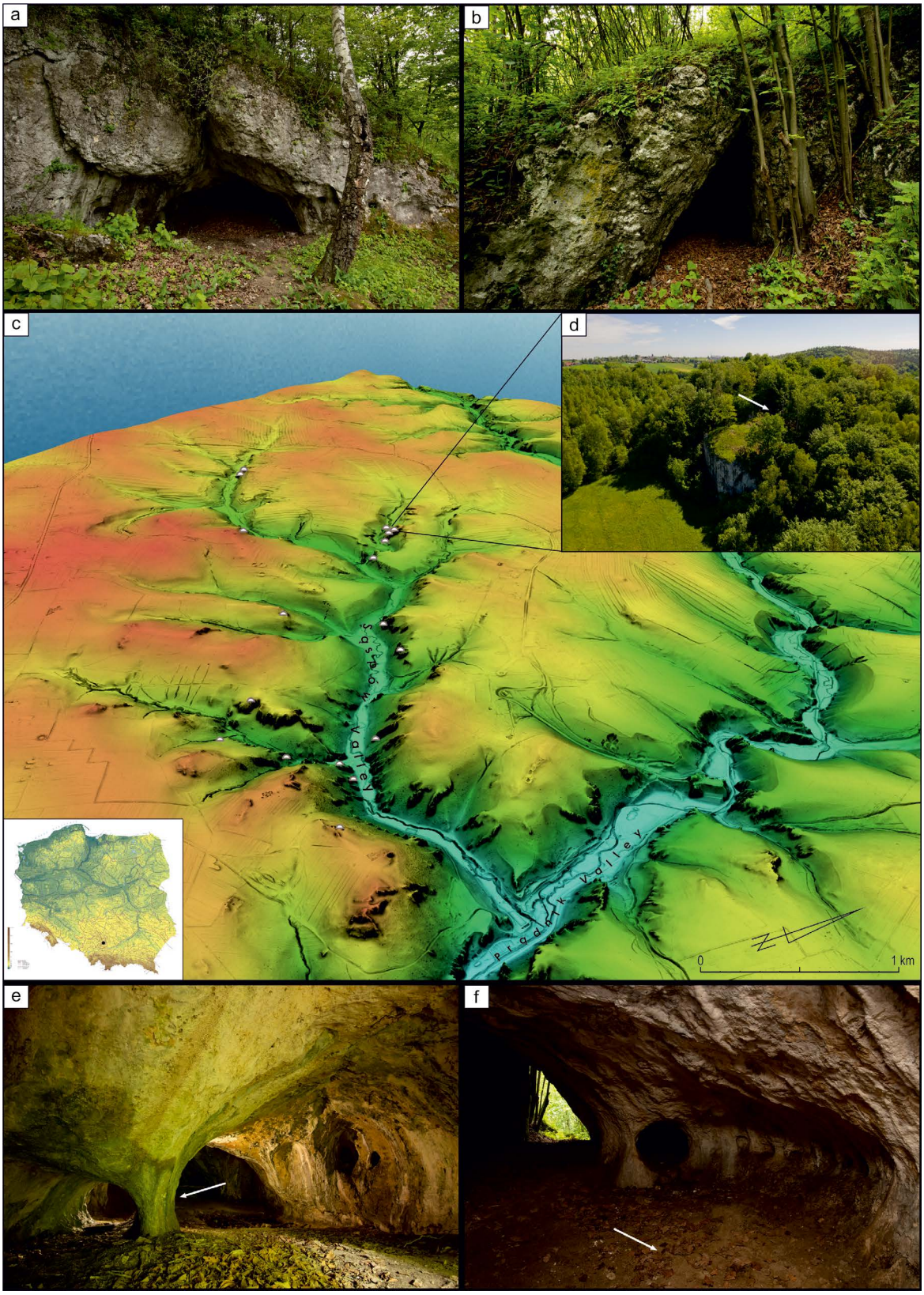

Fig. 2: Tunel Wielki Cave. a – the northern entrance; b – the southern entrance leading into the chamber where the burial was found; c – LiDAR map of the Sąspów Valley and part of Prądnik Valley with the location of Tunel Wielki Cave indicated; d – the massive Sadlane rocks; e, f – the south chamber from the inside (the burial location is indicated). Photos courtesy of M. Bogacki, map courtesy of M. Jakubczak.

The north chamber is 7×4 m in size and almost completely illuminated by the large cave mouth, whereas the south chamber is more spacious (10×4–5 m) but much darker – access to this part of the cave is currently via a 1×2 m opening. By the west wall of the south chamber, 1.5 m from this opening, there is a natural stone column which physically divides the inner space of the chamber into the two separate parts (Fig. 2e).

It is important to note that both the north and south chambers are dry and airy. Their floors are relatively flat and even. In contrast to the north chamber, which is preceded by a large flat terrace, the southern entrance overlooks the steep slope leading down to the bottom of the valley.

3 The burial

In 1967–1968 the first archaeological fieldwork took place at the site, directed by Waldemar Chmielewski as a part of a larger archaeological campaign focussed on cave sites in the Sąspów Valley[6]. To examine the stratigraphy in Tunel Wielki Cave, three trenches were opened – one in the entrance part of the north chamber, and two in the southern chamber (Fig. 3). Although the northern chamber provided a 4.5 metre-deep sequence of Pleistocene and Holocene-era strata[7], it was the southern chamber with its poor stratigraphic sequencing that yielded the juvenile inhumation burial, which has been ignored in the literature until now.

The human skeleton which is the focus of this paper was discovered in a trench opened in the middle of the southern chamber behind the stone column (Fig. 3). The grave cut was discovered at a depth of 10–20 cm below the cave floor. It was roughly oval in plan, orientated NNW-SSE, and approximately 0.45 m in width. The depth and length of the grave cut is uncertain – the latter is difficult to assess because the southernmost part of the grave was destroyed by later unidentified activities (shallow pit 1), evidenced from both Chmielewski's field records (Fig. 3) and excavations carried out in 2016[8]. The grave fill consisted of a dark humic layer mixed with loess (Fig. 3). It rested on the top of MIS 2 loess layers. The excavation did not produce evidence of a coffin or any other grave construction.

The skeleton was in a supine position at the bottom of the grave pit, with arms extended along the sides. The skull occurred about 10 cm above the level of the pelvis. The leg bones were disturbed by later activities, but their extended position is quite certain. While the lower leg bones were discovered within the loose sediment from disturbance activities, the foot bones were missing. The field records reveal that some bones were not in correct anatomical position, particularly those from the lower part of the skeleton. A single lumbar vertebra occurred beside the right shoulder together with a single phalanx. The pelvis was slightly moved, possibly by animal activities. The rest of the skeleton was undisturbed (Fig. 3). There were no grave goods, but a bird skull was found inside the deceased's mouth (Fig. 3, 6) and another bird skull was discovered to the left of the head by the deceased's mouth. As the head was slightly rotated to the left, it is possible that both bird skulls (bird heads) had originally been placed inside the mouth of the deceased, and that due to post-depositional processes one subsequently fell out of the mouth.

Both skulls were identified by Bocheński[9] as belonging to the Common Chaffinch (*Fringilla coelebs*).

According to Chmielewski, the child burial was of 19th-century origin[10], although it must be stressed that the field documentation provides no evidence to support such a date: no grave goods were found with the burial, and the only material retrieved from the grave fill were redeposited Neolithic pottery sherds and loose animal bones. The 2016 excavations did not contribute to the dating of the burial[11].

4 Methods & Materials

4.1 Osteoarchaeological analysis

Although this burial was discovered more than 60 years ago, the skeletal remains have not been analysed until now. In the late 1960s, the cranium and mandible were separated, and were possibly sent for anthropological examination. It is not known whether such an examination was ever made and the current location of the cranium is not known. Only the post-cranial skeletal remains were available for analysis for the purpose of this paper, and they are stored in the Faculty of Archaeology, University of Warsaw (inventory no. TW 595; see Fig. 4). Also missing are some

6 Chmielewski 1988.
7 Madeyska 1988; Krajcarz *et al.* 2016.
8 Wojenka *et al.* 2017.
9 Bocheński 1988.
10 Chmielewski 1988.
11 See: Wojenka *et al.* 2017.

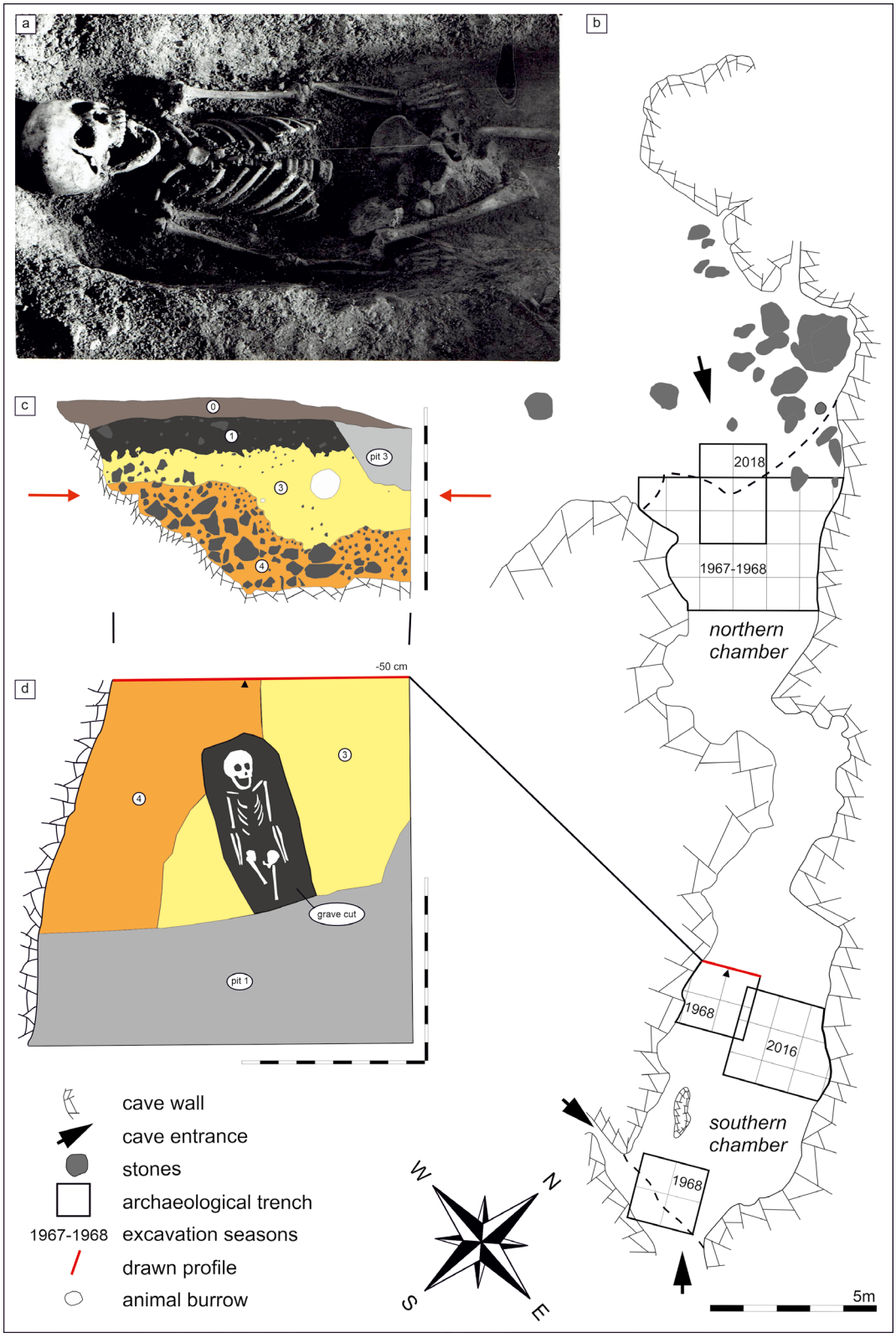

Fig. 3: The burial. a – the burial during the 1968 excavations; b – plan of the cave with location of trenches and dates of excavation; c – the northern profile of trench IV, where the child burial was discovered, red arrows designate the level demonstrated in fig. 3d; d – plan of trench IV, 50 cm below the cave floor with an in situ drawing of the child's burial. Illustration courtesy of the archives of the Faculty of Archaeology, University of Warsaw.

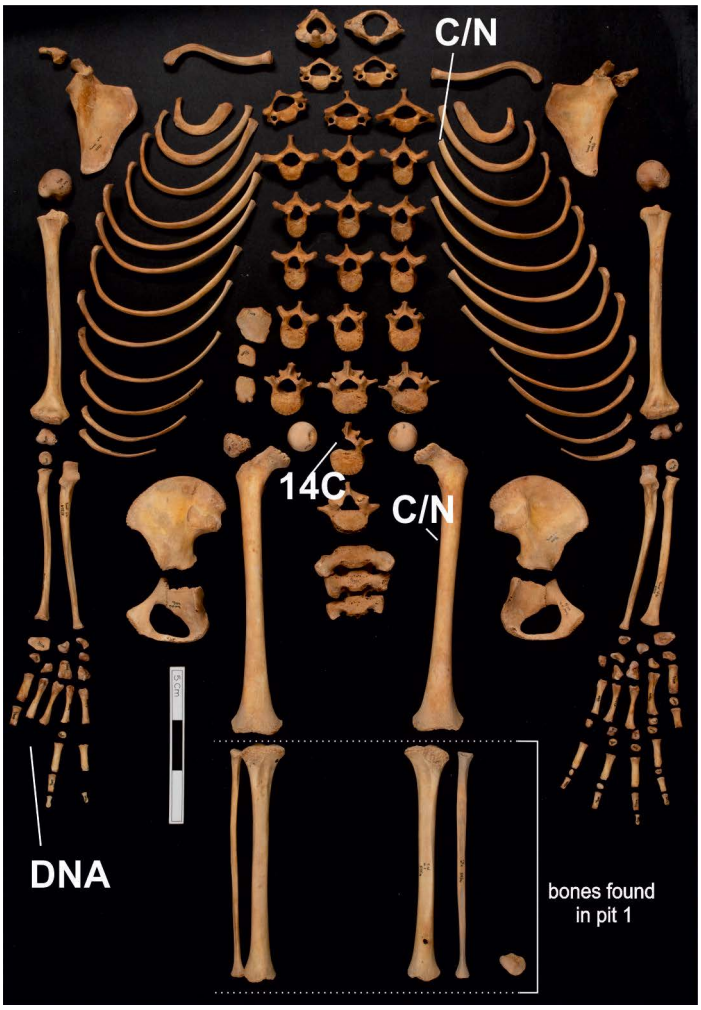

Fig. 4: The juvenile skeletal remains from Tunel Wielki Cave stored in the Faculty of Archaeology, University of Warsaw. Bones from which samples were taken for various analyses are indicated. Photo courtesy of M. Bogacki.

epiphyses (both right and left distal femoral epiphyses, both proximal and distal tibial and fibular epiphyses; right distal ulnar epiphysis, right major trochanter) and smaller bones: both patellas, some hand phalanges and both pisiform bones. The absence of some minor epiphyses could be a result of the excavation techniques or storage history, but a lack of ossification cannot be precluded, as the state of preservation visible on the archival photo taken during the excavation is unclear due to the low resolution of the image (Fig. 3). Only the left navicular has been accounted for; no other foot bones were present, probably due to the later pit 1 that truncated the original grave.

The post-cranial skeleton has been analysed using standard descriptive methods for juvenile skeletons following the protocol from "Guidelines to the Standards for Recording Human Remains"[12], A number of post-cranial measurements were taken according to the standard procedures of the Department of Bioarchaeology at the University of Warsaw, following the recommendations of Buikstra and Ubelaker[13], with some additional measurements necessary for age-at-death assessment according to Schaefer *et al.*[14] Due to the aforementioned missing cranium and mandible, some conclusions were partially based on a careful examination of the archival photo of the skeleton in situ[15]. The list of measurements are given in Table 1, and detailed information on methods employed is given in the results section.

In line with accepted juvenile analysis procedures, no attempt was made to assess the sex of this immature individual, although subsequent analysis established the sex by genetic research. Reconstruction of the in vivo stature followed the regression equation presented by Smith[16]. Due to the absence of the skull, an attempt was made to

12 Brickley/McKinley 2004.

13 Buikstra/Ubelaker 1994.
14 Schaefer *et al.* 2009.
15 Ibid.
16 Smith 2007.

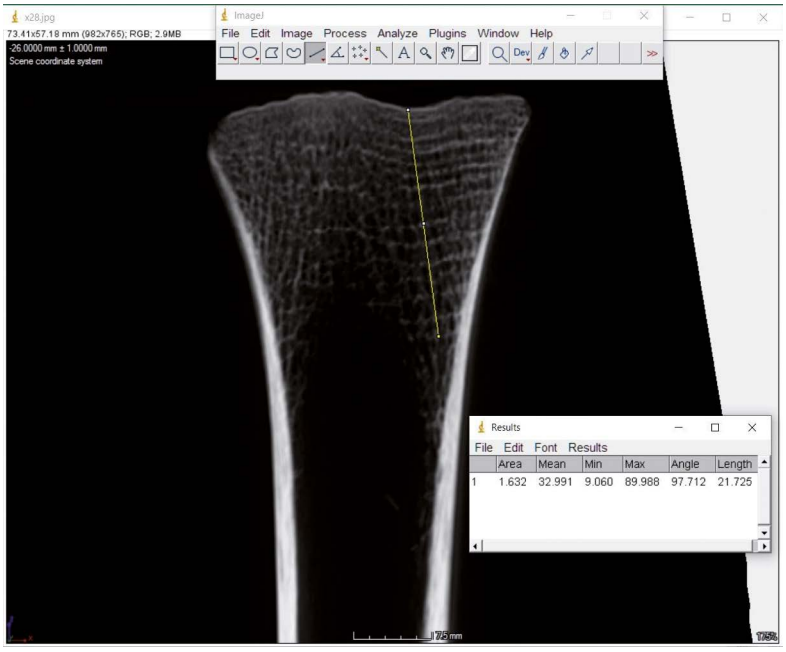

Fig. 5: The measurement of the location of Harris lines in distal metaphysis of the left tibia in ImageJ 1.52 software.

Tab. 1: Post-cranial measurements of the analysed individual. All measurements in millimetres.

Measurement	Left	Right	Mean
Clavicle: maximal diaphyseal length	108.0	107.5	107.75
Humerus: maximal diaphyseal length	207.0	210.0	208.5
Radius: maximal diaphyseal length	147.0	148.0	147.5
Ulna: maximal diaphyseal length	163.0	165.0	164.0
Femur: maximal diaphyseal length	280.0	280.0	280.0
Tibia: maximal diaphyseal length	224.0	227.0	225.5
Fibula: maximal diaphyseal length	220.0	222.0	221.0
2nd metacarpal: maximal diaphyseal length	43.0	44.0	43.5
Scapula: maximal length	94.5	95.0	94.75
Scapula: maximal width	69.0	67.5	68.25
Scapular spine: maximal length	85.0	83.0	84.0
Length of glenoidal surface	21.0	22.5	21.75
Length of glenoidal mass	35.0	34.5	34.75
Infra-scapular height	79.0	76.0	77.5

determine possible growth arrest periods by analysing the Harris lines. CT scans of the available long bones were taken courtesy of ImagineRT sp. z o.o. X-rays of energy ranging from 100 kV to 125 kV and currents from 310 μA to 330 μA were used for all the scans. Each scan was reconstructed from approximately 1,600 x-ray images (1000 pixels × 1000 pixels). A single x-ray image was averaged from two 250 ms images. These conditions, together with geometrical magnification, made it possible to obtain a reconstructed volume with a voxel size ranging from 0.1 mm to 0.13 mm. Observed changes have been analysed to establish the probable age at growth arrest events according to revised Byers' equations[17], with calibrated measurements taken by ImageJ 1.52 software[18] (Fig. 5).

4.2 Radiocarbon dating

A single lumbar vertebra (Fig. 4) was direct dated by AMS. The date was calibrated with OxCal version 4.2.4 software[19] using the IntCal13 radiocarbon atmospheric calibration curve[20].

4.3 Genetic analyses

DNA extraction, libraries preparation, sequencing

Genetic analyses were performed in facilities dedicated to ancient DNA at the Laboratory of Paleogenetics and Conservation Genetics, Centre of New Technologies at the University of Warsaw. All experimental procedures were performed according to the strict rules of work with ancient DNA to minimize the possibility of contamination from modern DNA. Prior to DNA extraction, the bone fragment of the studied individual was washed with double distilled water and UV-irradiated (245 nm) for 10 minutes. The

17 Kulus/Dąbrowski 2019.
18 Schneider *et al.* 2012.
19 Bronk Ramsey 2009; Bronk Ramsey *et al.* 2013.
20 Reimer *et al.* 2020.

outer surface of bone was removed and around 100 mg of bone powder was drilled from two separate places using a Dremel tool. DNA extraction was performed following the protocol optimized in recovering ultrashort fragments (<80bp)[21]. Double-indexed sequencing libraries were produced from each DNA extract using the modified protocol of Meyer and Kircher[22]. DNA preservation was assessed by shallow shotgun sequencing of the libraries on the NextSeq Illumina platform. The library with the highest amount of endogenous DNA and complexity was used for deeper shotgun sequencing on the NovaSeq Illumina platform.

Data processing

Sequencing reads were demultiplexed using Bcl2fastq, and adapter sequences were removed using AdapterRemoval v. 2[23]. The reads were mapped against the hs37d5 human reference genome using bwa 0.7.17[24]. Only reads with mapping quality over 30 and longer than 30 bp were retained, and duplicates were removed using Samtools[25]. Authenticity of the obtained ancient DNA sequences was assessed testing the DNA damage pattern with mapDamage 2.0[26]. The level of contamination with present-day human mtDNA was estimated using Schmutzi[27] and contamMix.[28] To minimise the impact of deaminated sites at the ends of the ancient DNA molecules on the genotype calling from the/low-coverage genome, we trimmed 7-bp from each side of the DNA molecules using trimBam script[29]. Pseudohaplotype was called using the pileupCaller – one of the SequenceTools (https://github.com/stschiff/sequenceTools/tree/master/src-pileupCaller), which randomly selects one read for each SNP position. The sex of the analysed sample was determined by calculating the ratio of sequence reads aligning to X and Y chromosomes[30]. The mitochondrial genome was reconstructed by mapping genomic data to reference the mitochondrial genome (rCRS, NC_012920), and the mtDNA haplogroup was assigned using HaploGrep2 (Phylo Tree 17)[31].

To examine genetic affinities of the studied individual, we selected 841 individuals from the Western Eurasian populations which were genotyped for 621,799 SNPs.[32] To further test the hypothesis of northern European origin, one contemporary Sámi and 15 ancient individuals from Fennoscandia were added to the dataset[33]. Principal Component Analysis (PCA) was constructed using smartpca script from Eigensoft package with the ancient individuals projected using option 'lsquare:yes'[34]. Admixture analysis was run using ADMIXTURE software[35]. To reduce linkage disequilibrium prior to admixture analysis, genotypes were pruned for minor allele frequency below 0.01 and linkage disequilibrium (plink -indep-pairwise 200 5 0.5). Five replicates were done for each K value between 2 and 10. ADMIXTOOLS package[36] was used to calculate outgroup f_3 statistics.

4.4 Isotopes

Carbon and nitrogen stable isotope analysis of bone collagen is a well-established method for diet reconstruction, allowing, in a terrestrial environment, for distinction between a vegan diet and a diet containing animal proteins, and between a diet based on C_3 plants (most of the Central European flora) and C_4 plants (e. g. millet, maize, sugar cane). Nitrogen stable isotope ratio is commonly used to reconstruct the trophic position of an individual. For a more detailed review see Lee-Thorp[37] and Koch[38]. Nitrogen stable isotope ratio is also sensitive to nutritional stress[39], but short term stress episodes do not usually find expression in bone tissue due to relatively slow bone turnover[40].

Samples for isotope analysis were collected from a rib and a femur as presented in Fig. 4. Due to different trabecular to cortical bone ratios, a rib has faster bone turnover than a long bone shaft[41], so they store isotopic information of the diet of the last few years and the last decade of life, respectively[42].

21 Dabney *et al.* 2013.
22 Meyer/Kircher 2010.
23 Lindgren 2012.
24 Li/Durbin 2010.
25 Li *et al.* 2009.
26 Jónsson *et al.* 2013.
27 Renaud *et al.* 2015.
28 Fu *et al.* 2013.
29 Jun *et al.* 2015.
30 Skoglund *et al.* 2013.
31 Weissensteiner *et al.* 2016.
32 Lazaridis *et al.* 2016.
33 Lamnidis *et al.* 2018.
34 Patterson *et al.* 2006.
35 Alexander *et al.* 2009.
36 Patterson *et al.* 2012.
37 Lee-Thorp 2008.
38 Koch 2007.
39 Fuller *et al.* 2005.
40 Nitsch *et al.* 2010.
41 Ott 2002.
42 Cf. Hedges *et al.* 2007.

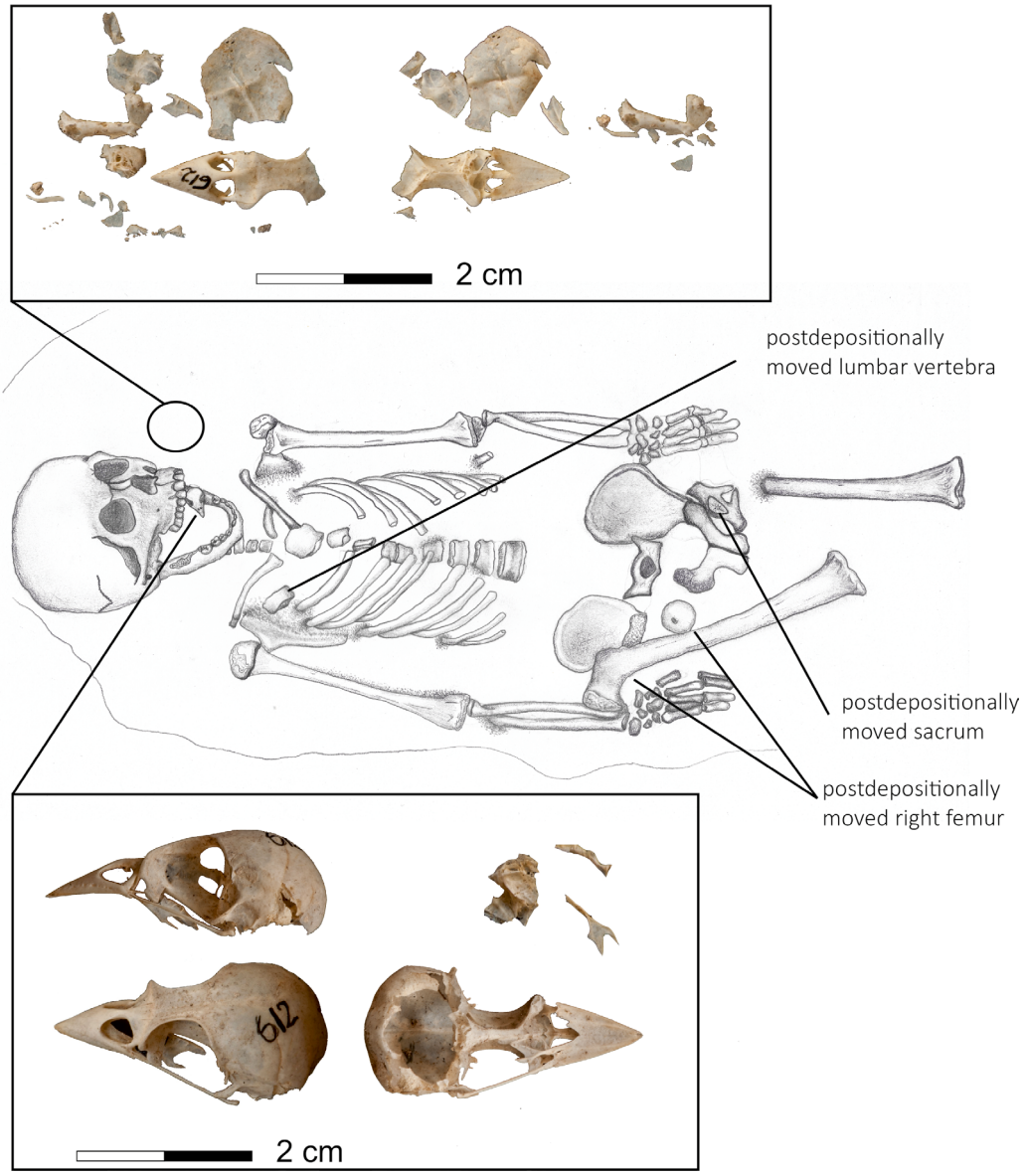

Fig. 6: The in situ position of the discovered burial and photos of the finches' skulls with their positions. Post-depositional changes in the bones' arrangement are indicated. Drawing of the skeleton by G. Czajka.

The surface of the bone samples was mechanically cleaned and then powdered. Bone collagen was extracted using the Longin[43] method. The obtained collagen was analysed in the stable isotope laboratory at the Department of Forest Ecology and Management, Swedish University of Agricultural Sciences (Sweden), using a Delta V isotope ratio mass spectrometer (Thermo Fisher Scientific, Bremen, Germany) and a Flash EA 2000 elemental analyser (Thermo Fisher Scientific, Bremen, Germany). Samples were measured against international standards (for carbon isotopes: IAEA-600, IAEA-CH-6 and USGS40, for nitrogen: IAEA-600, IAEA-N-2, USGS40 and USGS41) and expressed as $\delta^{13}C$ or $\delta^{15}N$ in permilles (‰).

4.5 Bird remains

The bird skulls from the burial (Fig. 6) are stored at the Institute of Systematics and Evolution of Animals, Polish Academy of Sciences, Cracow. They were re-examined macroscopically under a low power microscope (Leica MZ6, magnification range from 6.3× to 40×) for anatomical details as well as traces indicating taphonomy (as

43 Longin 1971; Brown *et al.* 1988.

human or animal traces)[44]. The maturity of the birds was established based on observed stages of skull pneumatisation[45]. In passerines, skull pneumatisation occurs in an orderly manner and thus may indicate the age of a bird[46]. Consequently, if both the pneumatisation pattern and the bird's clutching time are known, it is possible to infer from the skull the time of the year in which the bird died. To estimate the possible time of the birds' death, we used data published by Winkler and Jenni and Winkler[47] and assumed a similar breeding season for the chaffinches. Concurrent death of both birds was assumed. Extrapolation from data on a related species, Brambling (*Fringilla montifringilla*), was made to estimate the probable end of the possible timespan of the deaths.

Bird comparative osteological collection of ISEA PAS was used for the study.

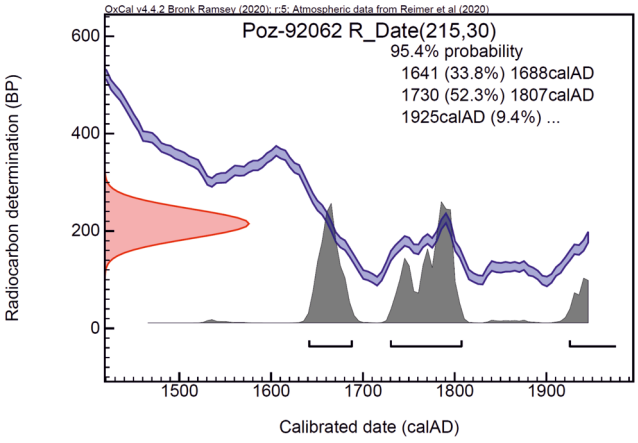

Fig. 7: The calibration of the radiocarbon date produced by the human vertebra.

5 Results

5.1 Chronology

A radiometric age of 215 ± 30 BP (Poz-92062) (Table 2) was obtained directly from the third lumbar vertebra human remains. The calibration with 95.4 % probability range indicates three possible periods: 1641–1688 AD (33.8 % probability), 1730–1807 AD (52.3 % probability) and after 1925 AD (15.7 % probability) (Fig. 7).

Tab. 2: Radiocarbon date obtained for the juvenile skeletal remains from Tunel Wielki Cave.

Sample ID	sampled material	radiocarbon date (y BP)	N (%)	C (%)	C/N
Poz-92062	3rd lumbar vertebra	215 ± 30 BP	13.6	4.8	2.83

We can exclude the possible date after 1925 from consideration because at the time of the discovery in 1968, the bones were not determined as from recent times[48]. The realistic assessment of the bones' age must acknowledge the state of preservation of the lower leg bones damaged by undefined works prior to 1968. At the time of the destruction of the lower part of the grave, the individual must already have been skeletonized, otherwise we would likely be able to observe some post-mortem damage to the lower leg bones.

Both the first and the second calibrated ranges (1641–1688 AD and 1730–1807 AD, respectively) fall almost completely within the period of the Polish-Lithuanian Commonwealth (1569–1795). The final stages of the second range correspond with the end of the independent Polish-Lithuanian state – in 1795, along with a major part of SE Poland, the area of the Sąspów Valley became part of the Austrian Empire. Both time periods in question are abundant in political events, including wartime periods.

5.2 Osteorchaeology

The size of the analysed skeleton, as well as the lack of fusion of nearly all the epiphyses, clearly indicates that the remains belong to an immature individual. The state of preservation of the bones is almost ideal; skeletal fragments present do not show any kind of changes either indicating antemortem traumatic events or post-depositional damage, even though the recorded placement of several elements suggests some disturbances of already skeletonized remains. The full inventory of the analysed skeleton is presented in Fig. 4.

The acquired measurements (see Table 3) have been used for establishing the possible age-at-death of the individual. A full list of the assessments is available in Table 4. To minimize the effect of the asymmetry between limbs, the mean value was used for age assessment. The results seem to indicate the individual to be a younger child, probably 6 to 8 years old, with scapular measurements giving a

44 For details see e. g. Fernández-Jalvo/Andrews 2016.
45 Winkler 1979; Jenni/Winkler 2012.
46 Jenni/Winkler 2012.
47 Winkler 1979; Jenni/Winkler 2012.
48 Chmielewski 1988.

Tab. 3: Age-at-death assessments of the analysed individual based on measurements of skeletal elements. If the range value is followed by an asterisk the range is in the 10th–90th percentile; the SD is indicated by ± sign.

Measurement	Age	N	Mean	Range/SD	Method	Schaefer *et al.* 2009; page number
Clavicle: maximal diaphyseal length	12–13 yrs	3	106.4	102.5–111.3	Black/Scheuer 1996	144
Humerus: maximal diaphyseal length	7 yrs	86	202.6	190.0–215.5*	Maresh 1970	174
Radius: maximal diaphyseal length	6 yrs	75	140.0	129.6–149.8*	Maresh 1970	191
	6 yrs	165	145.3	± 8.3	Gindhart 1973	192
Ulna: maximal diaphyseal length	7 yrs	86	164.8	154.2–176.3*	Maresh 1970	207
Femur: maximal diaphyseal length	6 yrs	75	268.9	252.1–287.8*	Maresh 1970	267
Tibia: maximal diaphyseal length	6 yrs	75	217.4	200.7–235.0*	Maresh 1970	286
	6 yrs	118	231.2	±15.2	Gindhart 1973	287
Fibula: maximal diaphyseal length	6 yrs	75	216.0	199.4–233.3*	Maresh 1970	302
2nd metacarpal: maximal diaphyseal length	6 yrs	12	40.9	±7.1	Kimura 1976	224
Scapula: maximal width	7–8 yrs	2	63.3	±2.8	Saunders *et al.* 1993	157
Scapula: maximal length	7–8 yrs	1	94	—	Saunders *et al.* 1993	157
	8.25; R^2=0.89				Rissech/Black 2007	158
Scapular spine: maximal length	8.79; R^2=0.91				Rissech/Black 2007	158
Length of glenoidal surface	7.26; R^2=0.88				Rissech/Black 2007	158
Length of glenoidal mass	9.01; R^2=0.86				Rissech/Black 2007	158
Infra-scapular height	8.96; R^2=0.88				Rissech/Black 2007	158

slightly older age, at around 8–9 years. The results based on the length of the clavicles show a significantly older age of 12–13 years. This surprising result could be explained by differences in body proportion, as the fusion of the triradiate complex of the pelvis has been reported to start around this age[49], and the studied individual has no sign of the initial stages of union. Additionally, there is a complete dens axis with fused *ossiculum terminale* present, which is indicated to occur at around 12 years[50]. Also, the development of both hamates shows a completely fused hook, which also implies an age of 10–12 years. As a result of this confusing data, a careful examination of the archival photo was made in order to consider the dental age of the individual – long established as the most precise ageing method for immature skeletal remains. Fortunately, the upper right dentition is quite clearly visible (see Fig. 3, 6). It seems quite certain that not only all the upper incisors are represented by permanent teeth, but the number of right teeth appears to be seven – which has to be interpreted as proof of a fully erupted second permanent molar. The form of the adjacent teeth seems to follow the pattern of canines and both premolars. Thus, the dental age should be established as at least 12 y.o. ±36 mos. according to the standard Ubelaker method[51]. This observation suggests that the individual could be older than the measurements suggest, which may point to the populational differences in growth patterns and/or some other factors influencing the stature of the individual. The author of the osteoarchaeological analysis (EJ) would like to suggest that the final age-at death assessment should point to at least 10, perhaps closer to 12 years old.

The maximal diaphyseal length was also used for calculating the in vivo stature of the researched individual. The regression formulae for girls presented by Smith[52] have been implemented, as the genetic sex suggests the individual was female. The full list of the estimates is given in Table 4. Again, for minimizing the influence of limb asymmetry the mean length was used. The mean result calculated from the separate assessments for each long bone is 120.03. This is significantly low stature for a child around 10 years old, as the modern percentile chart for the height of Polish children shows that it falls well below the 3rd percentile curve for girls' height[53]. If we change the age assessment for the lower age estimate (6 y.o.) then the result is well within the 50th percentile[54].

49 Schaefer *et al.* 2009.
50 Schaefer *et al.* 2009.
51 Ubelaker 1989; Buikstra/Ubelaker 1994.
52 Smith 2007.
53 Różdżyńska *et al.* 2013.
54 Ibid.

Tab. 4: Reconstructed in vivo stature based on diaphyseal length of the long bones according to Smith's (2007) regression equations.

Measurements	Stature	SE
humerus: maximal diaphyseal length	124.33	3.40
radius: maximal diaphyseal length	120.21	3.23
ulna: maximal diaphyseal length	121.13	2.94
femur: maximal diaphyseal length	119.16	2.26
tibia: maximal diaphyseal length	118.00	2.57
fibula: maximal diaphyseal length	117.33	2.68
femur + tibia: maximal diaphyseal length	118.60	2.10

Due to the absence of the skull (both cranium and mandible), the standard observation for stress markers like linear enamel hypoplasia or cribra orbitalia and/or porotic hyperostosis were not available. To assess the possibility of growth arrest events, which could influence lower than average stature of the individual, research into the presence of Harris lines in the long bones was done. Instead of standard x-rays, a set of full CT scans of all the long bones was performed. The results show multiple Harris lines within both the proximal and distal metaphyses of all the long bones. The calculations according to modified Byers' equations show that the growth arrest events occurred 3–5 years prior to death (depending on the estimated age at death: 3 years prior in the case of 6 years of age and 5 if the individual was actually 12 y.o.[55], with the possibility that earlier episodes are obscured by an enlarging medullary cavity). The maximal number of observed Harris lines was 14, present in distal metaphysis of the left tibia (see Fig. 5).

There were no other observations suggesting dietary deficiency (like rickets or scurvy) or other types of pathological changes observed in the postcranial skeleton. As mentioned previously, no evidence of antemortem trauma, which could explain a non-natural cause of death, has been observed on the skeletal remains.

5.3 Isotopic analyses

Collagen preservation in both samples was above 15 % of dry bone. The percentage of carbon in dry collagen was 44–45 % and nitrogen 15 %. The atomic C/N ratio for both samples was 3.5. The carbon and nitrogen isotope ratio for the rib sample was -19.7 and 11.2‰, and for the long bone the sample was -19.9 and 11.0‰.

The isotopic composition of the diet of the individual from Tunel Wielki is similar to those observed in Central European towns at that time (see Fig. 8). The diet was based on C_3 plants without a significant share of millet, or any other C_4 grass. The nitrogen isotopic ratio indicates the regular consumption of animal proteins. No visible change in the diet during the life of the individual was noted. A similar value between rib tissue and long bone tissue suggests there was no long-lasting nutritional stress in the last year/years of the individual's life.

Tab. 5: Sequencing stats. Sample TW595 – the studied individual; #reads – number of sequencing reads; #map hs37d5 – number of reads mapping against the reference human genome without duplications; #endDNA – the percentage of DNA fragments mapping against the human reference sequence; #mean cov (SD) – mean genome coverage; #deam 5'/3' – frequency of the dominated nucleotides on the 5' and 3' end; #map RCRS – number of reads mapping against the reference mitochondrial human genome without duplications; #cov mtDNA – coverage of the mitochondrial genome; mtDNA Hg – assigned mitochondrial haplogroup.

Sample	#reads	#map hs37d5	#endDNA (%)	mean length	#mean cov (SD)	#deam 5'/3'	Schmutzi contam (%) aver(low-high)	contamMix cont(95%quantiles)	#map RCRS	#cov mtDNA (SD)	mtDNA Hg
TW595	66, 412, 484	4, 748, 466	7.15 %	85.59	0.11 (0.38)	0.05/0.02	1 (0–2)	0.0 (0.0–0.01)	10,024	51.50 (20.11)	J1c2

55 Kulus/Dąbrowski 2019.

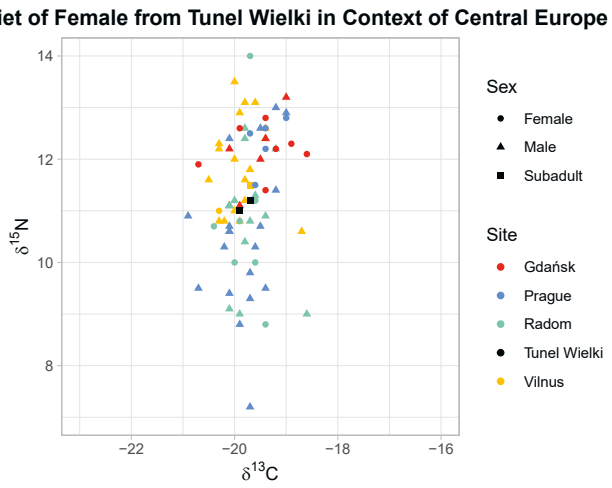

Fig. 8: Stable isotope values of the individual from Tunel Wielki compared to the diet of the population from Gdańsk (Mnich *et al.* 2018), Prague (Salesse et al. 2013), Radom (Lisowska-Gaczorek *et al.* 2017), and Vilnius (Schotten 2015).

5.4 DNA analyses

Authentication of the obtained sequences

We obtained 4,748,466 sequencing reads uniquely mapping to a human reference genome which resulted in 0.1× genome coverage of the studied individual (Table 5). Both approaches used to verify the obtained sequences as endogenous ancient DNA gave positive results. The amount of deaminated bases increased towards the ends of the DNA molecules and their length was lower than 100 bp. The estimated level of contamination with modern DNA was negligible (average 1 % with both methods; Table 5).

Molecular sex determination

The sample was determined to be female based on the ratio between X-chromosomal coverage and autosomal coverage (X/A = 0.90551) as well as on the number of sequences aligned with the Y chromosome compared to the total number of sequences aligned with both X and Y chromosomes (Ry-CI=0.001047111).

Mitochondrial DNA

We obtained a complete sequence of the mtDNA genome (mean coverage 51.50×) with a minimum 3-fold coverage of all nucleotides (Table 5). Its haplogroup was determined as J1c2, very common in modern-day Europeans.

Genetic affinity

The genetic ancestry of the studied individual was investigated using the dataset of modern-day western Eurasians described in Lazaridis *et al.*[56] It was shown that genome coverage around 0.1× is sufficient to perform PCA and admixture analysis[57]. The genotyping of the individual yielded 88,369 SNPs overlapping with the modern dataset. Its projection onto the PCA plot computed with modern genotypes revealed that the studied individual probably originated in Europe. However, it does not group with modern-day individuals from Poland, which suggests that the person buried in the cave did not originate from the Cracow Upland (Fig. 9a). Unsupervised genetic clustering analysis was performed using 191,669 LD pruned SNPs and showed that the most probable number of genetic clusters is 3 (the lowest CV-value; Fig. 9c). Three ancestry components are represented by different colours. There are two main components, one dominant in Europeans (red) and the other in Asian samples (green). The blue component was present in all samples.

The studied individual belongs to the red (ca. 85 %) and blue (15 %) clusters, similarly to modern Estonian and Lithuanian samples and ancient sample JK2065 from Levänluhta, a lake burial in Isokyrö, Finland[58]. Outgroup f_3 statistics were computed in the form (TW595, *Test*, Mbuti) where *Test* was each of the modern populations from Eurasia and ancient individuals from Lamnidis *et al.*[59] The highest values of f_3 statistic were found in the individual from Tunel Wielki Cave, JK2065, and modern Lithuanians, suggesting close genetic affinities among them (Fig. 9b).

The genetic analyses of the studied individual showed results that conflicted with the PCA, pointing to a Hungarian ancestry, while the admixture and f_3 estimates instead suggested affinities with the modern populations of the Baltic region. Both later analyses also revealed a close relationship with individual JK2065 excavated from the Levänluhta site in Finland with a clear archaeological context of the Finnish Iron Age[60]. However, JK2065 was an evident outlier from other individuals found at the Levänluhta site, suggesting a different ancestry. Unfortunately, the lack of genetic data from European individuals of an age similar to our case hampers more accurate conclusions. Mitochondrial J1c2 haplogroup is distributed uniformly throughout the whole of Europe and did not provide any valuable biogeographic information about the studied individual.

56 Lazaridis *et al.* 2016.
57 Omrak *et al.* 2016.
58 Lamnidis *et al.* 2018.
59 Ibid.
60 Ibid.; see Wessman 2009.

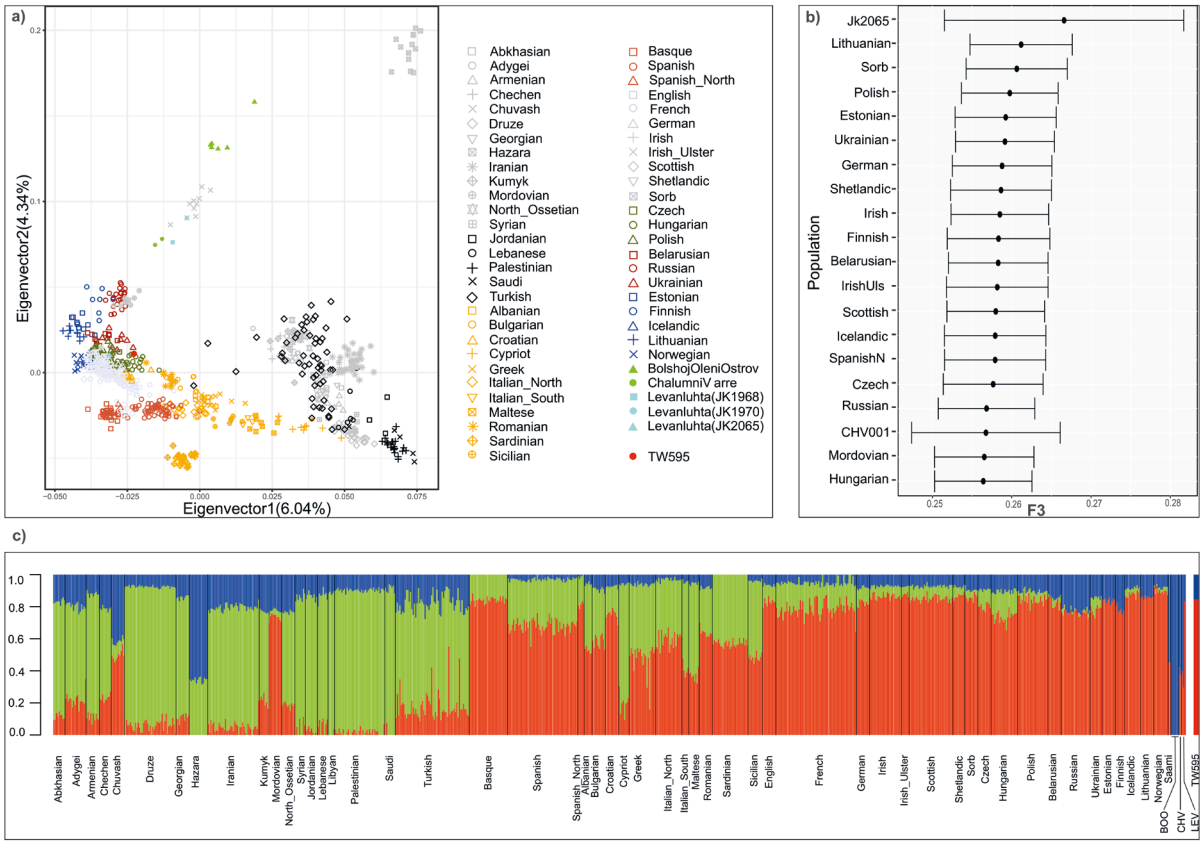

Fig. 9: Principal Component Analysis, outgroup f_3 statistics and ADMIXTURE analysis of the studied individual. (a) PCA plot of 842 modern European and western Asians with studied individual and ancient Fennoscandian individuals projected; (b) calculated outgroup f_3 statistics with modern populations sorted according to f_3 values; (c) admixture plot for K=3.

5.5 Bird remains

Both chaffinch skulls are preserved in multiple pieces. The more complete skull (S1) consists of three separate, distinctive fragments, while the other (S2) is preserved only through five such fragments (Fig. 6). In addition, a few tiny bone fragments are present (in both S1 and S2). S1 is almost complete; it lacks only fragments from both ear regions as well as a small part of the skull base. S2 is in worse condition; it lacks part of the occipital braincase, both ear regions, and the majority of the skull base. Both skulls are fragile and crumble easily. Maxillae are still connected to (parts of) the braincases.

Both skulls are partly pneumatised, which means both birds died in the first year of life[61]. S1 reached pneumatisation stage 4, whereas S2 reached stage 3 or 4. This allows us to estimate that the birds died after the first ten days of August, and most probably after the first ten days of September. By extrapolating from relevant data on Brambling, we think the birds were already dead in the first ten days of December.

No trace of animal activity (gnawing mark, digestion trace) or human agency (e. g. cut mark, burning trace) was detected.

6 Discussion

The burial presents three central overlapping factors which do not correspond with post-medieval or early modern funerary customs: 1) placing the dead outside of a regular cemetery; 2) placing the dead in a cave; and 3) placing a bird head or bird heads in the mouth of the deceased. It is necessary to look closely at all three features and attempt to account for their combination. Each will be considered after situating them in relation to the girl and her probable background.

61 Jenni/Winkler 2012.

6.1 The girl from Tunel Wielki Cave

The results obtained indicate that the Tunel Wielki Cave burial is an extended inhumation of a 10–12 year old girl, who possibly suffered from arrested growth in later years. She was buried in a simple grave cut without any grave goods, but with one or possibly two heads of chaffinches placed in her mouth. Thus, there are strong indications that she was buried with respect. It is worth noting that the grave's orientation (N-S) does not fit the typical E-W layout practiced by the Christian communities. This observation may correspond with foreign genetic ancestry of the girl, indicated by genetic research. The burial is radiocarbon dated to the 17th or the 18th c. AD, and it is important to note that this is the only post-medieval burial discovered in this cave[62].

The absence of the cranium and mandible poses some problems for osteoarchaeological analysis, as both the age-at-death estimate and determination of generic health issues rely heavily on the observation of dentition and other cranial features. The discrepancies in age assessment discussed in the osteoarchaeological analysis can partially be a result of a well-known osteological paradigm (or osteological paradox) – the stature of the individual can reflect living conditions which result in truncated growth, being abnormally short for the actual age[63]. This assessment seems to be confirmed by the only method available in this case to assess growth problems – analysis of Harris lines – a method which, although popular, is not unconditionally accepted and has been a subject of some controversies[64]. It has been argued that lines formed between age 5–9, the period of life when the Harris lines of the Tunel Wielki individual formed, tend to be a more reliable stress marker then later ones, which could indicate a prepubertal growth spurt[65].

The problems of estimating the age-at-death and stature are even more complicated in the case of this analysed individual due to uncertainty about her populational affiliation. Though it is widely accepted that most of the standard methods of age assessment, as well as stature equation, should work for the population of European ancestry[66], smaller and more isolated populations change more easily due to genetic drift[67]. Unfortunately, in the absence of populational data, the observations cannot be easily interpreted for an unambiguous estimate of both age and stature.

The genetic analyses indicate, however, that the girl was undoubtedly a stranger among the local Slavic population. Although her ancestry cannot be definitively identified, there are grounds for thinking that the area she came from was located north of Poland – in the regions inhabited by Finnic or Baltic populations. Prior to addressing the problem of her origin, let us draw a general picture of the settlement in the microregion of Sąspów during the periods indicated by the radiocarbon data.

In both calibrated ranges (1641–1688 AD and 1730–1807 AD), the area in question was part of the fairly densely populated, northern outskirts of Cracow. In these times, the area of Sąspów Valley formed part of a border between the set of lands belonging to the private Pieskowa Skała Castle, and the royal estate of the nearby Ojców Castle[68]. The immediate vicinity of Tunel Wielki Cave is likely to have been uninhabited then, although the only direct evidence for this assumption is an Austrian military map made between 1801–1804 by Anton Meyer von Heldensfeld (Fig. 10). Early in the 19th c., the cave was around 1.5 km as the crow flies from the villages of Sąspów and Wola Kalinowska, roughly 2.3 km distant from Ojców Castle and approximately 4 km from the nearest town of Skała. It is hard to resist the impression that the settlement in the times of Heldensfeld's mapping did not differ much from those of the 17th and 18th centuries. During those times, as now, the Sąspów Valley was largely a forested area.

Bearing in mind the uncertain genetic ancestry of the girl, let us provide a brief insight into the ethnic relations within the studied area during the periods indicated by the calibrated ranges. Although selective, the lists of population censuses from 1581 and 1787 for the villages situated near the cave are encouraging in that the microregion was then inhabited by Roman Catholics[69]. The nearest church (and cemetery) was in Sąspów, only 1.5 km distant from the cave. As regards the other ethnic groups who dwelled in the area, the earliest records are as late as 1765 and relate to lessees of Jewish origin from the immediate vicinity of Ojców Castle[70]. There is no evidence, however, for any other permanent residents of non-Slavic origin, except for a hermit from Samogitia (NW Lithuania), who lived in Ojców in the 1790s[71].

62 Cf. Wojenka *et al.* 2017.
63 Wood *et al.* 1992.
64 Lewis 2017.
65 Ibid.
66 Smith 2007.
67 Glass *et al.* 1952.
68 Noga 1997; Wyżga 2016.
69 Pawiński 1886; Kleczyński (Ed.) 1894; Roś 2007; Wyżga 2016.
70 Falniowska-Gradowska 1995; Kozibąk 2015.
71 Załuski 1976.

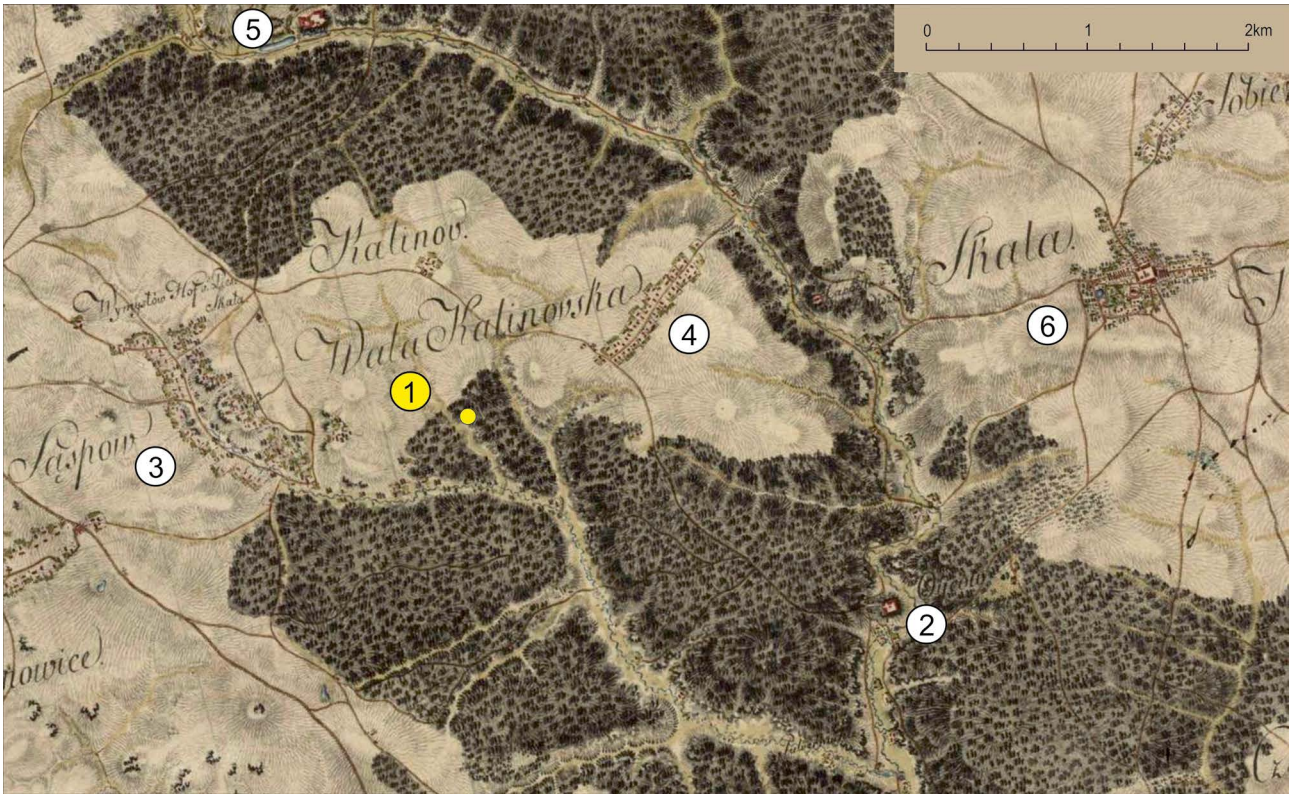

Fig. 10: Ojców and environs in the early 19th c. A section of the map by Anton Meyer von Heldensfeld, 1801–1804. 1 – Tunel Wielki Cave; 2 – Ojców Castle; 3 – Sąspów village; 4 – Wola Kalinowska village; 5 – Pieskowa Skała Castle; 6 – Skała town. Reproduction courtesy of the Austrian State Archives in Vienna, with additions.

6.2 A historical context for northern origin

In the light of genetic data, the possibility that the girl was of local origin must be rejected. Her genetic ancestry speaks in favour of a "northern" origin, pointing to the areas inhabited by Finnic populations or Lithuanians. The historical and geopolitical situation makes a Lithuanian background possible for either of the probable periods indicated by radiocarbon dating, 1641–1688 AD (33.8 % probability) or 1730–1807 AD (52.3 % probability). The incidental physical presence of Lithuanians in the Sąspów Valley area may be expected in this part of Poland during both periods, since both Lithuanians and Poles inhabited the same political organism. The presence of Finnic peoples may initially seem improbable, but, during the earlier period, the Swedish Army of King Carl Gustav invaded Poland and occupied the region from 1655 to 1657. The 17th c. Polish poet and historian Wespazjan Kochowski (1633–1700) provides detailed insight into the Swedish army: *as we were told, [King Carl] led his army of 7,000 people from Sweden, composed mostly of Finns and Lapps [Sámi], known as excellent soldiers*[72] (translated by MW). After several battles, the Swedes took control of the Wawel Castle in Cracow, which fell into their hands in August of 1655. Soon after this, in the early autumn of 1655, the invaders occupied Ojców Castle (see Fig. 10), which they used to store food and ammunition[73]. It is more than likely that the Swedish garrison from Ojców included many Finnish soldiers, since we know that the camp in Cracow, only 20 km away, was manned *by 3,000 people, mostly the Finns*[74] (transl. MW). Many historic accounts indicate that Swedish troops were particularly active in plundering and looting the surrounding countryside[75].

Even if we accept the very likely presence of the Finnish soldiers in Ojców in the mid-17th c., the essential question still remains: could the girl buried in Tunel Wielki Cave have any connection with them? The possibility becomes clear in the light of Geoffrey Parker's important work on

72 Kochowski 1966.
73 Sikora 1908; Falniowska-Gradowska 1995; 1999.
74 Kochowski 1966.
75 Falniowska-Gradowska 1995.

wartime military camps, demonstrating that these were places full of women and children[76]. The soldiers, for the most part of low rank, were commonly accompanied by wives, mistresses, and sometimes maidservants[77]. For example, the 368 cavalrymen in the military camp in Langenau (Baden-Württemberg) in 1630 were accompanied by 66 women and 78 girls, while in the late 17th-c. garrison in Spandau (Brandenburg) a group of 261 men resided with 171 wives and 295 children[78]. There is no doubt that women and children similarly accompanied Carl Gustav's troops in the Cracow area in 1655–1657. According to Kochowski, when the defeated Swedish soldiers were finally leaving the Wawel Castle in 1657, *there was the infantry wearing ragged clothes, mostly Finns [...] Furthermore, there was a group of women, and some of them were carrying one or even two children on their own backs* (transl. MW)[79]. A connection of the girl to these wartime populations would account for her genetic background along with a cultural background in which bird symbolism was strongly linked to beliefs about the dead and the afterlife.

A Finnish or Karelian background is thus possible for the period during the Swedish army occupation of the area in 1655–1657. Karelia is a transnational region. It was mostly on the Russian side of the shifting border between Sweden and Russia, which also formed a boundary between the spread of the Western and Eastern Churches. A significant portion of Russian Karelian territory was taken by Sweden in 1617 and integrated into its systems of taxation and military service, noting that, for the Swedes as for the Poles, Karelians were also seen as "Finns". Although it may be coincidental, the estimated season of the deaths of the chaffinches found in the cave coincides with a period of prominent activity of the Swedish troops in the Ojców area (early autumn of 1655).

The likelihood of a Finnish or Karelian background is conditional on the earlier dating being correct. When considering the burial in relation to ethnic background, the possible connection to a military action could be a relevant factor. The act of placing a bird's severed head in the mouth of the deceased, a custom which has no direct analogy in European records known to us, is an intimate act that would seem an extreme anomaly if not rooted in cultural symbolism and associated beliefs. If it is rooted in social culture rather than individual fancy, the uniqueness of the act would indicate an innovation, which does not appear to become repeated as a social practice. The exceptional circumstances connected with military action could, in principle, motivate innovations in burial practices, for instance owing to the geographical distance from other deceased kin, while the short-term presence from 1655 to 1657 might equally account for why this practice does not appear as socially established.

Of course, unique circumstances for a visiting Lithuanian family could also have occurred, or the event could otherwise reflect an isolated and otherwise inexplicable incident. However, the likelihood of ritual performance reflecting non-Christian concepts may be more probable for the demographic of Finns and Karelians coming for military service than those of Lithuanians arriving in the area through mobility within the Polish-Lithuanian Commonwealth. Both Finns and Karelians formally converted to Christianity mainly from the 12th through the 14th centuries and subsequently self-identified as Christians, yet their minority languages were not used in the church or state administration before the Reformation, and popular religion appears to have initially assimilated Christianity rather than being displaced by it[80]. People still used vernacular theonyms as personal epithets in parts of Lutheran Finland until the end of the 16th c.[81] while in some parts of Orthodox Karelia non-Christian religious and ritual practices largely broke down in the 19th c.[82] Non-Christian beliefs and practices were doubtless established among at least a significant portion of the "Finns" in the 1655–1657 occupation.

6.3 Burial in unconsecrated ground

The first of three distinctive factors is the burial of the girl in unconsecrated ground. This could speak in favour of considering her as a person situated on the fringe of society. In post-medieval Poland, however, such cases are few and, for the most part, they are limited to suicides, executed convicts, or unbaptized infants[83]. The age of the deceased makes it unlikely that she was unbaptized if she had been raised among Christians. That she was either a suicide or executed as a convict both seem doubtful if we consider her young age, although the archaeological evidence does not shed direct light on the question.

For a person who visited Tunel Wielki Cave in the 17th – early 19th centuries, this place could be perceived as easily accessible, since it was located in a marginal zone of the

76 Parker 1972.
77 Tallett 2003; Łopatecki 2007; 2012.
78 Tallett 2003.
79 Kochowski 1966.
80 Frog 2013.
81 Frog 2020a.
82 Siikala 2002; Stark 2006; Stepanova 2012.
83 Duma 2010; Kowalczyk-Heyman 2016.

forest. If the girl was of Finnish or Karelian background, an additional possible explanation comes into focus. Ethnographic evidence from 19th c. Orthodox Karelia reveals that a person who died in a forest could not be buried in a cemetery and instead had to be buried in the forest. Historically, this custom appears rooted in cosmological conceptions of a forest as being like a cemetery, constituting a discrete realm governed by a particular community of supernatural agents, and interaction with both was subject to restrictions and ritually regulated[84], although we should not underestimate the potential for variation in interpretations of constraints on moving the deceased[85]. The same custom may have been established in Finland as well but this remains unknown. If the girl was of Karelian or Finnish background and died in the vicinity, burial in unconsecrated ground would be consistent with a prohibition against removing her body from the forest. The girl's age and location in the forest reduces the likelihood of death by natural causes such as severe illness, even if there is no clear osteological evidence of injury. If the girl died in the forest, her burial there would still be "normal" for many 19th c. Karelians. The lack of a coffin would then presumably reflect the circumstances of the situation.

Kochowski also mentions Sámi among the Swedish soldiers[86], and the Sámi used rock shelters in similar sites for funeral purposes[87]. The Sámi interpretation presents the difficulty that the location does not appear as a social burial site and it is mysterious why a child would be removed to an isolated location for a lone burial rather than being interred with Sámi soldiers.

An additional possibility is that the girl was the victim of a violent crime, and her corpse was then buried in a discreet location. Unfortunately, limitations of the data concerning the depth of the grave make it difficult to assess whether the intention was mainly to conceal the deceased or also intended to avoid its disturbance, for instance by animals. Nevertheless, placing the birds in a grave as well as the act of burying the body indicate time, thought and preparation, which seems inconsistent with the rapid disposal and concealment of a corpse as evidence of a crime.

6.4 Burial in a cave

The second factor, the location used for the girls' burial, is extremely rare in historical times, at least in Europe, where cave burials disappeared early in the Middle Ages. A series of radiocarbon dates show the latest examples of funeral activity in caves on a larger scale occurred in the 7th–8th centuries AD in Cantabria and the Visigothic kingdom of Toledo[88]. Since that time, human remains were deposited in caves only very rarely, in isolated cases[89]. In the post-medieval period, the only other examples of human remains dated with certainty come from Ireland[90], with the exception of non-Christian (or self-defined Christian) Sámi practices, who placed their deceased inside rock shelters or under large stones up to the early 18th c.[91] This possibility returns to the question of why a single child would be buried in an isolated site in this way.

If the burial in the forest were owing to a prohibition against removing the body to a cemetery, the cave could have been the site of the girl's death or selected for being sheltered, providing a safe and discrete location since the girl could not be removed from the forest.

A third explanation could be that burial inside the cave was hidden and unlikely to be discovered when secrecy was of particular concern, which would be consistent with the girl being a murder victim.

6.5 Bird head depositions

The third factor – furnishing the girl with the heads of chaffinches – is the most mysterious. This act has no identified parallels, but acquisition, decapitation, and conscious placement of a bird head in the mouth in a funerary context indicates conscious and motivated activity that can be assumed to have held symbolic significance. It was certainly not a custom of the Slavic population, neither in the Middle Ages, nor in post-medieval or recent times. It is important to note, however, that in Poland, as in the other areas of Europe[92], birds played an important role in beliefs linked to death, mostly as heralds of demise[93], or as the form in which the soul leaves the corpse[94]. Among many cultures, the souls of children have also been conceived in the form of small birds[95]. Nevertheless, in the period in question, birds were never deposited into graves, let alone being placed in the mouth of the deceased.

84 Frog 2020b.
85 See also Metcalf/Huntington 1991; Bell 1992.
86 See: Kochowski 1966
87 Svestad 2018.
88 Hierro Gárate 2011; Arias *et al.* 2018.
89 E. g., Bergsvik 2018.
90 Dowd 2015; 2016.
91 Svestad 2018.
92 See: Serjeantson 2009.
93 Fischer 1921.
94 Moszyński 1967.
95 Ibid.

Placing an object in the mouth might be compared to stones placed in mouths of the deceased, a custom which is commonly interpreted as anti-vampiristic mortuary treatment[96], a Charon's *obol* or, alternately, it might even be intended to prevent the soul from leaving the body. However, such conjectures should be grounded in other evidence of the symbolic worlds of the people performing the burial. Bird symbolism is widespread, but its potential relevance is considerably reduced by the type of bird, the funerary context and the intimate connection made between the bird and the deceased. If rooted in cultural symbolism rather than one person's act of creative imagination for creating idiosyncratic meanings, the question of the birds' significance must be considered in relation to the girl's cultural background. The presence of only the birds' heads may have been a practical use of *pars pro toto* of whole birds motivated, for example, by the size of the girl's mouth.

The girl's northern ancestry, which seems most likely, relates her most strongly to Finnic groups and Lithuanians (Fig. 9c). Bird symbolism is particularly prominent in Uralic cultures, of which Finnic is one branch[97]. Within a funerary context, the discovery of a finch in the mouth of the deceased immediately invites association with the so-called "soul-bird" or "bird-soul" conceived as a form taken by a person's soul or spirit. Strong beliefs in a post-mortem soul-bird are found among both Finnic and Lithuanian ethnic groups as part of a broad cross-cultural phenomenon[98] that extends widely across northern Russia[99]. Near the Baltic Sea, the belief is found with an especially strong connection with ritual lament traditions[100]. Laments provided a medium of reciprocal communication with the dead, and the soul-bird was a form in which deceased people could visit the living, although the deceased's initial journey to the otherworld was by walking[101]. Lament traditions seem to have disappeared from western Finland through changes in the wake of the Reformation but they remained current in Orthodox areas in Karelia, where lament traditions and beliefs in soul-birds continued to be documented into the present century[102]. The bird-soul concept is also found in Slavic traditions[103], but it is not clear whether this concept had local contemporary significance or what could have motivated its otherwise unique use in this isolated burial. Among Finnic groups, soul-bird beliefs seem to have been of greater prominence and ritual significance than among either Baltic or Slavic groups. This belief was directly connected to beliefs about the dead and their ability to return among and communicate with the living. A Finnish or Karelian background would correlate with bird symbolism connected with the deceased as well as the possible explanation for not removing the girl to consecrated ground.

The soul-bird interpretation has two major weaknesses. First, connecting the bird with the deceased's soul could be an innovation linked to historical circumstances (i. e. as a means for the person who died to join the community of the ancestors in a geographically remote cemetery) and that never became socially established. The weakness is that Finnic and Baltic groups seem mainly to have conceived of the deceased's journey to the otherworld in anthropomorphic form: the bird was the form in which the soul could return among the living, not the form in which he or she first reached the ancestral community. This weakness is not so great if contextual factors had motivated innovation. It is possible to speculate, for instance, that the remoteness of the burial from a family cemetery in Finland or Karelia motivated the girl's family to try to provide her with a bird form because it was too far to walk. Alternately, the girl may have been residing in the Ojców military camp and been buried by someone who knew her origin, was only loosely familiar with the soul-bird tradition, and attempted to accommodate it. Proposing a link to a Slavic belief in the spirit departing in the form of a bird might seem to accord better with the placement of the bird in the mouth, yet the circumstances that would motivate the placement of the body and the unique use of a bird head all remain unaccounted for. The crux, however, is in the second weakness: the person's soul was singular yet the grave contains the heads of two birds. Two bird heads in the grave remain difficult to reconcile with a soul-bird interpretation, particularly if both heads had been deposited in the girl's mouth.

Although the location of the burial could be consistent with the girl as a murder victim, this situation is difficult to reconcile with the intimate and symbolic act of depositing bird heads and also the fact that this was a formal burial in a grave. The complexity in preparation as well the implications of ritual action seem inconsistent with simply concealing a murder victim. Although these actions might be accounted for in a murder scenario as the creative or compulsive act of a deranged mind, this would require an ad hoc supposition of the presumed murderer also being insane, for which there is neither positive evidence nor any reason to suspect.

96 Gregoricka *et al.* 2017.
97 Ahola *et al.* 2018.
98 Stepanova 2011.
99 Söderholm 1980.
100 Stepanova 2011; see also: Jugai 2019.
101 Honko 1974; Stepanova 2011; 2012.
102 Ibid.
103 Moszyński 1967.

It remains most probable that the remains of the chaffinches in Tunel Wielki Cave are somehow connected with cultural symbolism and traditional beliefs. The intention of the person or group who buried the girl is still far from clear. The use of the bird heads is, nevertheless, unambiguously of symbolic significance for the person or group performing the burial, while the placement of the bird remains in the deceased's mouth is not easily related to any culturally-rooted symbolism other than concepts of the soul and its movement between worlds.

7 Conclusion

The burial of the young girl from Tunel Wielki Cave appears unique in many respects. This is the only post-medieval cave burial in Poland and only verified in Europe for the period. The location of the burial, as well as the skull (head) of chaffinch placed in the mouth of the deceased – a remarkable outcome of some unusual, presumably magical rite – provide information without any direct parallels. Interpreting this unusual find leads into the complex world of funeral customs and popular religious beliefs which are difficult to unravel.

The results of the examination offer explanations of varying degrees of probability for the different features of the burial and associated empirical evidence balanced against different variables. The features of the burial in unconsecrated ground and the location in a cave present the most probable scenarios that either the girl was of Finno-Karelian background and the conditions of her death prohibited removing her from the forest or that she was a victim of a violent crime and concealed, which is much less probable. The former possibility remains conditional on the dating of the remains. The crux of the interpretation remains the ritual or ritual-like deposition of bird heads, which does not readily conform to any interpretation when there are remains of two birds. The avian body parts are most difficult to account for in a scenario of violent crime, where they would appear symptomatic of pathological behaviour. They easily connect to Finno-Karelian beliefs about the dead and could also be connected to Lithuanian and perhaps even local beliefs, although their precise significance in the burial remains opaque. Although the triangulation of factors sheds some light on the burial, opening onto scenarios that could account for most of its features, the riddle of the unique child burial from Tunel Wielki Cave cannot be fully explained. There are indirect archaeological and ethnographical data which, when combined with written accounts, make it possible to build a fascinating story surrounding this isolated case – yet the situation that produced it remains beyond the limits of scientific explanation.

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