BURIAL CRYPTS
Of St Francis of Assisi church in Cracow
In the light of interdisciplinary studies

BURIAL CRYPTS
OF ST FRANCIS OF ASSISI CHURCH IN CRACOW IN THE LIGHT OF INTERDISCIPLINARY STUDIES

ARCHAEOLOGY • STUDY OF DRESS AND TEXTILES • ANTHROPOLOGY • MICROBIOLOGY • ARTEFACTS CONSERVATION

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Anna Drążkowska

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Editing
authors

Layout
Anna Drążkowska, Maja Drążkowska-Narloch

DTP
Tomasz Jaroszewski

Cover designe
Maja Drążkowska-Narloch

Cover illustration: Angels by Wiesław Skibiński

Translation
Mateusz Józefowicz, Maria Cybulska, Tomasz Wolski, Laurie J. Reitsema, Marta Gorzkiewicz, Tomasz Grzybowski, Dorota Sobierajska, Beata Miazga

Proof-reading
Tim Brombley

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tel. +48 (0) 56 611 42 95, fax +48 (0) 56 611 47 05
e-mail: wydawnictwo@umk.pl
Distribution: ul. Mickiewicza 2/4, 87-100 Toruń
tel./fax +48 (0) 56 611 42 38
e-mail: wydawnictwo@umk.pl
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ZMIŁUJ SIĘ NAD NAMI

INTRODUCTION

Introduction

Anna Drążkowska

My ongoing scientific journey into funeral culture has brought me to Cracow, to the crypts of the church of St Francis of Assisi. This unique temple on All Saints' Square and St Francis Street in the Old Town struck me with its beauty – and its curious and dramatic history.

The space below the church floor was long used for funeral purposes. The numerous persons buried here include prince Bolesław V the Chaste and his sister, Blessed Salomea of Poland, two sons of Władysław I Łokietek (Ladislaus the Short), benefactors of the monastery, monks, nuns, burghers of high status, as well as high nobility, clergy, adults and children.

This broad-scoped study of the extraordinary necropolis was made possible by the project "Burial crypts of the St Francis of Assisi Church in Cracow in the light of interdisciplinary studies" funded by the National Science Centre within the OPUS 12 competitive funding scheme (project number: 2016/23/B/HS3/01910). To realise this interdisciplinary project I gathered a large scientific team representing many disciplines. It included archaeologists, art historians, conservators, chemists, microbiologists, anthropologists, palaeogeneticists, palynologists, archaebotanists, architects, archivists, geophysicists and textile specialists. I also collaborated with sculptors and specialists at the Police Central Forensic Laboratory in Warsaw. This is the first time burial crypts and the tombs they house have been the subject of such complex and versatile studies.

The majority of the underground chambers used for burials in the Cracow church were not marked in any way on the floor surface. In one regard this represented a significant obstacle, but from another, the great challenge it posed for archaeologists led them to make genuine discoveries and to test out various modern devices and survey methods.

In order to locate the crypts under the church and the cloister floor, a non-invasive ground penetrating radar (GPR) survey was performed in two stages. The first stage included field prospecting using three market-leading devices: a Swedish GPR – the Mala/ABM Ground Explorer (GX) with a monostatic antenna with a mid frequency of 450 MHz (working with HDR – High Dynamic Range technology); a VIY-300iw set manufactured by Ukrainian Transient Technologies with a 300-MHz monostatic antenna, and a Swedish Geoscanners AB U-Explorer GPR, also with a monostatic antenna and a nominal frequency of 300 MHz.

Reconnaissance was conducted using the Mala/ABM Ground Explorer[1] GPR in June 2015 by the members of the society *Stowarzyszenie Sakwa*, and encompassed the entire accessible floor surface of the Franciscan church and attached chapels (Welc, Łyczak, Drążkowska 2020). Separate profiles were made at a constant interval of fifty centimetres. The recorded GPR traverses were processed in SUBVIEW GPR software.

Anomalies at specific levels show up as darker areas that represent higher electromagnetic wave amplitudes, and are areas where the electrical properties exhibit a higher contrast (dielectric constant) than the surrounding soil. These areas can be interpreted as cavities (crypts), walls or rubble piles (Fig. 1). Non-invasive reconnaissance of the church interior using the VIY3–300 set covered the main nave, the presbytery, the transept and the chapels of the Passion of Jesus and Our Lady of Sorrows (Welc, Łyczak, Drążkowska 2020). The field survey resulted in forty temporal sections being processed and interpreted. Separate radargrams

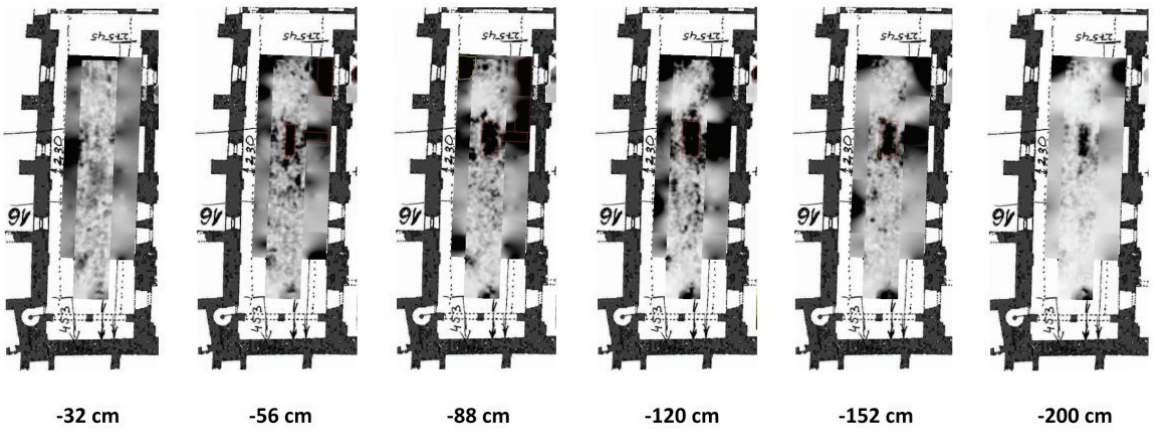

Fig. 1. Location of GPR anomalies recorded with Mala/ABM Ground Explorer at specific depth cuts in the area of the chapel of the Passion of Jesus. By Geo-Radar company 2015

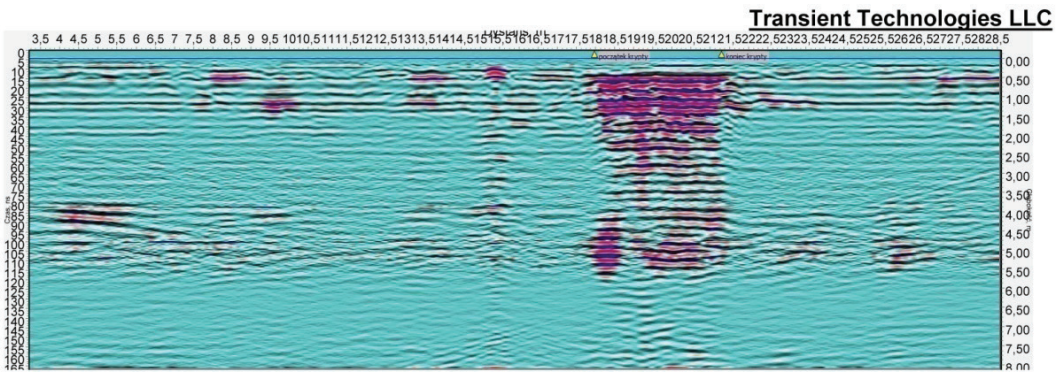

Fig. 2. GPR profile of an object in the central part of the chapel of Passion of Jesus, recorded with the VIY-300 device. Prepared by J. Adamiec 2018

[1] A description of the method of data recording and applied procedures is presented based on the results documentation of the Geo-Radar company, prepared by Anna Groffik for the paper presenting the first stage of non-invasive reconnaissance (Łyczak et al. 2018, p. 357–72).

(Fig. 2) revealed groups of anomalies in the form of diffractive hyperbolas, reflective surfaces and zones where electromagnetic (EM) waves were either amplified or attenuated. The location of recorded anomalies was shown on properly prepared result maps of the signal amplitude distribution.

Measurements with U-Explorer[2] antenna were made in October 2017 in the main nave, the presbytery, the transept, the chapels of the Passion of Jesus and Our Lady of Sorrows, and in the eastern and the southern cloisters. Survey profiles were conducted at spacings of between ten and fifty centimetres. A 3D survey methodology was adopted that is based on making a series of parallel 2D profiles (Welc, Łyczak, Drążkowska 2020).

The results of the surveys performed with the three types of available GPRs were quite similar. They were compared to two archived plans (from 1908 and 1922) of the church and the cloisters that were made by father Alojzy Karwacki. He defined the locations of all burials, tombs, crypts, altars and epitaphs known to him in 1908 (Karwacki 1908, 1922). The majori-

Fig. 3. Franciscan church plan with results from specific survey areas presented as selected temporal cuts with depth reading (data processed by F. Welc). Elements of contemporary heating installation shown in green, crypts shown in red

[2] The description of data acquisition and procedures used are presented based on the results documentation prepared by TMT Projekt Sp. z o. o. (Dąbrowski 2017).

ty of the marked tombs and crypts were then matched to the recorded geophysical anomalies. Furthermore, the comparison of non-invasive survey results against the archival data allowed underground chambers to be captured that had been unknown before the study.

The main goal of the second stage of GPR prospection was to work out the best possible way of acquiring and processing the GPR data. The survey was performed using the Mal/ /a/ABEMm Ground Explorer.[3] It has a resolution sufficient to potentially identify crypts, burials and infrastructural elements. The prospection was performed with using a 450-MHz electromagnetic wave frequency antenna. The device was equipped with a control panel with Ground Vision firmware for field data acquisition. All radargrams from the field were processed by F. Welc in Reflexw-Win software by Sendmeier Software (Welc, Łyczak, Drążkowska 2020). The reconnaissance was performed in May 2019 (Welc, Łyczak, Drążkowska 2020) on the whole available surface of the Franciscan church, including attached chapels and monastery cloisters (Fig. 3).[4] The measurement grid was dense, with profiles conducted twenty or thirty centimetres apart. This allowed numerous details to be captured that were helpful in defining the location of crypts (Welc, Łyczak, Drążkowska 2020).

During the survey, eighteen crypts were located in the church, and four crypts in the cloisters (Fig. 4). Thirteen were opened, and twelve sepulchral rooms were entered and comprehensively surveyed: nine in the church (B1–B9) and three in the monastery cloisters (K1–K3).[5]

The remaining nine underground chambers[6] were studied with non-invasive methods only. The analysis was performed based only on images from an inspection camera introduced through a narrow borehole. Some of the chambers were filled with debris, but in all cases a sepulchral function was confirmed (Welc, Łyczak, Drążkowska 2020). Furthermore, the non-invasive survey results allowed us to record with high probability the remains of foundation walls from old surface structures. Such spectacular survey results were possible due to the adopted methodology. The outstanding value of these surveys is due to the fact that, during one project, a detailed non-invasive (GPR) reconnaissance was performed that tested the applicability of several types of devices, followed by exploration (archaeological) and measurement (architectonic) works that were correlated with the results. Such detailed non-invasive methods helped define the locations where the floor should be removed and openings to the crypts should be pierced. Each time, the location needed to be defined very precisely, since we were allowed to remove only five 30×30-cm floor tiles in each case. Using an inspection camera was a valuable experience. We were able to evaluate its usefulness for analysing crypt preservation status, estimating crypt sizes and determining the number of burials inside. We were able to draw very interesting conclusions when we were able to contrast the image from the camera with the reality observed upon opening successive crypts. The non-invasive survey was an important alternative that allowed us to study chambers that for various reasons were inaccessible to us. Although the camera allowed only a very general evaluation of these chambers, it did allow us to confirm their existence and sepulchral function.

[3] This GPR device is the first to be equipped with HDR technology, which provides high measurement quality and efficiency.

[4] The profiles were made by F. Welc with the support of archaeologists M. Łyczak, M. Czernikowska, A. Stachyra.

[5] Crypts located under the church floor that were entered are marked with the letter B and numbers from 1 to 9. Crypts located in the cloisters are marked with the letter K and numbers from 1 to 4. Crypt K4 located in the cloisters was completely filled with bones and functioned as an ossuary.

[6] Based on arrangements with the Voivodeship Historical Monument Protection Administration in Cracow

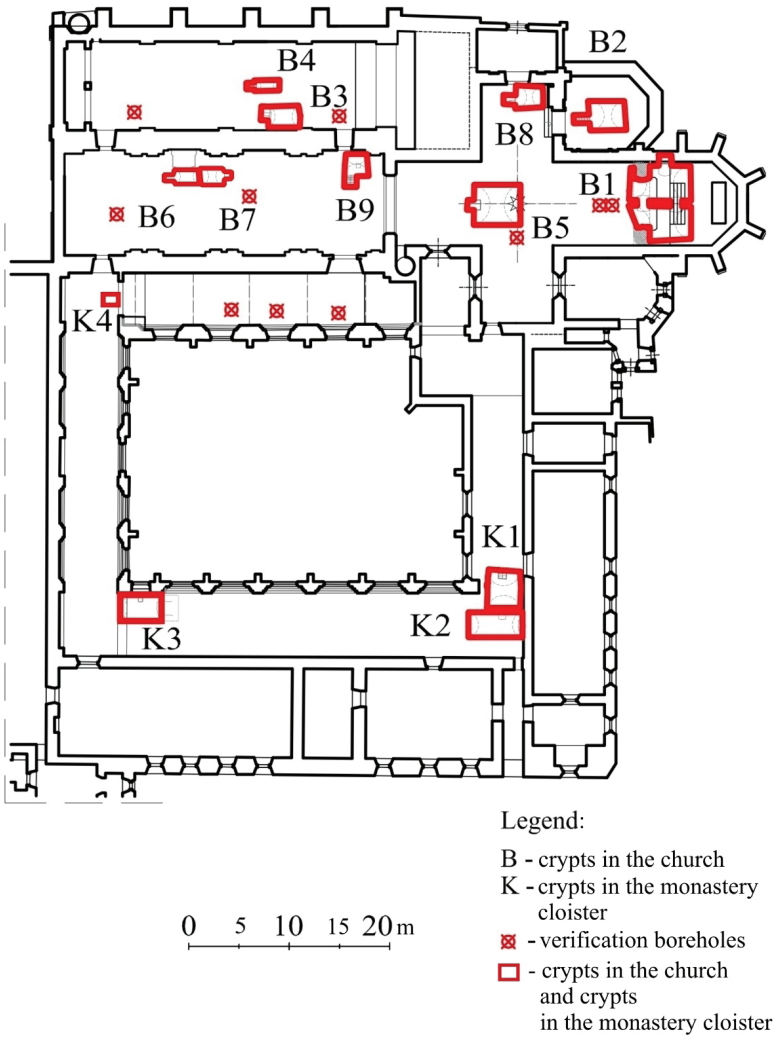

Fig. 4. Plan of the church and cloisters, showing crypts and boreholes

Exploratory and non-invasive surveys helped determine that the crypts under the Franciscan church and the cloisters did not constitute a unified, contiguous spatial system of underground chambers and are neither architectonically nor chronologically consistent. They were not designed during the same period. Their locations within the church space seem to be quite accidental. This is because they were built as needs arose, when wealthy families expressed the desire to bury their loved ones in such underground chambers. For this purpose, more or less prestigious locations were chosen. The location of a tomb depended on the person's status and, in the case of clergymen, on their place within the order. In the case of laymen, both social status and family wealth were important, since a more prominent crypt location required a much larger financial contribution. A place under the church floor was also available to the church and monastery benefactors. The studies reveal that the crypts were built in locations previously occupied by other brickwork funeral objects. This suggests that the location of new underground chambers was sometimes chosen quite spontaneously, without analysing the location of older tombs.

Both maps of father Alojzy Karwacki were of special importance to us, since the marked tombs are associated with specific persons or families. In the absence of other premises, this allowed us to perform a general, probable identification of the persons.

After the crypts were opened, there were numerous standard activities to be performed and, in the interests of the correctness and credibility of separate analyses, we had to carry them out in a proper and unvarying sequence. Thus, procedures were prepared that allowed us to maintain the same sequence and to remember about specific tasks. The work of archaeologists was not limited to exploring the crypts and making an inventory of architectural structures and burials, but also included taking various samples to be studied by other scientists. Microbiological material was secured before anything else.

Before disinfection, I descended into the crypt with an assistant, who helped me in properly taking and marking samples. Material was taken from various places, including coffins, skeletons, clothes and walls, each time covering an area of the same spatial extent so that the results could be compared. Then, after disinfection the drawing documentation was prepared and architectonic analyses were made by architects. Underground chambers were additionally documented by 3D scanning by two teams using different types of devices. Additionally, the entirety of the church and cloisters was scanned, allowing the location of all crypts to be identified within the church and monastery. Two laser scanners were used for measurements in the crypts of the Franciscan church and monastery in Cracow. The first scanner, a *time-of-flight* Z+F Imager 5010C provides high-precision measurements (Bernaś, Rzonca 2020; Curyło 2020). The second device was a Faro Focus 3D with medium precision. It is compact and lightweight and can be used on a camera tripod. It was used in one of the crypts with very difficult access through a tunnel that it was impossible to carry the scanner through. After archiving, point clouds were used to generate orthoscans (Bernaś, Rzonca 2020; Curyło 2020). Orthoscans are digital images with orthographic projection on a horizontal or vertical plane that show the contents of the point cloud. The point clouds were used also for generating movies – presenting spatial documentation in the form of a virtual tour of the crypts, with the possibility to enter each of the open underground chambers and examine the architecture and the burials.

After scanning, the recording of the inventory of the burials and gathering of other samples commenced, including: textiles for dye analyses and technical analyses, and plants from pillows, mattresses, wreaths and bouquets. From the remains we sampled molar teeth for DNA analysis, and ribs for dietetic analyses. Also, anthropological analyses were carried out *in situ*, including on the remains placed in the sarcophagus of Bolesław V the Chaste. Furthermore, two teams performed an analysis of faces using two different methods. The first team, from the Wrocław Reconstruction School (Wrocławska Szkoła Rekonstrukcji)[7] and led by Prof. Dr hab. Barbara Kwiatkowska and including anthropologists and sculptors, prepared an anthropological reconstruction of the possible appearance of three faces (Fig. 5, 6, 7) based on tissue determinants identified based on skull morphology (Kwiatkowska et al. 2020). This method merges scientific knowledge and artistic skill. In order to avoid damage to the bone material the scanned skulls were printed in 3D (Kwiatkowska et al. 2020). The skulls were scanned with a SMARTTECH 3D Scan3D Surface optical scanner linked to an automated rotary table and SMARTTECH 3D Measure software.

[7] Initially active at the Anthropology Lab of the Wrocław University and later (for over 10 years) at the Anthropology Lab of the Wrocław University of Environmental and Life Sciences.

Fig. 5. Reconstructed appearance of a person (a man of *maturus* age), artistic aspect, photo R. Bonter-Jędrzejewska

Fig. 6. Reconstructed appearance of a person (a woman of *adultus* age), artistic aspect, photo R. Bonter-Jędrzejewska

Fig. 7. Final reconstructed appearance of a person (a man of *maturus* age), artistic aspect, photo R. Bonter-Jędrzejewska

The skulls were printed on a Prusa i3 filament printer, with head working temperature of 210 °C and table working temperature of 60 °C (Kwiatkowska et al. 2020). The copies of skulls were a base for manual reconstruction of soft tissues using the combined Manchester method. This method reproduces muscle outlines taking into account suspected thickness of soft tissues in particular areas of the face. Average thickness of soft tissues for each individual head was evaluated basing on the person's gender and age at time of death (Kwiatkowska et al. 2020). After determining the outline of the face, the layers corresponding to the thickness of soft tissues were added using depth markers, and the muscle layout was reconstructed. The last stage of reconstruction works lay in the hands of artists, and involved giving the models their individual features; these were made of plastic mass and corresponded to the gender, age and social status of the individual. Computer graphic reconstructions were made by D. Zajdel of the Police Central Forensic Laboratory (Zajdel 2020). The image of the skull *en face* underwent graphical processing, emphasising the edges of the bone areas of importance to the reconstruction (Fig. 8, 9, 10).

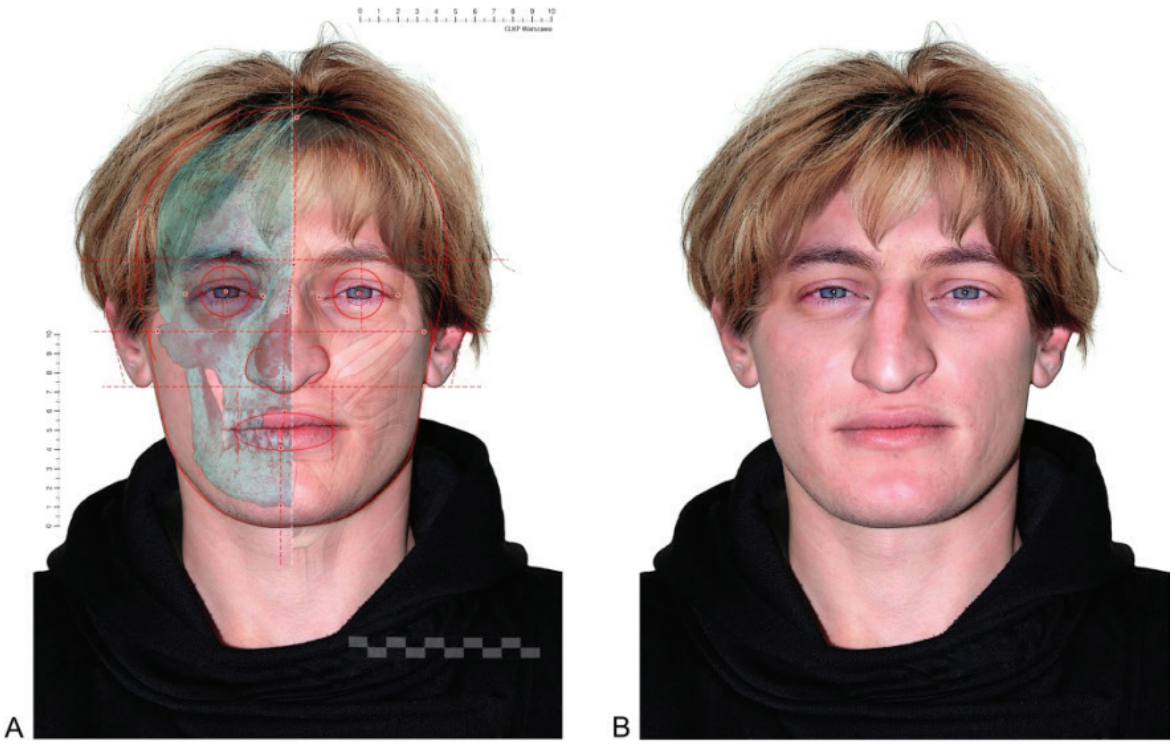

Fig. 8. Reconstruction of an individual marked as P2, with marker grid applied, study and photo by D. Zajdel

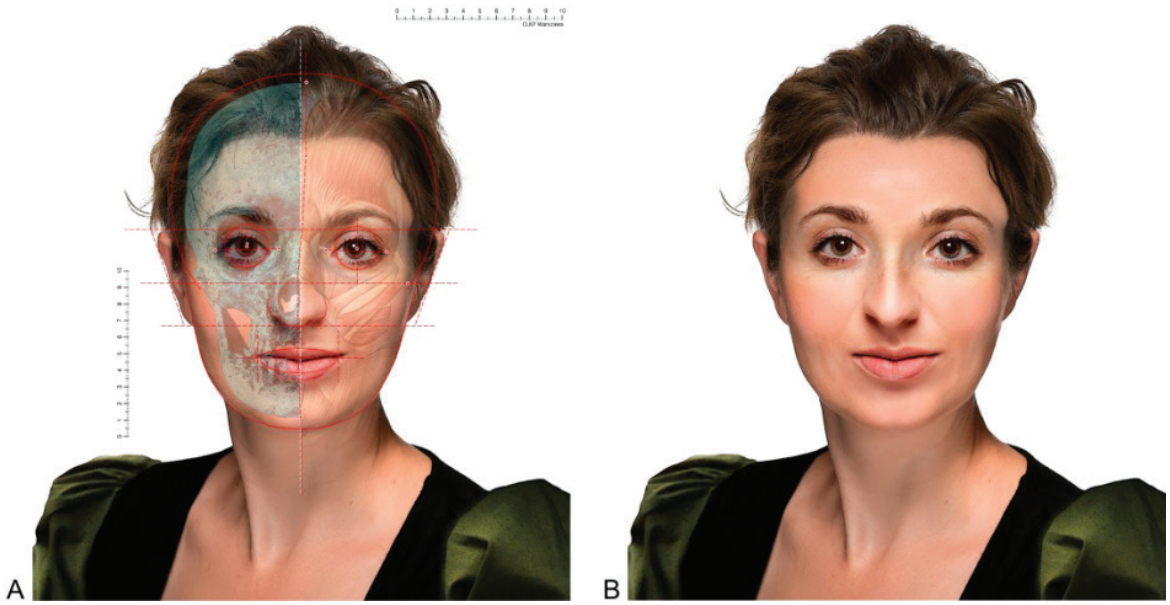

Fig. 9. Reconstruction of an individual marked as P9, with marker grid applied, study and photo by D. Zajdel

Fig. 10. Reconstruction of an individual marked as P4, with marker grid applied, study and photo by D. Zajdel

Then a grid was applied for eyeball placement in the eye sockets and the thickness of the skin part of the upper lip was applied. The assumed length and location of the oral fissure was defined based on how far apart the canines were set in the jaw and the height of the incisor teeth. The scalp was created basing on fragments of elements of external face structure from a proprietary portfolio of photographic elements (Zajdel 2020). These prepared graphical elements were imposed over the marker grid, and placed in the proper parts of the skull. The final stages of basic head reconstruction of two men and one woman focused on graphically merging the reconstructed fragments of the face and the head.

The project I led allowed a comprehensive study of the burial crypts with the tombs. We performed an analysis of architectonic crypt layout and recorded the full inventory using state-of-the-art techniques. Furthermore, sets of archaeological artefacts constituting tomb furnishing were also studied in detail. Selected objects underwent metallographic analysis. The funeral clothes underwent costumological analysis and the fabrics were catalogued with by modern analytical methods that also allowed dyes to be identified. Also, microbiological surveys of the crypts, human remains and grave furnishings constituted an important activity. Additionally, artefacts of importance to national heritage were taken for conservation; these were parts of the furnishing, such as clothes and devotional items. The project was conducted on multiple areas and its aim was to show new directions in crypt studies. The analyses will be presented in papers and several longer monographs.

The spatial evolution of St Francis of Assisi church in Cracow

Halina Rojkowska-Tasak

The monastery complex of the Order of Friars Minor includes structures erected during several historical periods (Rojkowska-Tasak 20020, p. 86 –119). The St Francis of Assisi Church is one of the oldest parts of the complex and is situated in the northern part (Fig. 11). Towards the south and west, there are monastery buildings grouped around two cloister garths. The oldest monastery buildings are situated around a first, square quadrangle. The buildings originating mostly from the seventeenth century are placed around a second, irregular garth. The western part of the Franciscan area was occupied by a vast yard that is currently a green area linked to Cracow's Planty Park that was established on the site of the medieval city walls. A housekeeping yard and a garden are located on the southern side of the construction. The provincial library, completed in 2017, is the youngest facility. The Franciscans arrived in Cracow from Prague in 1237 at the decision of the Franciscan authorities and were accommodated on the edge of the open pre-charter settlement that was next to the fortified suburb called Okół.

The founding of the Cracow monastery was not the achievement of just one person. Jan Długosz (Johannes Longinus) reports that the founding of the Friars Minores' church and monastery were attributable to Bolesław V the Chaste (*Wstydliwy*) (Długosz 1973, p. 548 –549; Długosz 1864, p. 463). But most scholars consider Teodor Gryfita, the voivode of Cracow, to be the original founder of the monastery. Bolesław the Chaste became a great protector of the monastery after taking over the rule of the Cracow Province after 1243. The Friars Minores commenced construction on the church and monastery immediately upon arrival. In 1249 the province Chapter gathered in Cracow for the first time. In 1254 a ceremony of Elevation of relics of St Stanislaus the Bishop took place and his canonisation was announced in Poland. Holding the Chapter gathering – a meeting of several dozen of the province's higher officials – and the canonisation ceremony required that there be proper quarters and a temple within the monastery. This proves that part of the church (possibly the eastern part) and monastery buildings (that were possibly partially wooden) already existed around the middle of thirteenth century. In 1269 duchess Salomea of Poland (of Poor Clares), sister to Bolesław the Chaste, was buried in the church (she had died the year before). The original location of her tomb is commemorated by a slab in the floor.

There are numerous hypotheses related to the original form of the Franciscan church. They are based mainly on analysis of its projection and body and of the preserved architectural details (Kremer 1859; p. 72–73; Łuszczkiewiecz 1891, p. 160; Skibiński 1977; Skibiński

Fig. 11. Franciscan church and monastery from the east, photo H. Rojkowska-Tasak

1974, p. 333–341; Grzybkowski 1992, p. 97–98; Pencakowski 1990, p. 57–60; Pasiciel 2002, p. 7–11; Węcławowicz 2013, p. 93–107; Włodarek, Węcławowicz 1989; Włodarek 1995; Włodarek, Węcławowicz 2006, p. 45–69).

The architectural studies performed along the years of conservatory works and later dedicated works were compared against parallel archival and iconographical queries to distinguish the oldest structure of the church and its later transformation (Niewalda, Rojkowska 2006, p. 81–130; 2008, p. 271–298).

The eastern part of the church is the oldest. It was erected on a plan of an equal-armed cross, it had slender proportions and it is built in gothic brick with finger-marked grooves, 80–87×130–138×275–280 mm (northern part) and 80–87×130–138×278–290 mm (southern part). Monk (Slavic) bond was used. In the surface part the cross arms are bound together (except at the north-eastern corner). This suggests a single erection activity, despite the differences in the cross arm sizes, brick sizes and decoration of end walls. Metric analysis of the crossing part, which is enclosed in a square, revealed its modular sizing. The whole crossing arrangement can be enclosed within a square of side 26.40 m, being a multiple of a 120 cm (4–30 cm) module, which was the thickness of all walls. The side arms have an external width of eight modules, and the eastern and western arms – nine modules. Relics of the foundations of the original eastern wall are preserved in the crypt under the presbytery. A double-span sacristy (the "old" sacristy), closed in a polygon and vaulted with square-section ribs, was erected together with the crossing part of the church. Inside the sacristy there are wall pilaster dec-

orations that are similar to decorations in the Franciscan monastery in Prague and dated to the fourth decade of the thirteenth century. They allow a similar dating of the Cracow structure (Włodarek, Węcławowicz 2006, p. 65, 66; Węcławowicz 2013, p. 97). The oldest part of the crossing also includes a round staircase, whose lower part up to a height of about nine metres is preserved, with stone spiral stairs. It leads from the ground floor to the church attic, and is bound to the south-western corner of the western cross arm in the areas of the ground floor and the attic. The erection of the crossing is dated to between 1237 and around 1250. Traceries of such composition are dated from around 1270 (Grzybkowski 1992, p. 99–101; Węcławowicz, Pietrzykówna 1989, 49–50; Szyma 2008; Szyma 2014).[8]

The nave body in its present shape, with 160-cm thick walls, was added to the eastern crossing part probably in the third quarter of the thirteenth century. The southern wall is best preserved. It features an exposed monk bond, and above the cloister it is built of finger-marked brick, 80–85–88×113–116–126×258–265–275 mm, with triangular grout cut. The proportions of the internal layout of the body are defined as a width-to-length ratio of 1:1.5.

The monastery choir was enlarged, probably in the first third of the fifteenth century, by adding a polygonal vaulted apse. The current pseudobasilica arrangement was probably introduced after the fire of 1462, and the collapse of the tower in 1465. In Długosz's report, the tower was situated between the choir and the body. According to the historian's descriptions, brickwork changes to the walls in the attic area and analogies to other mendicant order monasteries suggest that a small, square tower may have been placed at the external corner of the cross, between the western and northern arm, as a secondary element (Włodarek, Węcławowicz 2006, p. 58–63).

The roofs, vaults, columns (pillars) and eastern end of the northern nave were destroyed. The new vault (at least above the crossing part of the church) was founded by a Cracow merchant, Jan Klethner (Długosz 1878, p. 411). In the crossing part, a corner between the northern and western arms was added, along with a western wall. It is possible that it had previously been damaged during the tower's collapse. The wall between the naves was rebuilt. The southern nave was extended, which required that internal cladding be added. Traces of vaulting are preserved on the attic level. The northern nave was significantly lowered and the windows were finished with pointed arches between the original oblique jambs. Traces of the original jambs and vaulting are visible in the attic.

In the western wall of this nave a large window framed with ashlars was made (Fig. 12). The pillar-buttress rib vault system covering both naves was reconstructed by Karol Knaus in 1901 basing on relics discovered during the renovation of the church (Tomkowicz 1912, CXVIII–CXXXII). There are two known chapels originating from the second half of the fifteenth century: one located at the northern arm of the cross (currently the Blessed Salomea's Chapel) with a three-sided enclosure to the east that is similar to the sacristy at the southern arm of the cross. The first mention of the Italian Chapel comes from 1472 (Włodarek 1995, p. 130). Later reports and a plan from 1796 reveal a sacristy (and later a small vault) attached to the chapel. The chapel was roofed with a groin vault. In 1589 the Italian chapel was moved to the abandoned Hungarian chapel at the eastern arm of the cloister (Rosenbaiger 1933, p. 129).

[8] Marcin Szyma dates the crossing part to no later than 1260 (Szyma 2008, p. 25–34), like A. Grzybkowski (1992), basing on form of traceries.

Fig. 12. Fragment of the western elevation of the church after restoration by K. Kremer. On the left, between the lower small windows there is a fragment of the gothic window of the original side nave, 1926.

In 1563 a new tower was erected (Fig. 13) in the cemetery. It was the result of efforts by the guardian, Stanisław Kozłowski. It was located in line with the northern transept arm and partially attached to the corner of the Italian chapel vault (KZSP 1971, p. 108). Between the tower and the transept an antechurch was created, with the church entrance located in the transept wall. This situation is depicted on the archival plan of 1796, while the view of the tower is shown in an 1800 drawing by Wojciech Gutowski, where a three-level tower is covered with a bulb-shaped tented roof (Kęder, Komorowski 2007, p. 114, Fig. 58). In 1801 the tower was demolished, and the antechurch received a classicistic elevation, topped with a triangular pediment with vases, as is well visible on Karol Balicki's 1850 drawing (Kęder, Komorowski 2007, p. 118, Fig. 61). In 1595 the Cracow cannon, Marcin Szyszkowski, and the Bishop of Cracow, Jerzy Radziwiłł, founded the Confraternity of the Lord's Passion (soon transformed into the Archconfraternity of the Lord's Passion) at the Franciscan church. The archconfraternity received the abandoned Italian chapel and the northern nave of the church (Niewalda, Rojkowska 2015). The adapted chapel was transferred to the confraternity in 1609. The northern nave was subdivided by a wall, which changed the layout of the church into a single nave with a transept created by the side arms of the cross. During the Swedish invasion in 1655 the church was heavily damaged. A fire caused the collapse of the roofs and gothic vaults in the church nave and in the chapel of the Passion of Jesus. The rebuilding of the

Fig. 13. View of the church from the east. Drawing by W. Gutowski, 1800

vault in the nave commenced in 1668. The rebuilding of the church was completed in 1673 (Kracik 1984, p. 134).

A new, span-canopy vault was added. Its traces remain at the attic level. Gothic windows in the southern wall were partially bricked up and new windows with a semicircular top were inserted. The re-faced western elevation was topped with a new triangular pediment and two elongated, semicircular windows. The main nave and the chapel of the Passion of Jesus were covered with a common roof. In the years 1726–27 a new floor of black and white marble slabs was placed in the main nave. The complete rebuilding of the chapel of the Passion of Jesus was carried out in stages, between the years 1659 and 1669. The interior decorations: the main altar, the painting of Jesus on the cross at a rainbow pillar, and a group of sculptures depicting scenes from the Passion were created at the same time (Dettloff, Rojkowska 2016). In 1905 the decaying archconfraternity transferred the chapel to the monastery. A new, neogothic elevation was made by the Confraternity of the Passion of Jesus in 1842, according to Stanisław Gołębiowski's design. A little earlier (1836), gables with pinnacles and windows were added to the mono-pitched roof of the chapel. The chapel of carpenters and bricklayers was added in 1674, in a baroque style. The remains of Blessed Salomea of Poland were placed there (Kantak 1937). The chapel was covered with a low dome. It also contains the remains of Bolesław the Chaste, the duke of Cracow, which were moved there in 1922 from the presbytery. Since the beginning of the seventeenth century the chapel has also contained the crypt of the Zborowski family and epitaphs of different ages. New damage to the church and the monastery was inflicted in 1850 during the great fire of Cracow. The vault collapsed in the eastern part of the

church. In the main nave and the presbytery the baroque stalls, paintings and wooden elements of the altars were burned. The chapels suffered less damage. The rebuilding of the church between 1851 and 1860 was led by Karol Kremer, while works at the chapel of the Passion of Jesus were led by Stanisław Gołębiowski in 1852. The philosophy adopted involved restituting the church's gothic character that had been lost during the baroque rebuilding. In the eastern part, neogothic vaults were placed, and gothic windows were re-opened and fitted with neogothic traceries and geometrical stained glass. The western elevation of the nave was changed by capping it with a tall, neogothic gable. On the axis an entrance was created and fitted with a stone portal. The northern church entrance was removed. The barrel vault remained in the nave, as well as the semicircular niches between the pillars. The wide, profiled cornice and baroque wall pilaster decorations were removed. A multi-sided, western arcade chorus was also removed (Bęczkowska 2010, p. 319–353; Kęder, Komorowski 2007, p. 120–122, Fig. 63, 146). Neogothic architectural and internal furnishing elements were completed by the end of the nineteenth century.

Fig. 14. Church interior with S. Wyspiański's polychrome of 1895, photo H. Rojkowska-Tasak

In 1876 a single-level antechurch was added to the northern transept arm, and the northern church entrance was re-established. Two years later the western chorus was erected according to Jacek Matusiński's design. In 1879 a passage was created from the nave to the future chapel of Our Lady of Sorrows, near its altar. The painting decoration of the chap-

Fig. 15. Interior of the church, photo M. Łyczak

el of Our Lady of Sorrows was made in 1897 by Piotr Niziński, with the contribution of Stefan Matejko. Another restoration, led by Władysław Ekielski, commenced in 1895 on the presbytery side. To emphasise the interior space, in front of the eastern cross arm a slightly bent rood beam with a crucifix featuring a baroque figure of Christ was installed (Fig. 14). The chapel was outlined and fitted by directly connecting part of the cloister to the church nave (Karwacki Pamiętniki, 151; APF sign. A-I-14; Solarz 2008; Borowiejska-Birkenmajerowa, 1985, p. 24–40; Kęder, Komorowski 2007). In the same year, Stanisław Wyspiański designed and led painting works, covering the walls and vault of the cross part of the church with polychrome. Wyspiański painted the walls in a layout of separate zones, depicting flowers from Polish meadows and gardens, stylised leaf motifs, hearts, peacock feathers and even heraldic motifs of the Piast crowns and eagles (Fig. 15). The vault architecture was strongly emphasised by colour and decorated with stylised stars. Beautiful stained glass designed by Wyspiański was installed in the windows. The walls were also covered with polychrome by Tadeusz Popiel (1904–1905), who continued the ornamentation in a style similar to Wyspiański's. The last change to the church image, which remains till today, was Franciszek Christ's rebuilding of the western elevation in the years 1964–67.

ARCHEOLOGY

Burial crypts: architectonic analysis

Monika Łyczak, Anna Drążkowska, Halina Rojkowska-Tasak, Stanisław Cechosz, Łukasz Holcer

The present spatial arrangement of St Francis church is basically an effect of a renovation of its historical appearance performed in the second half of the nineteenth century (Łyczak, Drążkowska et al. 2020, p. 86–119). This blurred the evidence of the eighteenth-century underground layout because most tomb slabs and crypt entrances were removed during the renovation of the floor. These objects were no longer needed, because in 1786 the Austrian emperor Joseph II issued a decree forbidding burial in church cemeteries and in crypts located within churches. With the passing ages, the location of burials and crypts has frequently changed, and the eighteenth-century arrangement was merely the end result of a long process of changes. Non-invasive survey methods and archaeological surveying captured traces of early brick structures. Two stone wall toothings located within a two-chamber crypt under the presbytery (church – crypt B1) are the oldest identified architectonic elements. This massive stone foundation constitutes the remains of the eastern wall of the first presbytery of the thirteenth-century Franciscan church. After adding an additional span with a multi-sided presbytery closing, this wall was no longer needed and was dismantled. From the beginning of its existence, the interior of the church was used for burials. Probably most popular were earth burials, due to the costs being lowest. Their relics in the form of mixed strata with human remains were observed while making an excavation between two crypts in the central part of the chapel of the Passion of Jesus (the church – crypts B3 and B4).

Single persons, and families of higher status and wealth, as well as the order's supporters could hope for a more honourable place of eternal rest. The exploration and non-invasive studies reveal that Franciscan crypts did not exhibit a consistent, well-planned layout with consistent chronology (Fig. 16). They are distributed across all parts of the church: the presbytery, the transept, the main nave, and the chapels of Passion of Jesus, Our Lady of Sorrows and the Blessed Salomea of Poland. They are also recorded in all three arms of the cloisters. All discovered crypts originate from Modern times. At least some can be matched with some probability to specific persons or families, based on a comparison with the plans made by Father A. Karwacki (Karwacki 1908, 1922).

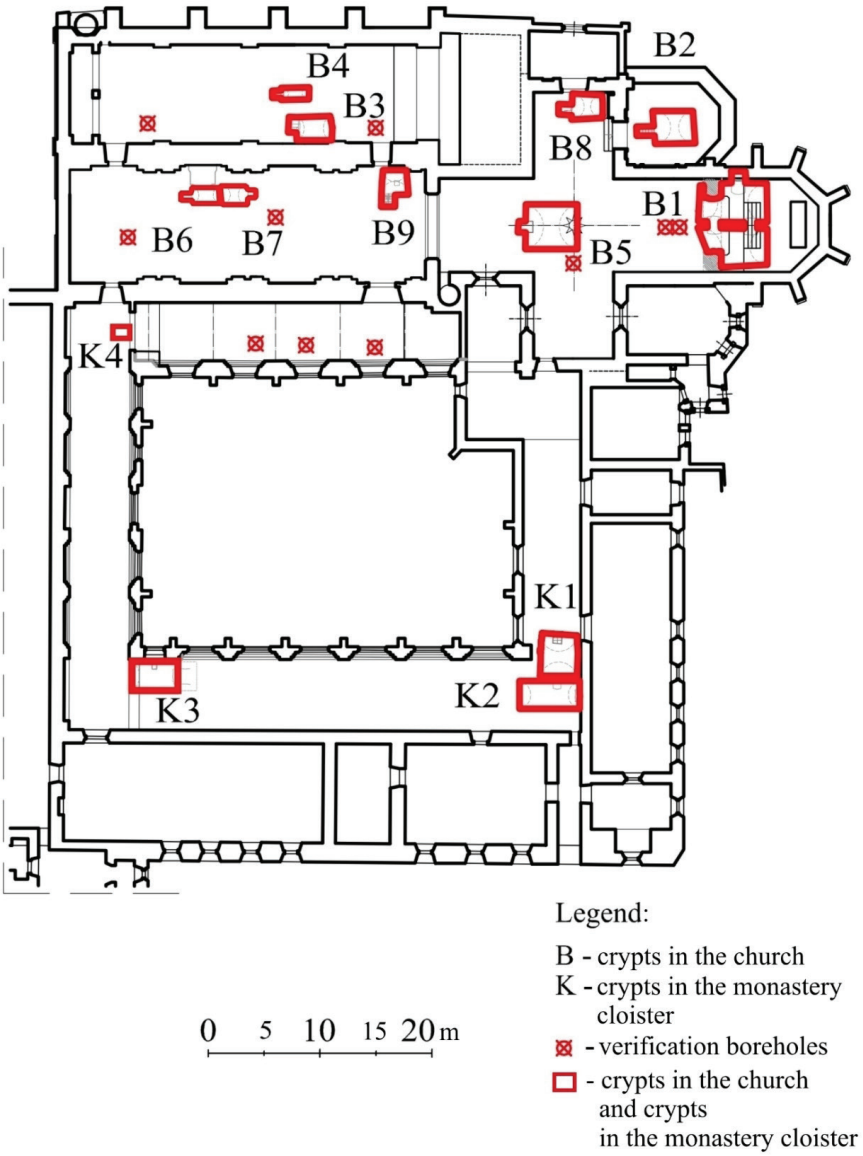

Fig. 16. Location of crypts in St Francis of Assisi Church in Cracow and in the cloister of the Franciscan monastery in Cracow
Legend: B – crypts in the church; K – crypts in the monastery cloister, ⊠ – verification boreholes

THE CHURCH: CRYPT B1 – "BROTHER'S TOMBS" (N° 166 on the Karwacki plan of 1908 N^{os} 1, 2, 3 on the plan of 1922)

The crypt is located in the eastern part of the presbytery. It is approximately rectangular, measuring 750×620 cm and about 200–210 cm high. It is divided into two chambers (a northern and a southern chamber), and partitioned by a massive brick wall with two passage openings (Fig. 17). The main walls are made of brick, including dismantled bricks, with a small addition of broken limestone. Both chambers are covered with brick barrel vaults (Fig. 18).

Furthermore, very rough, secondary brick works are visible on the western walls of both rooms. The floor of both chambers remains unhardened, and the usable level was formed by a levelled ground bed (of yellow sand). In the south-western and north-western corners there are relics of a stone wall of *ca* 160 cm wide that is partially bricked by the relics of the primary foundation of the rectangular presbytery closing.

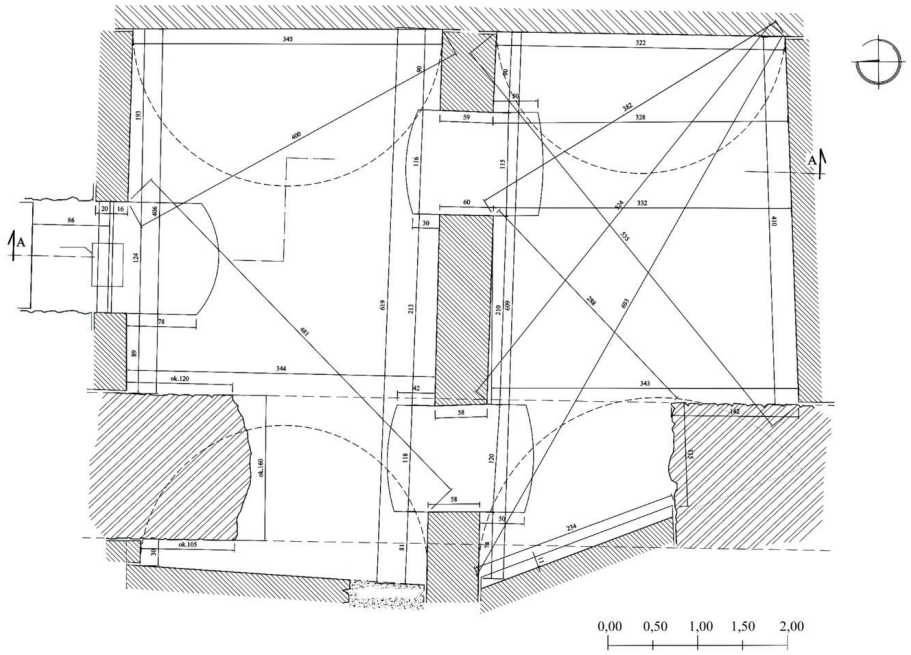

Fig. 17. Architectonic inventory of crypt B1 under the presbytery, drawing by S. Cechosz, Ł. Holcer

Fig. 18. Southern shield wall, photo M. Łyczak

In the northern chamber, there is, at the northern presbytery wall, the original passageway opening in the form of a ventilation duct that pierces through the vault. It is currently covered with a concrete slab and not marked on the floor. The existing (secondary) entrance to the interior is located in the body of the northern outer wall of the presbytery. In the northern chamber, six wooden coffins were gathered at the eastern wall, with mixed human skeletal remains. In the southern chamber an ossuary space was sub-divided by planks. Numerous bones, probably originating from a clearing of other crypts and tombs, were deposited there. Based on brick dimensions and analyses of bonds the crypt was determined to have been erected no earlier than about the mid-seventeenth century, with the use of older, bricks salvaged from the demolished eastern wall of the original thirteenth-century church presbytery.

THE CHURCH: CRYPT B2 – "ZBOROWSKI FAMILY TOMB" (N° 167 on the Karwacki plan of 1908, N° 25 on the plan of 1922)

The crypt is located within the chapel of the Blessed Salomea of Poland. It was established on a near-rectangular plan of 300×360 cm (Fig. 19, 20). Its walls were made of finger-marked brick in a stretcher bond. The facing of the wall is partially trowelled with thick-grained limestone-sand plaster with a charcoal admixture. The chamber is embraced by a barrel vault made of finger-marked brick. The floor is made of finger-marked brick. The crypt entrance is closed with a stone slab visible in the chapel floor (Fig. 21). The crypt contained twelve upholstered coffins with human relics, including one double coffin. At the southern wall children's coffins were placed, and the remaining space was occupied by chests with remains of adult laymen. The crypt is dated to the period from the end of the sixteenth century to the fourth decade of the seventeenth. One of the coffins (burial N° 1), containing the remains of a woman, bore the date 1714. The clothes of the buried persons were made for multiple uses and have a cut typical of clothing used between the seventeenth and mid-eighteenth centuries.

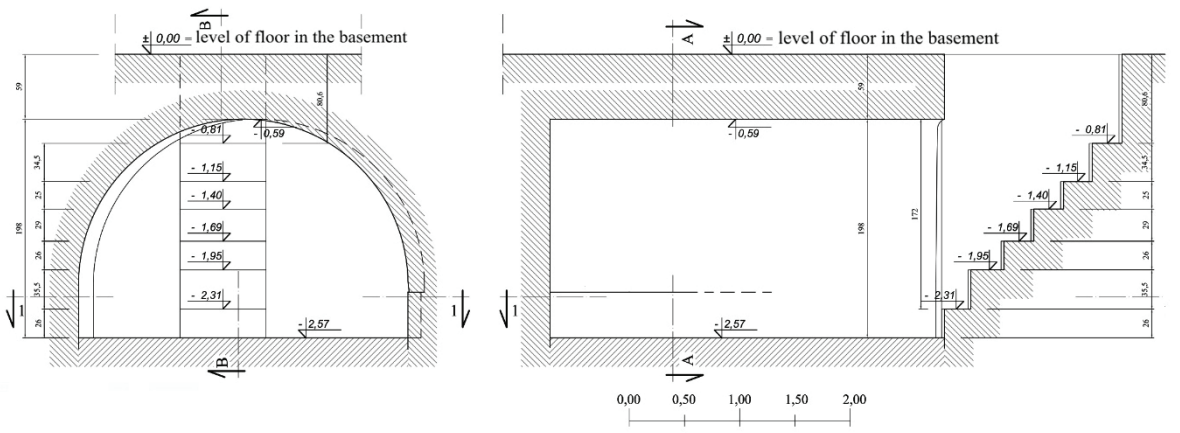

Fig. 19. Architectonic inventory of crypt B2, longitudinal and transversal section, drawing by S. Cechosz, Ł. Holcer.

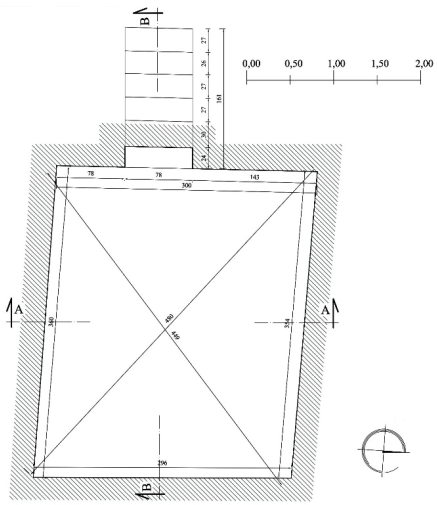

Fig. 20. Architectonic inventory of crypt B2, projection, drawing by S. Cechosz, Ł. Holcer

Fig. 21. Western shield wall of crypt B2, photo M. Łyczak

THE CHURCH: CRYPT B3 (not included on the plan by father A. Karwacki)

The crypt is located in the southern part of the chapel of the Passion of Jesus. Its projection is approximately rectangular, measuring 300–316×207–217 cm (Fig. 22). It has a brick, barrel vault. The eastern part is made of broken limestone with small admixture of brick fragments. Its southern section is made of large limestones, supplemented with bricks (Fig. 23). The northern and southern walls are made of finger-marked brick, with dimensions of 70–75×130–140×265–

275 mm. The western wall is integrated with the crypt's longer walls. The entrance is loosely covered with stone beams, and a concrete levelling above. The original entrance is not marked on the floor. Seven wooden coffins are gathered at the eastern wall inside the crypt. They contain human remains. The four last-deposited coffins are very well preserved, and they belong to members of the Archconfraternity of Good Death. They are marked with dates (1796, 1789, 1775, 1768). There is also the coffin of Franciszek Bętkoski son of the Poznań voivode. Underneath there were also the highly damaged graves of adult laymen and one child.

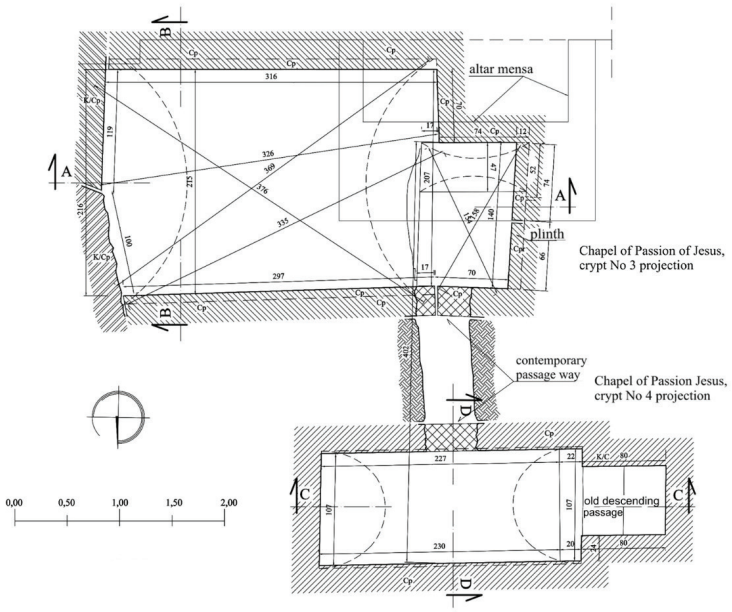

Fig. 22. Architectonic inventory of crypt B3, B4, longitudinal and transversal section, drawing by S. Cechosz, Ł. Holcer.

Fig. 23. Eastern shield wall of crypt B3, photo M. Łyczak

Architectonic study revealed that the crypt was built no earlier than in the middle of the sixteenth century. The younger part of this wall seems to be a later element, added to the medieval tomb before this crypt was built. Descending entrance with buttress was added in 18th century.

THE CHURCH: CRYPT B4 (not included on the plan by father A. Karwacki)

The crypt is located in the central part of the chapel of Passion of Jesus. It is rectangular, measuring 250×107 cm (Fig. 24). The northern, southern and eastern walls are made of finger-marked bricks of 60–65×120–125×250–260 mm, with stretcher bond predominating (Fig. 25A). The western wall was made of broken limestone with admixture of bricks and carefully finished limestone blocks. Steep stairs lead down to the underground chamber. The crypt is covered with a barrel vault made of finger-marked brick in a stretcher arrangement (25B). The floor is made of bricks. The original entrance opening is currently not marked on the floor, and an *ad-hoc* crypt entrance was made in the southern wall, from the crypt B3, during the exploration activity.

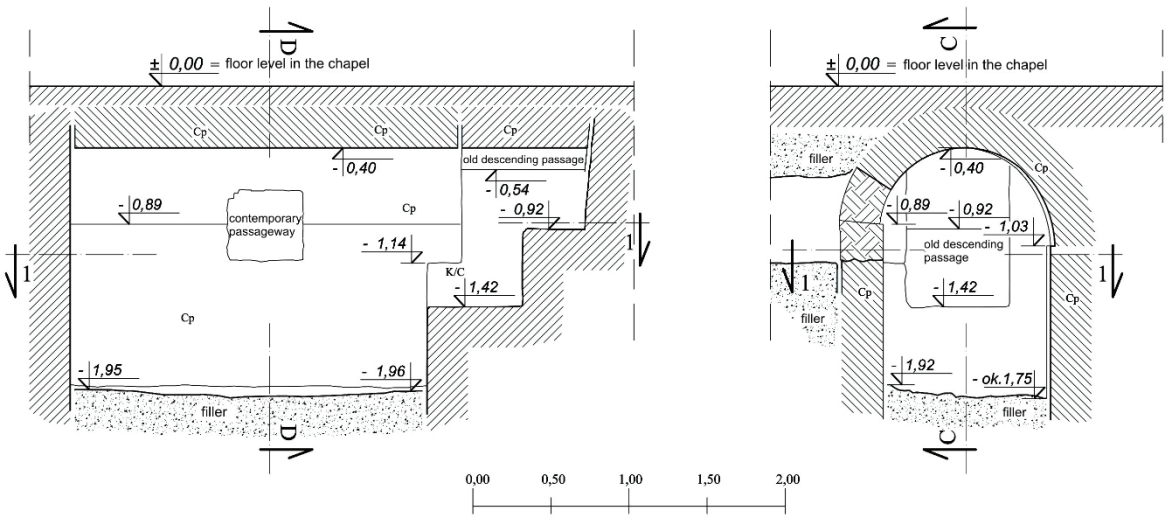

Fig. 24. Architectonic inventory of crypt B4, longitudinal and transversal section, drawing by S. Cechosz, Ł. Holcer

Fig. 25. Crypt B4: A) Eastern shield wall and; B) western wall with the stairs to the crypt B4, photo M. Łyczak

At the wall of the northern crypt, on two flat metal bars, a wooden coffin with upholstery had been placed. It contained human remains. Archive data and architectural analysis results point to the beginning of the seventeenth century.

THE CHURCH: CRYPT B5 – "PRZYŁĘCKI FAMILY TOMB" (N° 146 on the Karwacki plan of 1908, N° 15 on the 1922 plan)

The crypt is located in the central part of the so-called "cross", near the point of transection of the axes of symmetry of the original church, which was erected on a Greek cross plan. Its is roughly square (Fig. 26), 465×400 cm. The walls are made of manually produced brick, 50––55×120–130×265–275 mm, with small admixture of secondary limestone material and demolition brick (Fig. 27).

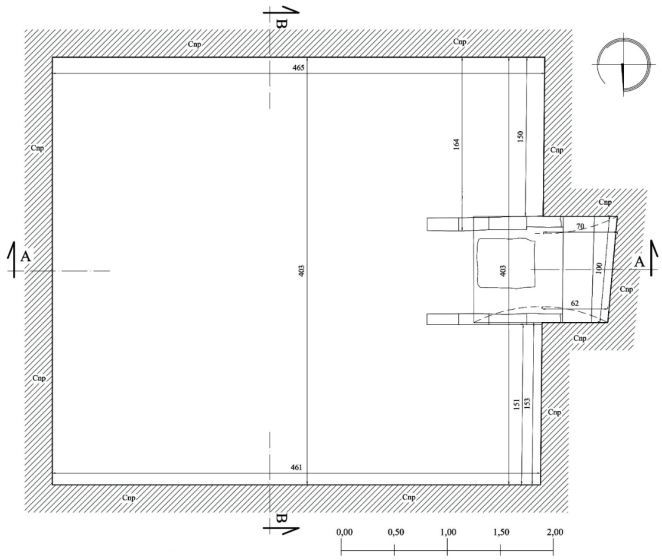

Fig. 26. Architectonic inventory of crypt B5, projection, drawing by S. Cechosz, Ł. Holcer

Fig. 27. Eastern shield wall of the crypt, photo M. Łyczak

In the western wall there is a central descending opening with steep brick stairs (Fig. 28). Currently it is not marked on the floor. The chamber has a barrel vault resting on the northern and southern walls. The vault is made of bricks similar to those used in the walls. The original crypt bottom has been left unhardened. In the eastern part of the crypt, along the north–south axis of the eastern wall, two wooden joists of *ca* 40×20×400 cm rest on two transversal wooden ground beams (of *ca* 40×20×80 cm).

Fig. 28. Western wall and crypt's descending shaft with the stairs/ramp, photo M. Łyczak

In the eastern part of the crypt (on the wooden joists) and at the northern and southern walls, twenty-six coffins with human remains are gathered. Analysis of clothing shows that the crypt was used for burials of laymen of high material status. Several coffins were marked with the following dates: 1760 (burial 3), 1728 (burial 6), 1705 (burial 19) and 1645 (burial 25). They show that this underground space may have been used for burials for about 120 years. This is further attested by the clothing analysis, since the discovered set included clothes cut according to the style of the seventeenth and eighteenth centuries.

THE CHURCH: CRYPTS B6 – "UNKNOWN BURIAL" AND CRYPT B7, "GIELC FAMILY TOMB" (Nos 152 and 154 on the Karwacki plan of 1908, Nos 20 and 22 on the 1922 plan)

The crypts ale located in the central part of the main nave, within the third span from the east. The spatial arrangement along the east–west axis is constituted by two chambers attached by their shorter sides, and partitioned by a wall of about 15 cm thick. They are roughly rhomboid, with only slightly leaning walls, and dimensions of 142–148×242.5–250 cm (crypt B6) and 164–165×226–238 cm (crypt B7) (Fig. 29, 30). The longitudinal walls, partition wall and vaults were made of the same type of finger-marked brick, 60–69×123–135×250–265 mm, bound with quite strong lime mortar. The eastern wall (crypt B7) was erected with bricks, with small admixture of limestone, while in the western wall, at its intersection with the northern wall (crypt B6) a relic of a stone wall with broken-off facing was found. This is possibly a relic of an older chamber. Both chambers were covered with brick barrel vaults.

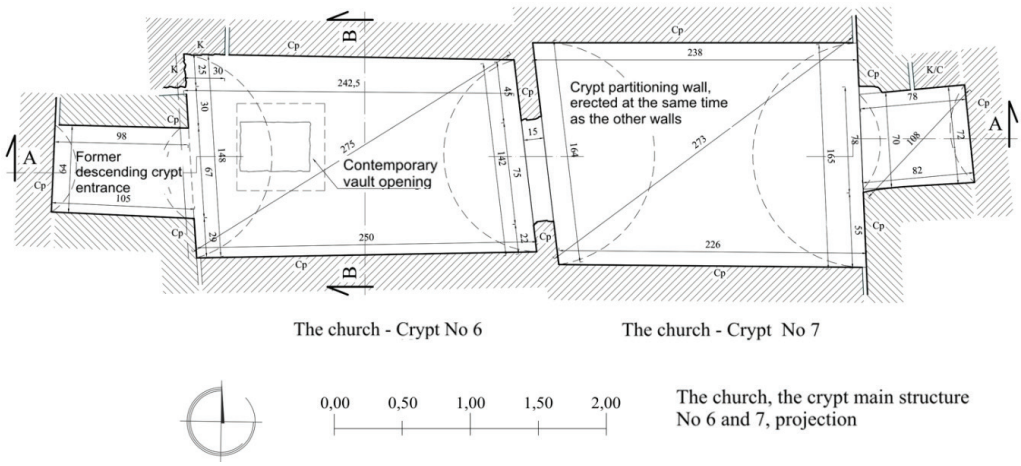

Fig. 29. Architectonic inventory of crypt B6 and B7, projection, drawing by S. Cechosz, Ł. Holcer

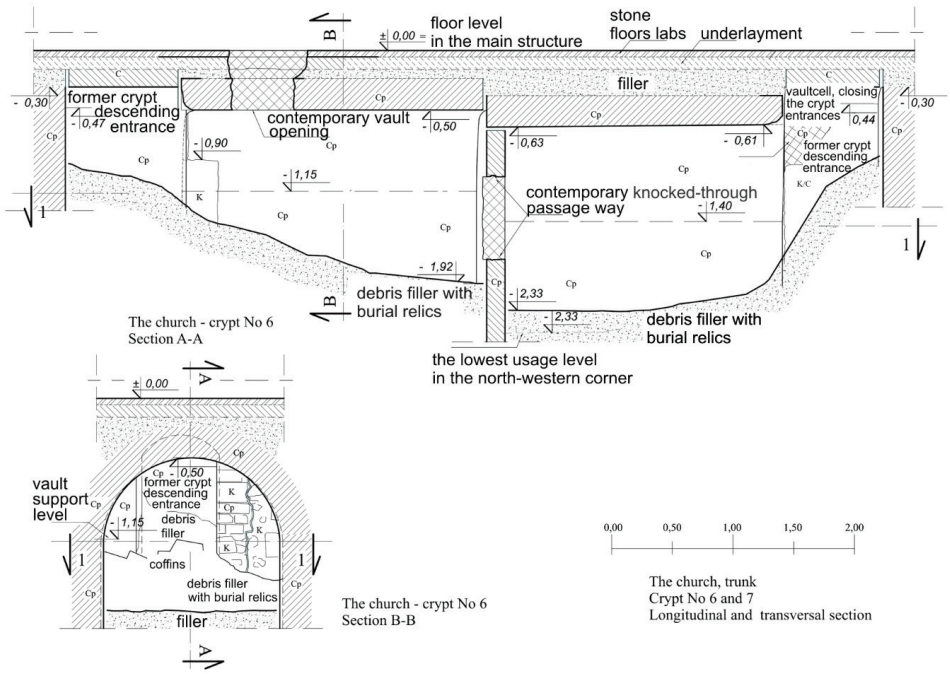

Fig. 30. Architectonic inventory of crypt B6, B7, longitudinal and transversal section, drawing by S. Cechosz, Ł. Holcer

The original entrances to both crypts are currently not marked on the floor plan. An *ad-hoc* entrance to crypt B6 was knocked through the vault, and crypt B7 is accessed through a passageway made in the partition wall. The floor is made of a stone–brick mixture with mortar. Both crypts contain wooden coffins with human remains. Crypt B6 contained six coffins: of adults and three children.

Two coffins were marked with dates: 1683 (burial 1) and 1659 (burial 5). In crypt B7 four coffins prepared for adults were found. One chest had the date 1700 marked in hammered studs. Both crypts were built at the end of seventeenth century or the beginning of the eighteenth. Relics of an older structure were most likely used.

THE CHURCH: CRYPT B8 – "BRZECHWA FAMILY TOMB" (N° 144 on the 1908 Karwacki plan, N° 4 on the 1922 plan)

The crypt is located at the north-eastern corner of the transept, in the direct vicinity of Salomea of Poland's chapel. It is roughly rectangular, 205–232×267–280 cm, and oriented along a west–east axis (Fig. 31). The barrel vault covering the chamber rests on the northern and southern longitudinal walls and is made of finger-marked brick. In the western shield wall

Fig. 31. Western shield wall with descending shaft, photo M. Łyczak

Fig. 32. Eastern shield wall with descending shaft, photo M. Łyczak

there is the neck of the original descending entrance. In the south-eastern corner wall toothings made of finger-marked brick 86–95×118–127 mm were found, with a finished joint on the northern facing. The southern part of the wall (added to the facing of the older wall), only 14 cm thick (the width of a brick header), was made with bricks in a stretcher bond (Fig. 32). The northern part of the wall was made of finger-marked, reclaimed brick. Along the northern and southern walls there are layers of wooden coffins with the remains of eight people: five adults and three children. The crypt vault with its western wall was built in the second half of the seventeenth century or in the eighteenth century.

THE CHURCH: CRYPT B9 – "BEŁCHACKI FAMILY TOMB" (No 150 on the Karwacki plan of 1908, No 7 on the 1922 plan)

The crypt is located in the north-eastern corner of the main nave, in the vicinity of the eastern entrance to the chapel of Passion of Jesus. It was built on a trapezoidal plan, 220×210––242 cm, oriented along the north–south axis (Fig. 33). It is covered by a barrel vault. The vault and the walls are made of finger-marked brick, 52–66×120–140×217–255 mm. On the southern side there is the original entrance with stone stairs, which were originally wider, then narrowed. On the southern wall of the entrance there is a plaster-covered fragment of wall with the date 1905, carved with the names of four workers who "made the walls" (Fig. 34B). Inside the crypt there are fourteen wooden coffins containing remains of noble laymen of both genders, two children and churchmen (possibly Wincenty Wyszkowski – a coffin bears the initials XWW, and a monk in a Franciscan habit). A coffin deposited in a lower part of the crypt bears the date 1667, and chests placed higher have the dates 1747, 1753, 1757, 1765, 1770, 1780. Brick sizes confirm that the crypt was built in the second half of the eighteenth century.

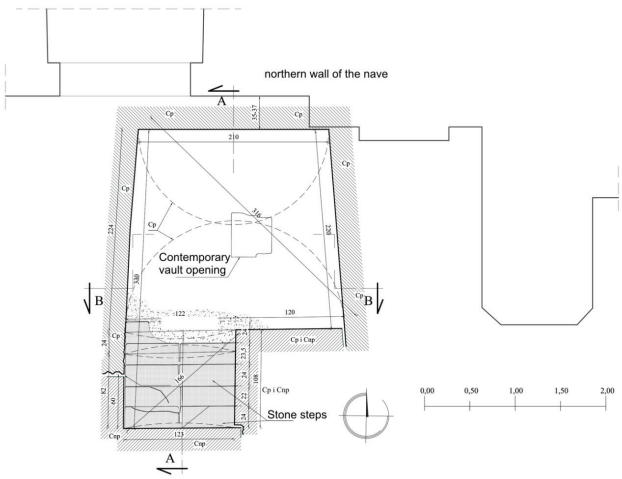

Fig. 33. Architectonic inventory of crypt B9, projection, drawing S. Cechosz, Ł. Holcer

Fig. 34. Crypt B9: A) Northern shield wall of the crypt; B), C) Southern shield wall with descending shaft with stairs, with mason's names written on the wall, photo M. Łyczak

CLOISTERS: CRYPT K1 (symbol γ on the Karwacki plan of 1908, N° 42 on the 1922 plan)

The crypt is located in the southern part of the eastern monastery cloister arm. It is an irregular rectangle, of almost equilateral proportions, about 330×355–370 cm (Fig. 35, 36). Its walls are made of partially crushed, finger-marked brick . At the northern wall there are stairs with narrow, high steps not present in the original structure (Fig. 37). The crypt has a barrel vault made of finger-marked brick.

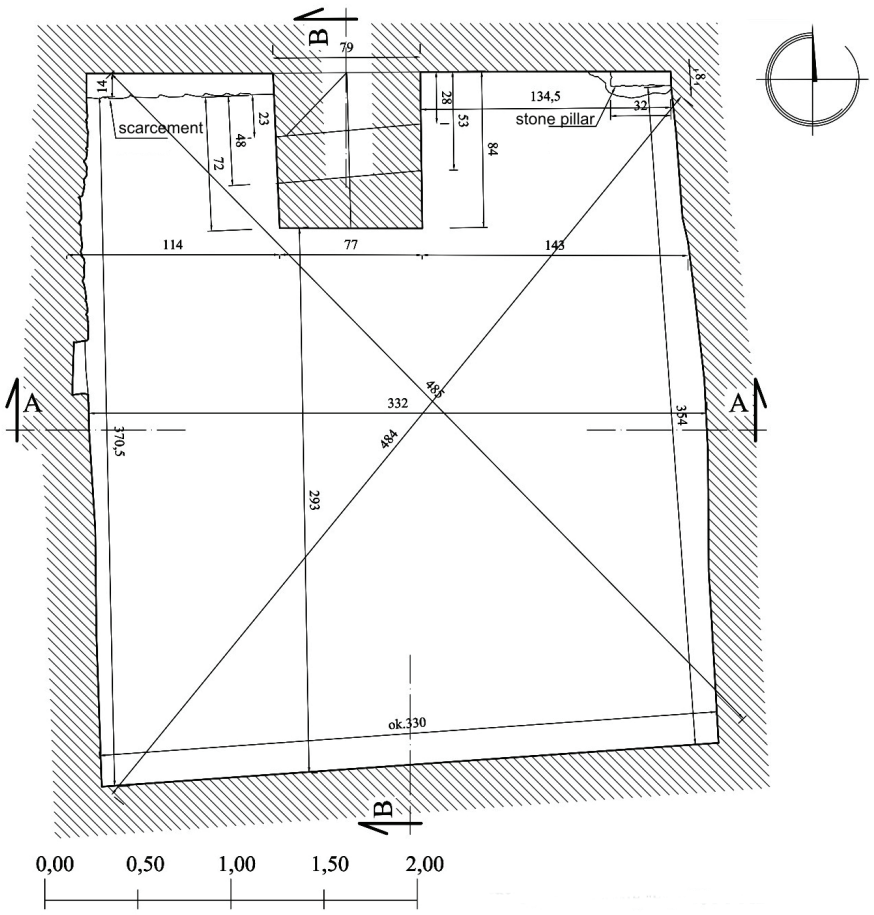

Fig. 35. Architectonic inventory of crypt K1, projection, drawing S. Cechosz, Ł. Holcer

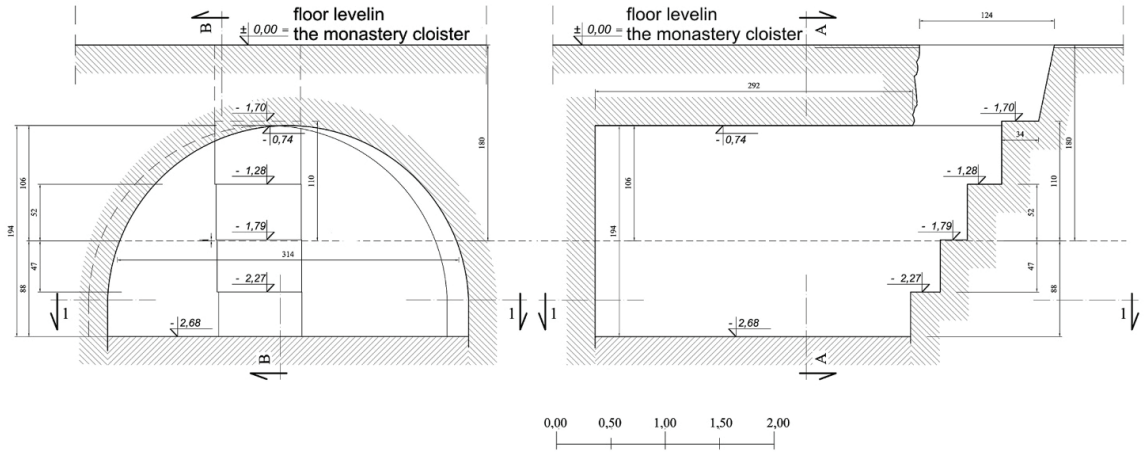

Fig. 36. Architectonic inventory of crypt K1, longitudinal and transversal section, drawing S. Cechosz, Ł. Holcer

Fig. 37. Northern shield wall with descending shaft, photo M. Łyczak

The crypt entrance is closed by a stone slab that is visible on the floor. In the southern part of the chamber a wooden coffin was found, partially covered with debris and dirt. At the stairs, numerous, loose human bones were gathered (mainly long bones and skulls), most likely originating from tidying of the crypts or church surroundings, and dumped directly through the opening in the cloister floor. The crypt was built in the mid-seventeenth or early eighteenth century. The stairs were added in the late nineteenth or early twentieth century.

CLOISTERS:– CRYPT K2 (symbol δ on the Karwacki plan of 1908, N° 43 on the 1922 plan)

The crypt is located in the southern part of the eastern monastery cloister arm, at the intersection with the southern arm. It has a rectangular contour of 540×250 cm, and lies along an east–west axis, with the shorter side attached to the eastern cloister wall (the former Italian chapel) (Fig. 38, 39). Brick longitudinal walls of the crypt are added to a stone-brick eastern wall. In the older eastern wall, broken stone predominates. The crypt's own walls (northern, southern and western), and the barrel vault, are made of finger-marked brick.

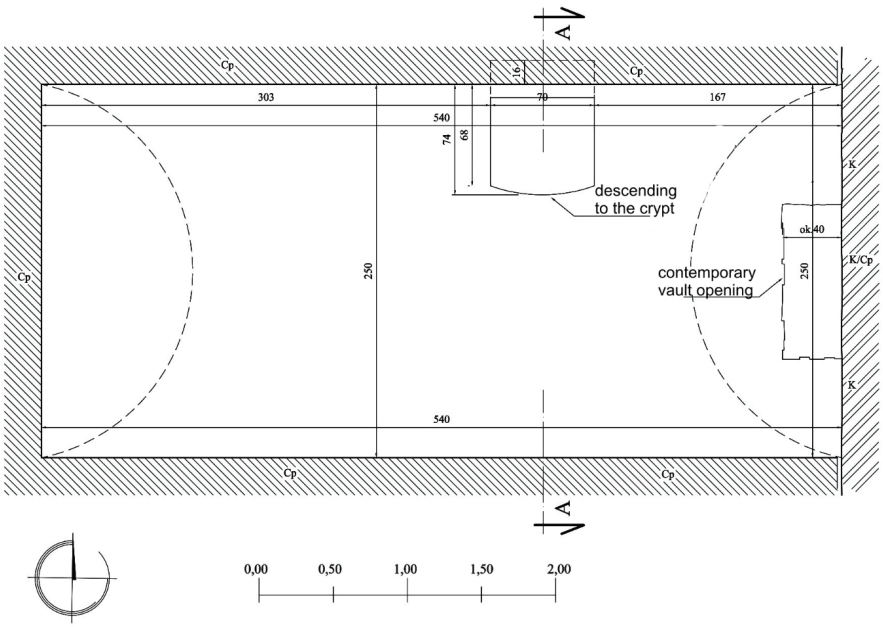

Fig. 38. Architectonic inventory of crypt K2, projection, drawing S. Cechosz, Ł. Holcer

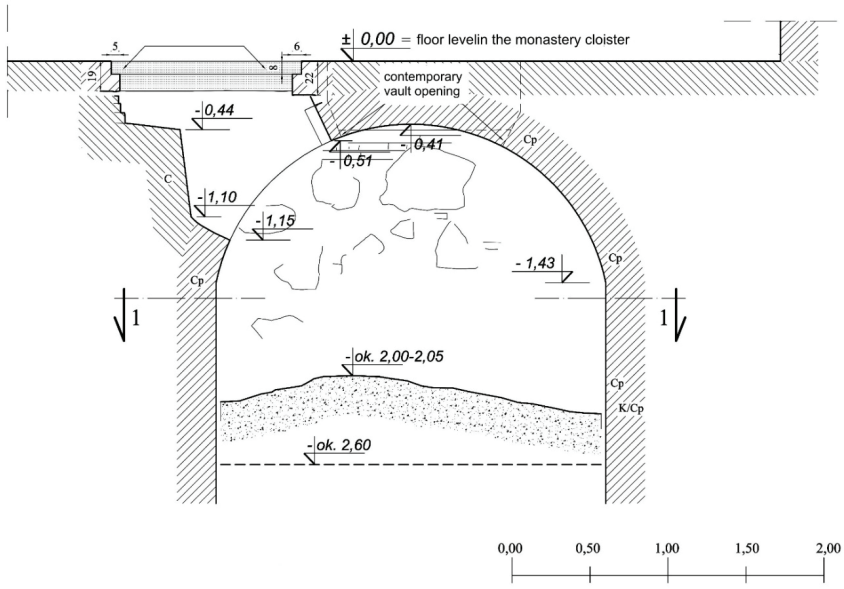

Fig. 39. Architectonic inventory of crypt K2, longitudinal and transversal section, drawing S. Cechosz, Ł. Holcer

The entrance descending to the chamber – steep stairs completely contained within the wall's thickness – was made in the northern wall (along the axis of crypt 1's descending entrance in the cloisters). It was created during the crypt's construction. The opening in the cloister floor is closed by a rectangular stone slab. There is a secondary opening knocked through the vault, at the wall. It is covered by a concrete screed on a boarding (partially preserved).

The original bottom of the crypt was unhardened, and the usage level was formed by a levelled ground bed (yellow sand). Currently, the whole surface of the crypt floor is covered by debris-dirt material of significant thickness. In the western part of the chamber, there are wooden coffins. They contain partially skeletal and partially destroyed human remains. Ten burials are recorded, including of two children. The coffins were most probably removed from other locations. Three coffins bear the dates 1704 (burial 9) and 1707 (burial 5), and the partial date 177? (burial 3). Directly below the entrance opening there was also a deposit of a significant amount of human bones originating from the tidying of other crypts or dirt graves, and dumped directly through the cloister floor opening. They formed a filler cone. Thus an ossuary was formed. According to A. Karwacki, this crypt should contain the remains of Poor Clares nuns. Analysis of clothing revealed that it contains laymen's tombs. Architectural analysis reveals that the crypt was constructed in the eighteenth century and it is possible that one of the walls was reworked in the sixteenth to seventeenth century.

CLOISTERS: CRYPT K3 (not marked on the Karwacki plan of 1908, Nº 48 on the 1922 plan)

The crypt is located beneath the southern wing of the monastery cloister, at the intersection with the western wing, immediately adjacent to the northern wall of the cloister. The vast chamber lies along an east–west axis, on a plan of a 257-cm-wide elongated rectangle. Its total length is impossible to define, since the crypt is in part filled with dirt mixed with a few human bones (Fig. 40, 41).

The longitudinal walls are made of finger-marked brick. The location of the original entrance is unknown, and an *ad-hoc* entrance was made in the vault, from the northern side. The bottom of the crypt was originally left unhardened. Analysis of the bricks and bond of the shield wall determined the times of the crypt origins: the first half of the sixteenth century.

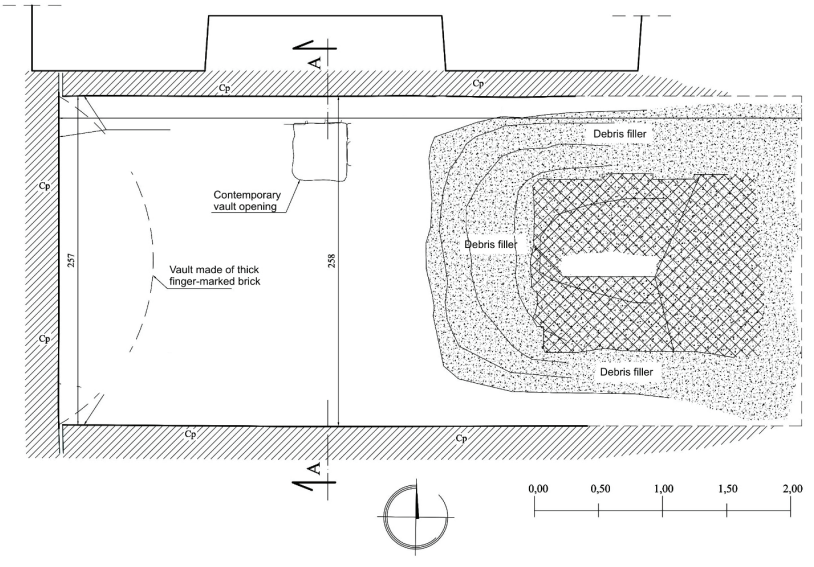

Fig. 40. Architectonic inventory of crypt K3, projection, drawing S. Cechosz, Ł. Holcer

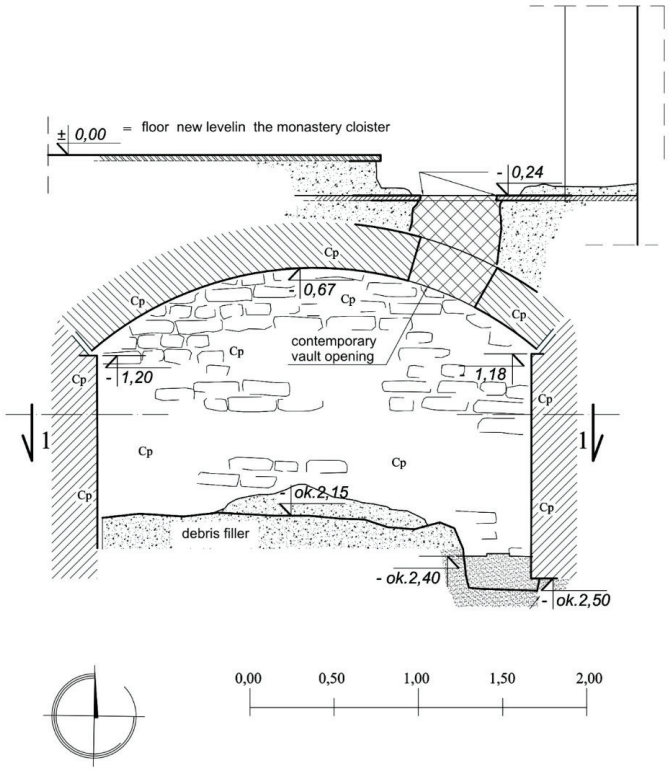

Fig. 41. Architectonic inventory of the crypt, transversal section, drawing S. Cechosz, Ł. Holcer

CLOISTERS:– CRYPT K4 – "A TOMB" (N° 121 on the Karwacki plan of 1908, N° 5/4 on the 1922 plan)

The crypt is located in the northern part of the western cloister, at the intersection with the former southern cloister (currently the chapel of Our Lady of Sorrows). The crypt entrance is currently marked on the floor with a stone slab covering the opening. After lifting the slab it turned out that the crypt was filled with human bones up to the vault and the stairs. Thus, it was used as an ossuary.

Burials from the crypts of the church and monastery cloister: analysis and attempted identification

Anna Drążkowska

During the surveys, thirteen crypts were opened: nine crypts in the church (Fig. 42–48) and four in the monastery cloister (Fig. 49, 50). In twelve crypts, ninety-six burials in ninety-five wooden coffins were found and catalogued. In one case – crypt B9, coffin 11 – the remains of two persons were found in one coffin: a male and a female. Probably the female remains were additionally placed in this coffin when the crypt was tidied. Besides the coffin burials, several crypts contained large bone concentrations in the form of ossuaries, with mixed human remains of adults and children of various ages (Drążkowska 2020, p. 120 –141). The ossuaries were located in the church, beneath the presbytery, in the southern part of crypt B1 (Fig. 42) and in crypts K1, K2 and K4 in the cloisters. In crypt K4 the bones reached the vault. They covered the stairs up to the slab over the entrance.

Fig. 42. Arrangement of burials in crypt B1 beneath the presbytery

The placement of the human remains at the northern side of the cloisters, at the very entrance to the crypt, suggests that they were transported here on barrows and dumped down. They may have been excavated while some earthworks were being performed around the church. The ossuaries contained the remains of about sixty persons in crypt B1, about fifty in crypt K1, and nearly eighty in crypt K2, while in the case of crypt K4 estimates are impossible since, as mentioned above, the bones covered its whole surface and exploration was cancelled. In crypts B1, K1, K2, besides the bones in the ossuaries, coffin burials were also located.

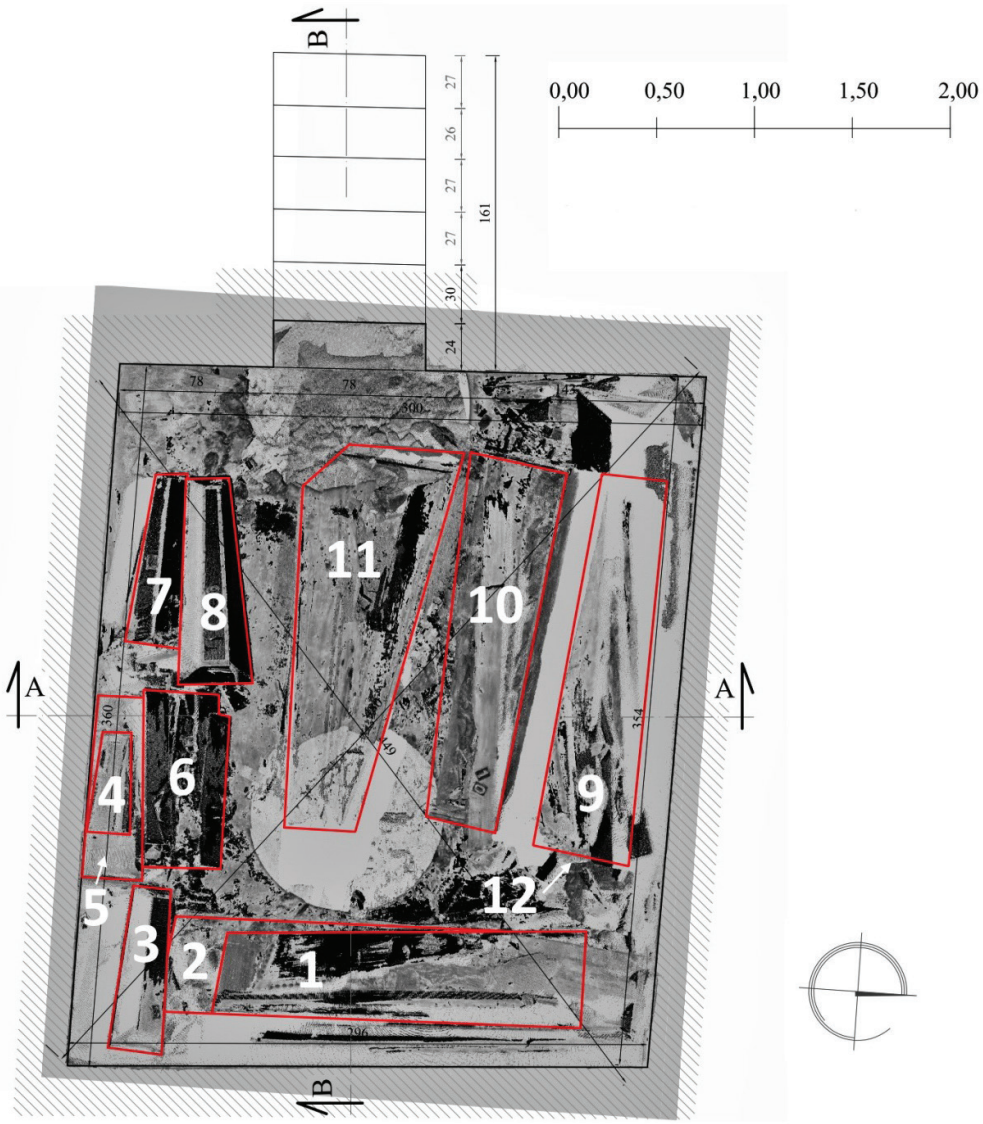

Fig. 43. Arrangement of burials in crypt B2 under the Blessed Salomea chapel

The remains deposited in ossuary piles were in relatively good shape. This suggests that they were initially placed directly in the ground. The coffin burials found in the crypts were much more heavily damaged. Some of the bones were stratified, while others had fragmented under their own weight. Parts of them were heavily decayed or calcified. Such severe degradation resulted from the fact that most of the surveyed crypts lacked ventilation and their entrances were sealed. This caused high humidity levels – from 72% in crypt B3 to 98.2% in crypt B8. The destruction of bone material was also caused by microorganisms: fungi and bacteria.

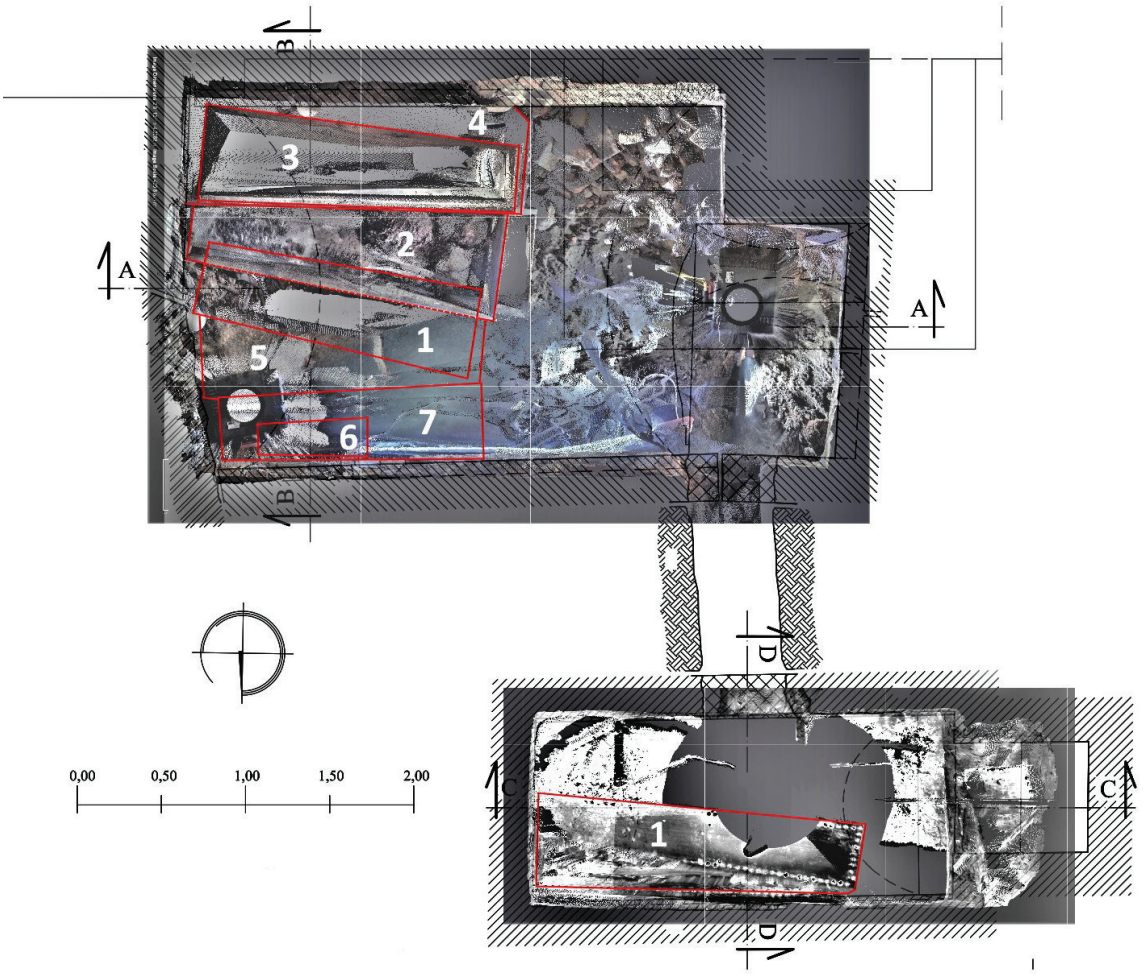

Fig. 44. Arrangement of burials in crypt B3 and B4 under the Chapel of the Passion of Jesus

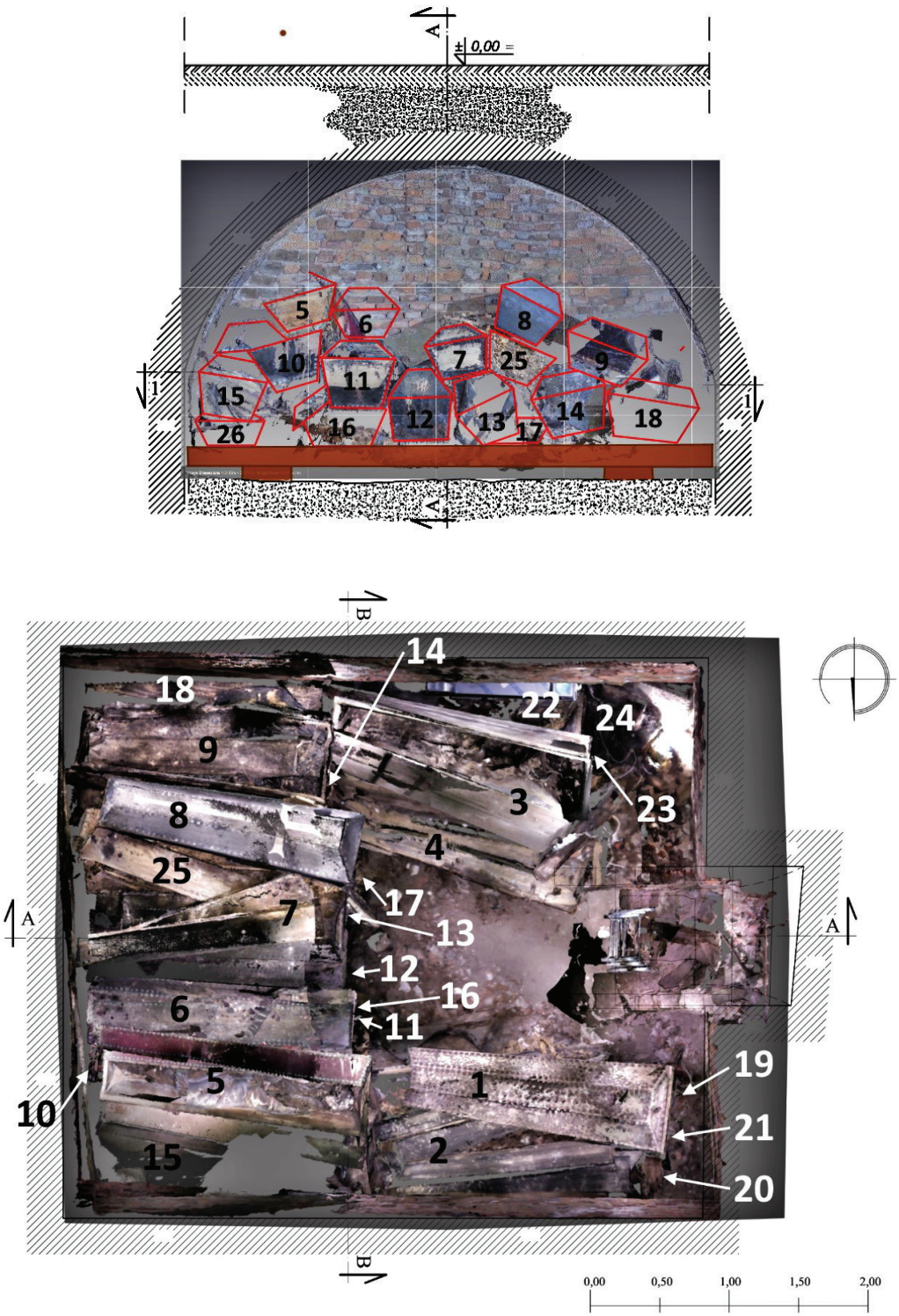

Fig. 45. Arrangement of burials in crypt B5 in the transept

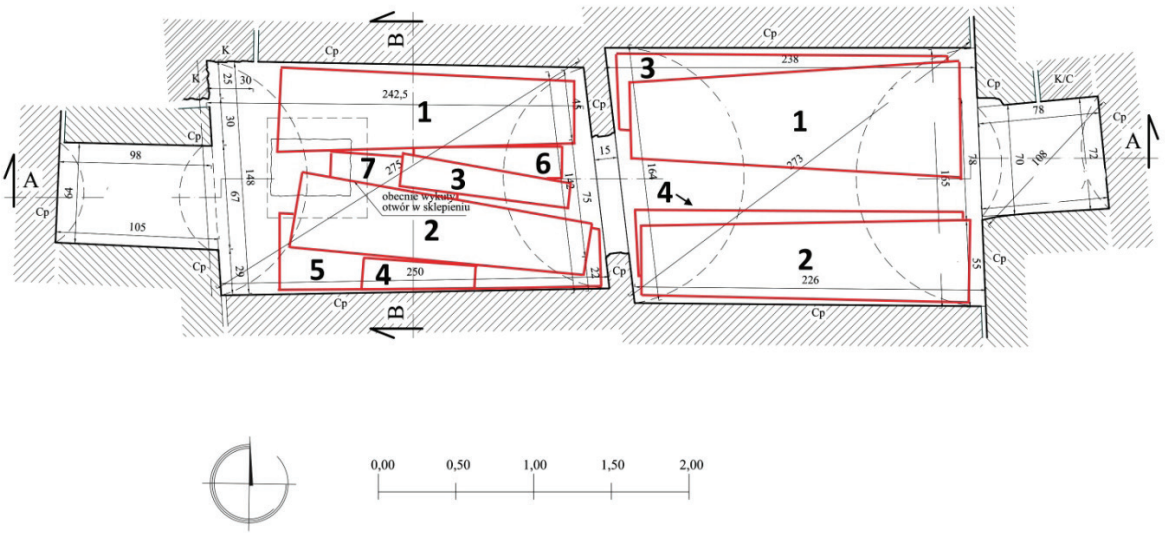

Fig. 46. Arrangement of burials in crypts B6 and B7 in the church's main nave

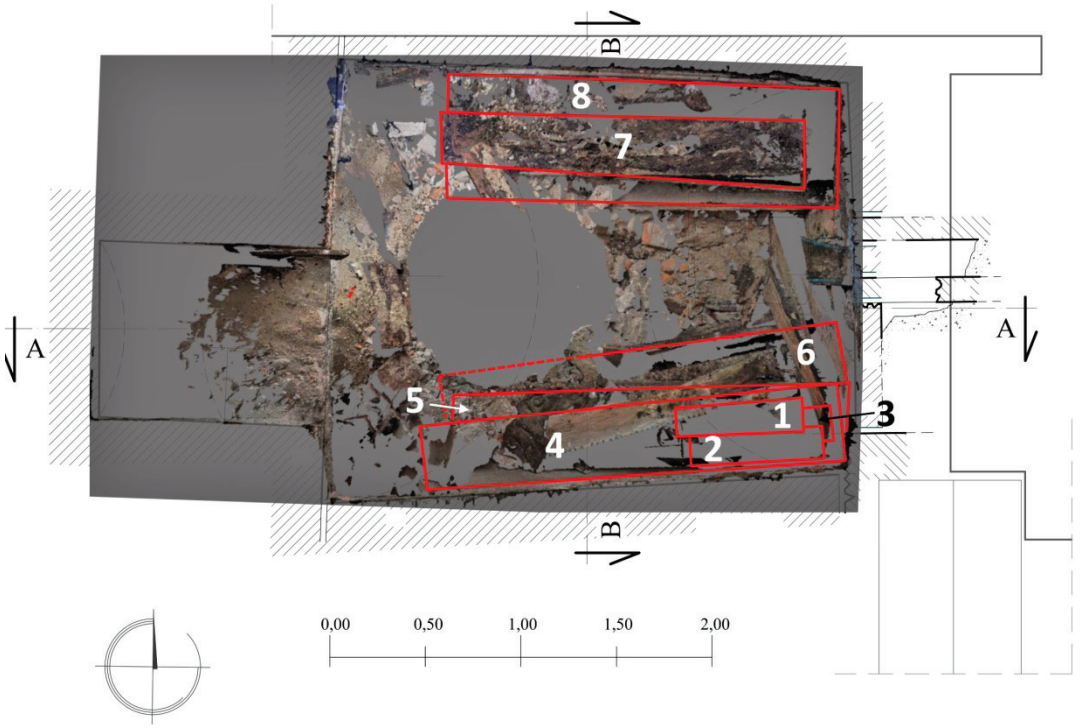

Fig. 47. Arrangement of burials in crypt B8 in the transept, in front of the Blessed Salomea chapel

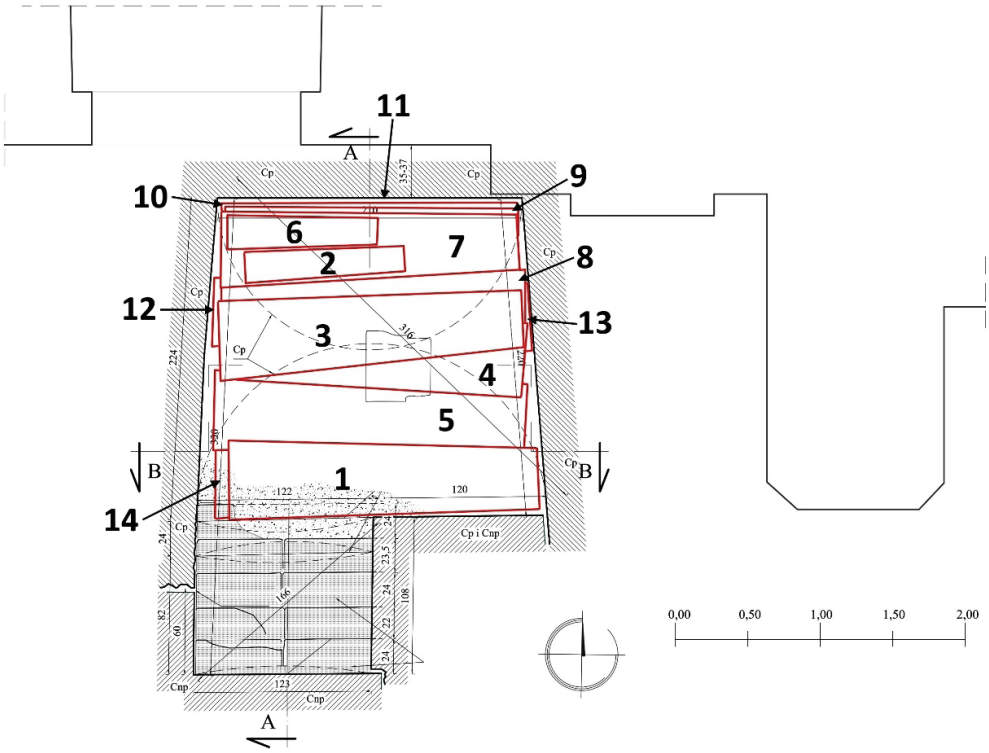

Fig. 48. Arrangement of burials in crypt B9 in the main nave in front of the entrance to the Chapel of the Passion of Jesus

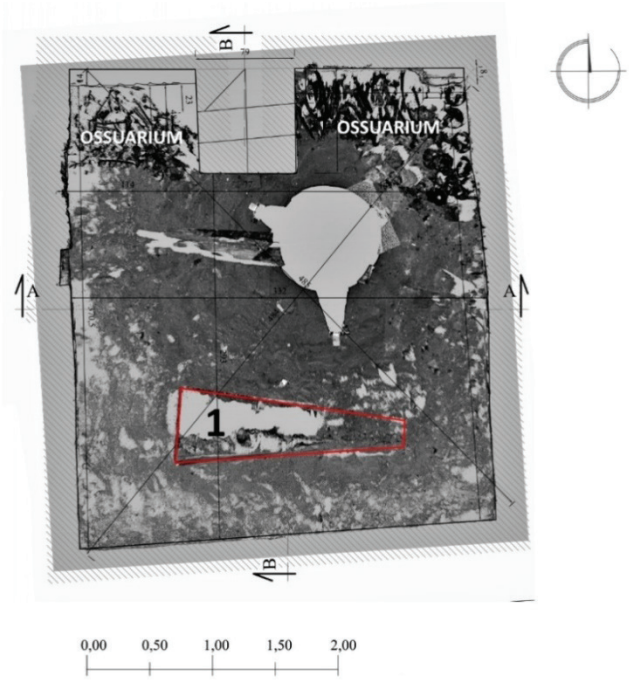

Fig. 49. Arrangement of burials in crypt K1 located in the eastern wing of the cloister

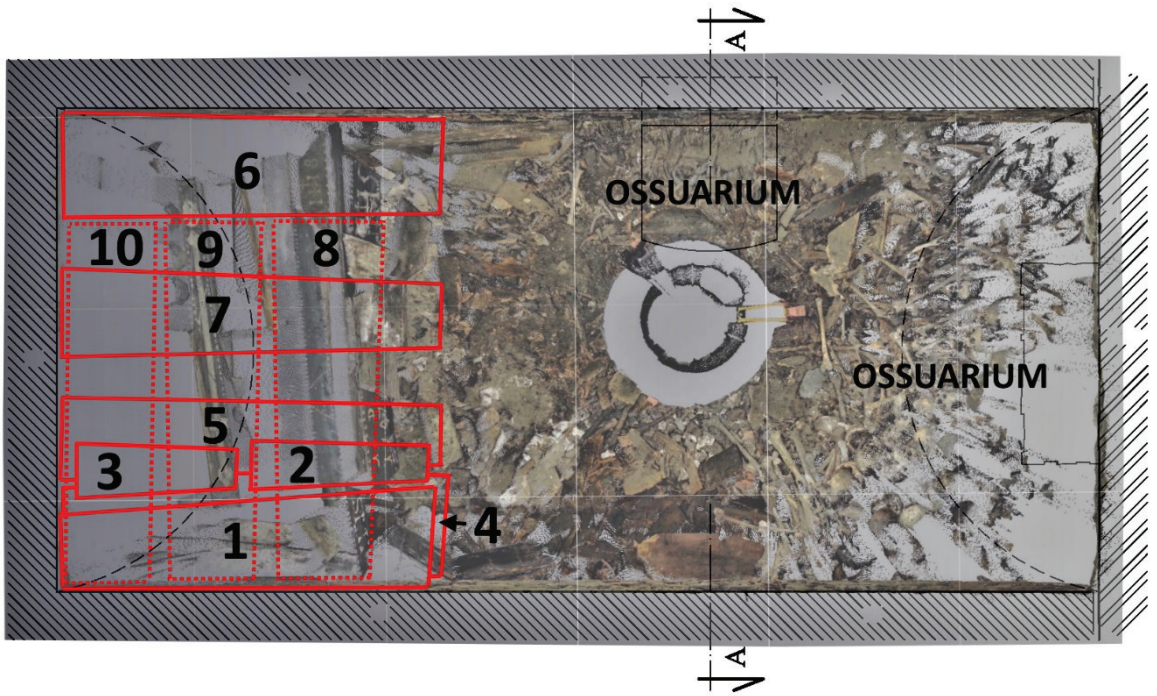

Fig. 50. Arrangement of burials in crypt K2 located in the eastern wing of the cloister

Several skeletons bore fragments of mummified skin: crypt B3/1 (on the hands), crypt B5/3 (on the skull), crypt B5/7 (Fig. 51A), B5/10, B5/19, B5/23, crypt B8/1, crypt B9/1 (Fig. 51B), B9/4, B9/7, B9/14. In two cases (crypt B5/10 and crypt B7/4) it was observed that part of the skeleton had broken apart and the remaining bones were covered by dried skin. Almost all child skeletons were heavily damaged. The skeleton of a newborn, born prematurely in the seventh month, was in surprisingly good shape (crypt B8/1). It is probable that the tight wrapping of the child in swaddling clothes helped to inhibit decay of the delicate bones.

The number of burials in specific crypts was differentiated (Table 1). To a large extent this resulted from the different sizes of the underground chambers. Most contained from a few up to twenty coffins. The largest number of burials (26) was found in crypt B5, located in a very prestigious place in the transept, under the presbytery (Fig. 52). Only one crypt (B4) under the chapel of the Passion of Jesus, contained a single coffin. The analysed set contained numerous heavily damaged skeletons. Thus only some were subjected to detailed anthropological analyses. In the case of the almost complete destruction of human remains, gender identification was made based on the clothing found in the coffins.

Damaged burials of adults without clothing that allowed gender to be distinguished were catalogued as "gender undefined". The studied material included as many as twenty-four such cases. These aside, forty male burials, fourteen female burials and eighteen child burials of *infans* age were classified (Table 1). The majority of the skeletons discovered in the coffins were placed according to the Christian burial rite, in an anatomical, stretched pose on the back, along an east–west axis, with the head pointing to the west (Fig. 51A). In several cases some differences were observed in cardinal orientation of burial. The largest such discrepancy was

Fig. 51. Skeletons with fragments of mummified skin: A) Mummified skin remaining on the hands, purple colour caused by microorganisms, crypt B5 burial 7; B) Mummified monk remains, crypt B9 burial 14, photo M. Łyczak

Fig. 52. Arrangement of burials in crypt B5 in the transept, photo M. Łyczak

observed in crypt B2 under the Blessed Salomea of Poland chapel. Two skeletons of adults were placed in coffins standing along the eastern wall and oriented along a north–south axis, with heads pointing to the south. Child burials located at the southern wall were placed along an east–west axis, with head pointing to the east. The remaining adult burials, placed in the central and northern part of the crypt, were also placed along an east–west axis, whereas their heads were pointing to the west. Peculiarly, in crypt B9 even the men of the church, a priest and a monk (Fig. 51B), had the heads pointing in the same direction as the laymen inside. At other sites, such as the archcathedral of St John the Baptist and the Assumption of Mary in Przemyśl (Drążkowska 2014, p 117), in St Nicolaus church in Gniew and the church of the Name of the Saint Virgin Mary in Szczuczyn (Dudziński et al. 2017, Fig. 1) the clergymen had heads pointing to the east. It does happen that if burials, especially ground ones, lack the inventory typical of clergymen, the placement of the remains helps in identifying clerical burials. The analysed set also included mixed human remains in some coffins. The mixing may have occurred during tidying of the underground chambers and moving or searching of the chests.

Table 1. Number of burials in successive crypts

CRYPT	GENDER	NUMBER	TOTAL
THE CHURCH			
B1	FEMALE	0	
	MALE	6	
	CHILD	0	
	UNDEFINED[a]	0	
	6		
B2	FEMALE	2	
	MALE	4	
	CHILD	6	
	UNDEFINED	0	
	12		
B3	FEMALE	0	
	MALE	5	
	CHILD	1	
	UNDEFINED	1	
	7		
B4	FEMALE	0	
	MALE	0	
	CHILD	0	
	UNDEFINED	1	
	1		

Table 1. Number of burials in successive crypts (continue)

CRYPT	GENDER	NUMBER	TOTAL
B5	FEMALE	6	
	MALE	13	
	CHILD	1	
	UNDEFINED	6	
	26		
B6	FEMALE	1	
	MALE	0	
	CHILD	3	
	UNDEFINED	2	
	6		
B7	FEMALE	1	
	MALE	2	
	CHILD	0	
	UNDEFINED	1	
	4		
B8	FEMALE	0	
	MALE	2	
	CHILD	3	
	UNDEFINED	3	
	8		
B9	FEMALE	4	
	MALE	5	
	CHILD	2	
	UNDEFINED	4	
	15[b]		
THE CLOISTERS			
K1	FEMALE	0	
	MALE	0	
	CHILD	0	
	UNDEFINED	1	
	1		
K2	FEMALE	0	
	MALE	3	
	CHILD	2	
	UNDEFINED	5	
	10		
TOTAL 96[c]			

[a] The category of undefined gender included burials of adults that were highly damaged, making identification impossible.

[b] One of the burials in this crypt (B9\11) is double. In coffin 11 two skeletons – male and female – were found.

[c] The final result of the table shows that 96 persons were buried in the crypts in coffins. Only 95 coffins were catalogued and the difference results from the fact that in crypt B9 coffin 11, two persons were buried.

The anatomical layout of the skeletons suggests that the corpses were placed in the coffins in a stretched position on their backs, with head straight. Such a head position was aided by a pillow on the bottom of the chest. In several cases, especially in the cases of burials with remains of mummified skin, the head was slightly turned rightwards (crypt B5/7, B5/11, B5/13, B9/12, B9/13) or leftwards (crypt B3/1, B3/4, B5/2, B5/3, B5/10, B9/14, B5/18, B5/19, K2/4). The heads may have been repositioned due to exportation to the crypt or to the body decaying, or the drying of tendons and skin. In most of the studied cases, where skeletons retained the anatomical layout, the upper limbs were placed along the body (crypt B2/11, B3/2, B3/3, B5/2, B5/10, B9/11) or were slightly bent at the elbows, with palms placed on the pelvis. The hands were placed freely or lightly crossed, with intertwined fingers (crypt B2/1, B2/2, B2/9, B5/19, B9/14). In some cases they were also crossed and placed straight, one on top of the other (crypt B7/4, B8/5).

In an attempt to identify the persons buried in the crypts, analyses were carried out at several levels, considering various degrees of detail as the available sources allowed. First, information placed on the coffins was used. Only in two cases did the ends of the coffins bear the first and last name of the buried person. Under the presbytery in crypt B1, in coffin 2 the remains of the guardian Teofil Nowakowski were found, while in crypt B3, coffin 2 under the Passion of Jesus chapel, the remains of a son of Poznań, Voivode, (Woiewodziwic[a] Poznaski[ego]" Fran.[ciszka] Bentkowskiego) deceased in 1789 were found. Thirty-two coffins had painted or nailed symbols, such as initials, dates and coats of arms (crypt B2/1 – Leliwa coat of arms, B3/2 – Ostoja coat of arms, B6/1 B6/5 – possibly Odyniec, B8/1 – Jastrzębiec, B9/13 – possibly Sas).

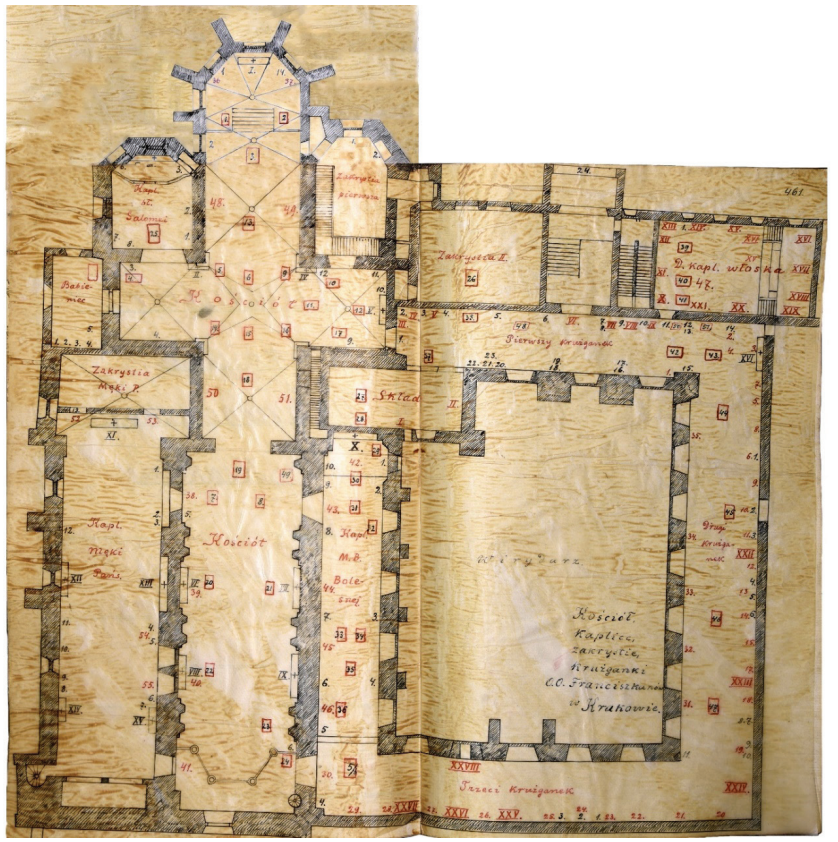

Fig. 53. Plan by Father A. Karwacki of 1922, with "tombs" marked

This suggests that the mentioned locations belong to nobility. Only in one case was it possible to identify a person based on initials placed on the coffin. In crypt B9, coffin 1 contained the remains of a priest, Wincenty Wyszkowski (initials XWW on the coffin). Available written sources were used for identification of the dead, and these were compared against the archaeological sources. Memoirs and plans by Father Alojzy Karwacki (Karwacki 1908) were used for comparative analysis. He guides us around the church, telling us about the crypts present at that time.[9] His reports seem to be true, since he apparently penetrated some of the crypts. Further detailed information about the crypts and the burials inside them are provided by the Inventory of the Franciscan Order in Cracow and another church plan, with marked memorials and tombs[10] made in 1922 by father Alojzy Karwacki (Fig. 53, 54).

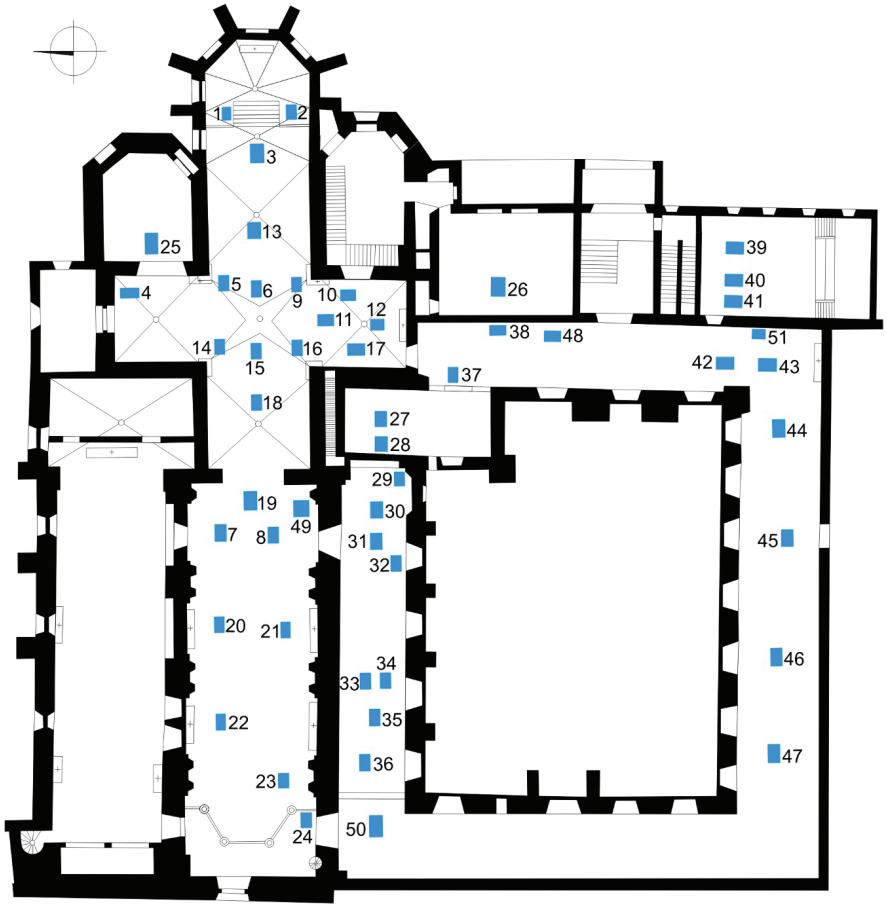

Fig. 54. Redrawing of plan by Father A. Karwacki of 1922, with "tombs" marked

[9] Father A. Karwacki described successive tombs, based also on earlier documents found in the Franciscan archive, including INVENTARIUM ECCLESIAE CRACOVIENSIS ORDINIS MINORUM S. P. FRANCISCI CONVENTUALIUM PER R.P.B. VINCENTIUM A PAULO WYSZKOWSKI CONSCRIPTUM A. DNI 1792 R. (AKF, sign. AK–IV–3, p. 1 –213).

[10] Father A. Karwacki created two hand-drawn plans that marked tombs and burials, with numbers. In a few cases the same tombs are marked with a different number on each of the plans.

Information included in the Inventory by Father Karwacki and on another plan of his from 1922 was correlated with crypts discovered during the archaeological survey. This allowed an attempt to identify the dead. In some cases it was possible to identify their families with high probability.

They have been complied in the table below for clarification (Table 2).

Table 2. Compilation of crypts from archaeological survey with the information from the plan and inventory of 1922 by Father A. Karwacki

CRYPTS SURVEYED ARCHAEOLOGICALLY	N^{O} FROM THE PLAN	CRYPT DATE FROM INVENTORY AND PLAN BY FATHER A. KARWACKI OF 1922
THE CHURCH		
Crypt B1	1,2,3	1. Tomb of provincial superiors 2. In the presbytery – tomb of older Brothers 3. In the presbytery – tomb of Brothers, but buried in coffins
Crypt B2	25	25. In the chapel of Blessed Salomea of Poland – Zborowski family tomb
Crypt B3		Not marked on the plan
Crypt B4		Not marked on the plan
Crypt B5	15	15. Przyłęcki family tomb
Crypt B6	22	22. Gielc family tomb
Crypt B7	20	20. Main nave – to the left, tomb of 1792, unknown
Crypt B8	4	4. Brzechwa tomb
Crypt B9	7	7. Main nave – at the door leading to the Chapel of the Passion of Jesus, Bełchacki family tomb
THE CLOISTERS		
Crypt K1	42	
Crypt K2	43	43. Poor Clares tomb
Crypt K3	48	46–47. unknown
Crypt K4	5/4	

On the plan of 1922 no crypts were marked in the Chapel of the Passion of Jesus. It is the only such space within the church. Ground penetrating radar survey, boreholes and archaeological survey (B3 and B4) revealed that there were also burials under the floor of this chapel. It was revealed that in crypt B3 four members of the Archconfraternity of Good Death and a small child were buried. Besides the mentioned crypts (B3, B4), at least two more underground chambers were located beneath the floor. We do not know who was buried there.

Part of the information derived from the memoirs of Father A. Karwacki and the aforementioned inventory was confirmed by archaeological survey. In crypt B1 there were indeed monk burials. Crypts B2, B6, B7, B8, B9 contained remains of laymen and children. These might be whole families. Crypt B5 contained as many as twenty-six persons. It is difficult to state whether or not they belonged to a single family. An underground space limited with brick vault and walls, and marked by archaeologists as B9, is worth mentioning. Besides laymen burials, it

contained a body in liturgical robes (probably of Wincenty Wyszkowski, convent definitor) and a person in Franciscan order habit. In K2 crypt, located in the eastern cloister arm none of the Poor Clares burials mentioned by Father A. Karwacki were confirmed. The crypt contained layman and child burials.

The plans of 1908 and 1922 were also used for identification of the underground empty spaces surveyed with non-invasive methods (ground penetrating radar and endoscopic camera). In the main nave, two empty spaces were located and surveyed non-invasively. They were located in the vicinity of tombs marked on the 1922 plan as 21 ([*Main nave*] *There – to the right, Pacek tomb)* and 23 ([*Main nave*] *There – to the right, in 1792 unknown tomb*). In the chapel of Our Lady of Sorrows it was possible to locate three crypts, appearing in the vicinity of tombs marked on the aforementioned plan as 30\31, 32 and 34 (*tomb with coffins, of unknowns*). In the transept only one crypt was found, with the use of boreholes. It was close to tomb 9 as marked on the drawing – a tomb that was supposed to be located *in the middle of the church cross – as a joint Dobrodziej family Tomb, next to the altar of the Holy Virgin, but no mark visible* (Karwacki 1922, p. 543 –545).

Ornamentation of 17th- and 18th-century coffins: forms and methods

Anna Drążkowska

During the survey, ninety-five coffins were recorded. All the dead were buried in the crypts beneath the church and cloister floors. The remains were arranged anatomically. They were placed in wooden coffins consisting of a bottom chest and its upper cover (Drążkowska 2020a, p. 142––178). The bottom was usually made of a single, thick and wide plank narrowing towards the feet, or of two joined planks. The chest was formed by two long planks attached to the bottom, and two short planks constituting the front of the coffin at the head end, and a smaller one at the feet. The thickness of the planks in coffins was between 2.4 and 3.5 cm for adults, and between 1.8 and 3 cm for children. Most of the coffins were made of pine wood. Only a small percentage was made of deciduous wood. Most of the analysed coffins had side walls resting on the base plank, whose edges were flush with the side walls. In some cases (crypt B2/ 4, B2/7, crypt B3/1, crypt 5B/3, crypt B9/1, B9/14) the bottom had rounded or slightly profiled edges, and protruded beyond of the plane of the sides. The end sides of all discovered coffins were inverted trapezoids or something approximating this. They did, however, differ in the profiling of the edges and the angle at which the side walls opened outwards, away from the vertical. Most of the chests had widely splayed sides. Within the analysed set, these might belong to the older, seventeenth-century forms. Only one child coffin, N° 4 from crypt 2 under the chapel of Salomea of Poland and originating from the eighteenth century, was of a clearly different shape than the other chests. It resembled a cup. This effect was achieved by the narrowing of the coffin front half way up and the semicircular profiling of the edges. Within the analysed set only two coffins (B2/2, B5/17) had a flat cover with an oval opening cut above the person's face (Fig. 55). One of the coffins, N° 2, was placed in crypt B2 under the chapel of the Blessed Salomea. In this case a glass window was made in the flat cover of an internal chest placed within a larger, external chest. The planks were covered with black, woollen fabric and the shape of the window was outlined with large iron studs. The second chest with a flat cover (N° 17, crypt B5) had an opening cut and prepared for glazing, but it was closed with wood, tightly fitted within the round space and later covered with black silk velvet. It is possible that the family of the deceased did not want to look inside the coffin through the glass and the carpenter easily covered the window. Coffins with glazed openings are found in various crypts, but still they are not common. Single specimens are found in the archcathedral of Saint Johns

in Lublin (Niedźwiadek 2012, p. 122; Niedźwiadek, Drążkowska et al. 2015, p. 35) and in the archcathedral of Saint John the Baptist in Warsaw (Niedzwiadek, Drążkowska et al. 2015, p. 66). A glazed opening was also found on the cover of dugout coffin from the Jasna Góra Basilica (Młodkowska-Przepiórowska, Przepiórowski 2013, p. 53–74).

The ends of a coffin had an important function. On these parts inscriptions were placed, such as initials and dates, as well as decorations and coffin portraits.

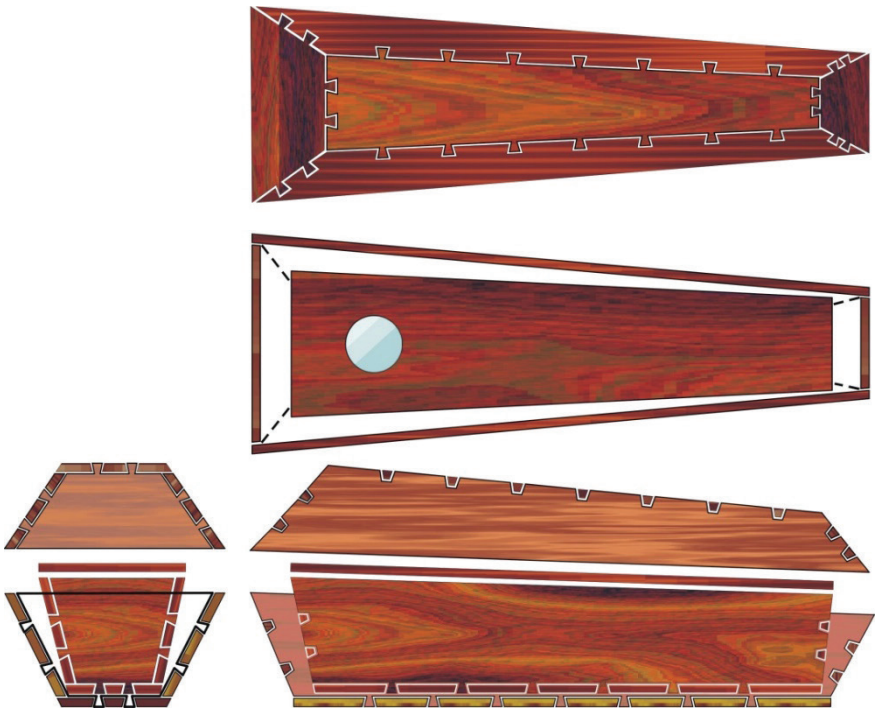

Fig. 55. Structure of the double coffin, crypt B2 burial 2, drawing by R. Niedźwiadek

Coffins resting on a catafalque displayed this end face to the attendants at the funeral ceremony. During funerals of laymen the chest was arranged with its shorter, long tapering end (and the deceased's feet) pointing towards the altar (Nowiński SDB 2000, p. 45; Drążkowska 2014, p. 298). In the majority of the discovered coffins the planks are connected with wooden, oval pins (crypt B2/11). Only in three cases was a dovetail joint used (crypt B2/2, crypt B9/11, B9/13). This method of joinery was much more difficult to perform on planks and required of the carpenter far more skill and experience; it was also more time consuming. This might be why it was less popular. The top of one such coffin was marked with the date 1667 in studs (crypt B9/13). Almost all discovered chests had their covers rested in place without any fixing elements. This seems surprising since it made transporting the coffins, especially carrying them down into the crypts, difficult. While being moved through narrow openings and down stairs, the coffins would have had to be tilted to the side or placed at various angles. There was a risk that an unfixed cover might slide off. Only a few coffins had covers fixed with pins or lamellae (crypt K2/10, Fig. 56A; crypt B5/5, crypt B6/4, Fig. 56B; crypt B8/4, B8/8). Two chests had the cover nailed with forged iron nails (crypt B6/5, crypt B9/1).

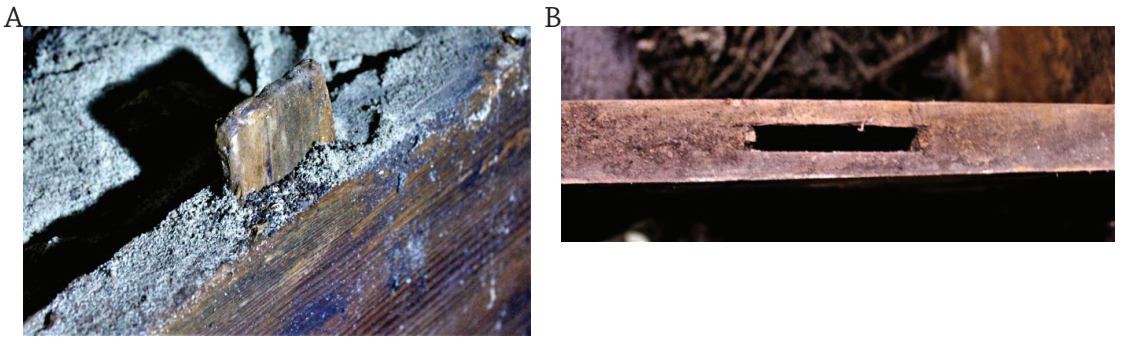

Fig. 56. Methods of coffin closing: A) Lamella, connecting the cover and the chest, crypt K2 burial 10; B) Opening cut in the cover as a setting for a lamella, crypt B6 burial, photo M. Łyczak

The coffins discovered during the survey presented various states of preservation, depending on multiple factors. Most of the surveyed crypts lacked ventilation. This was significant and caused higher humidity levels, leading to the decaying of planks. They lost resistance against mechanical factors and broke apart under their own weight. The lower chests were most exposed to damage, especially their bottoms, which absorbed liquid substances produced by the decomposition of bodies (Drążkowska 2014, p. 297). Destructive processes were more rapid in cases of coffins placed directly, flat on the floor. The dripping was then unable to flow away freely and the coffins would stand on a moist substrate for a long time. For instance, this situation was recorded in crypt 2 under the Blessed Salomea chapel. Most of the surveyed crypts did not have flooring and chests containing bodies were placed directly on the sand. This absorbed the liquids dripping from the coffins. This situation was recorded in the church, in crypts B1, B3, B6, B7, B8 and B9, as well as in the cloisters, in crypts K1 and K2. In a few cases it could be seen that an attempt had been made to separate the planks from the moist substrate by raising them. For this purpose the coffins were placed on wooden ground beams (crypt B5), or on iron slabs fixed in the walls of crypt B4 under the chapel of the Passion of Jesus. A single coffin was placed on them. This allowed the chest to be suspended about sixty centimetres above the ground. In crypt B5 some of the coffins located along the eastern wall were placed on wooden ground beams, one on top of another, forming a few layers. This allowed the coffins placed directly on the ground beams to be suspended above the ground at a height of about forty centimetres. The chests along the northern and southern wall were placed on sand. This arrangement created the impression that they had been placed as additional ones, making use of the free space next to the walls.

The condition of the coffins in the discussed crypts was also influenced by their placement. The lowest coffins, on which subsequent chests were placed, were the most damaged. The covers were broken and the planks were crushed under the weight of the upper coffins.

A

B

Fig. 57. Interior of a coffin cover sealed with tar and tightly woven linen adhered in the place of plank connection, A) crypt B5/7; B) B7\1, photo M. Łyczak

This was especially visible in crypt B5 mentioned above. In some cases the chests placed directly on the sandy ground were partially sunken into it (crypt B3, B6, B7, B8, B9). Of the analysed coffins, some were sealed with tar. This substance was observed on seventeen upholstered coffins (crypt B2/2 double, B2/9, B2/12, crypt B5/9, B5/10, B5/14, B5/15, B5/17, B5/18, B5/19, B5/20, crypt B6/1, crypt B7/1, crypt B8/7, crypt B9/13, crypt K2/2) and on only one painted chest (crypt B5/20) and one undecorated inner chest (crypt B2/9). In most cases the adhesive substance was used only for sealing gaps between connected planks. Inside some

of the coffins, bands of tightly woven, impregnated linen had been adhered (Fig. 57). This was an additional protection against the dripping of the liquid substances produced during the decomposition of bodies (crypt B5/14, B7/1, B8/7, K2/2). This method was used mainly for protecting chest edges, especially where the side walls were attached to the bottom. In some cases, however, coffin covers were also sealed. This may indicate the intent to seal in not only the liquid substances, but also the odour of the decomposing corpse within.

Tar also had biocidal properties. In crypt B7, coffin 1 was covered with adhered fragments of linen of various density. We do not know if this was an intentional application for better sealing or whether the fabrics were chosen incidentally, based on their availability (Fig. 57). The coffins were usually sealed on the inside, but were sometimes painted with tar on the outer side. Some of the analysed coffins were painted with tar in their entirety (crypt B2/2, B2/9, B5/12) and whole planks were covered with adhered flax linen. Tar was usually applied to the outside of coffins once the dressed corpses were already inside. This is evidenced by lines of dark or black spots, assumed to be tar, along the clothes in places that correspond to gaps that had been tarred closed between planks of the chest. The tar must have leaked in some places before it solidified on the surface of the planks. The stains are so heavy that it was impossible to remove them during preservation works. The use of tar for chest sealing can be observed at various sites. But this practice has not always been common. Within large sets, usually a few or a few dozen chests were secured in this way. Tar was applied in the Przemyśl archcathedral of John the Baptist and the Assumption of Mary, on the bottoms of the coffins containing bishop Walenty Wężyk, Hieronim Wielogłowski and Franciszek Szembek (Drążkowska 2014, p. 303). The chest containing the body of Franciszek Szembek was sealed along the gaps from the inside and outside, as well as on the cover. A coffin completely covered on the outside is also located in the so-called gothic crypt of the John the Baptist cathedral in Warsaw (Drążkowska 2014a). This method of securing the coffin was usually applied if the body was transported from a distant location to its final resting place. Another way was to place the body in two coffins: a smaller internal one and a larger external one. In crypt 2 under the chapel of the Blessed Salomea, two adult burials were found in double coffins (crypt B2/2, B2/9). In the first double coffin (burial 2) a male body was placed. The internal chest, with woollen upholstery, was sealed with tar along the edges, and the bottom was covered with mineral filler. The outer coffin was completely covered with tar, with adhered thick fabric of linen weave. In another chest (burial 9) a female body was placed. The internal coffin without decorations was sealed with tar from the inside. The outer coffin was completely covered with tar on the outside. It had a thick fabric of linen weave adhered and silk velvet was applied.

Certainly double wooden coffins were more suitable for corpse transportation. They were especially practical in summer, and sealing each one with tar helped contain liquids inside and inhibited the unrestrained spread of odour. Despite this fact, such coffins were rarely found in the crypts. A double coffin was used for the burial of bishop Andrzej Pruski in the Przemyśl archcathedral (Drążkowska 2014, p. 201). Use of such coffins is also proven by information in written sources (Kizik 1998, p. 97). Wooden chests were additionaly secured against the leaking of liquid substances by filling them with a mineral filler – a mixture of loess and lime. This was intended to absorb liquids (Niedźwiadek et al. 2015, p. 28). On such a substrate a pillow and mattress were placed. Within the analysed set, mineral filler was discovered in three coffins from crypt B5/12, B5/20 and crypt B2/2. It is relatively uncommon. Its appearance has been confirmed in a small number of coffins, including ones at St Johns cathedral in Lublin (Niedźwiadek et al. 2015, p. 28). More often the bottoms were covered with a thick layer of

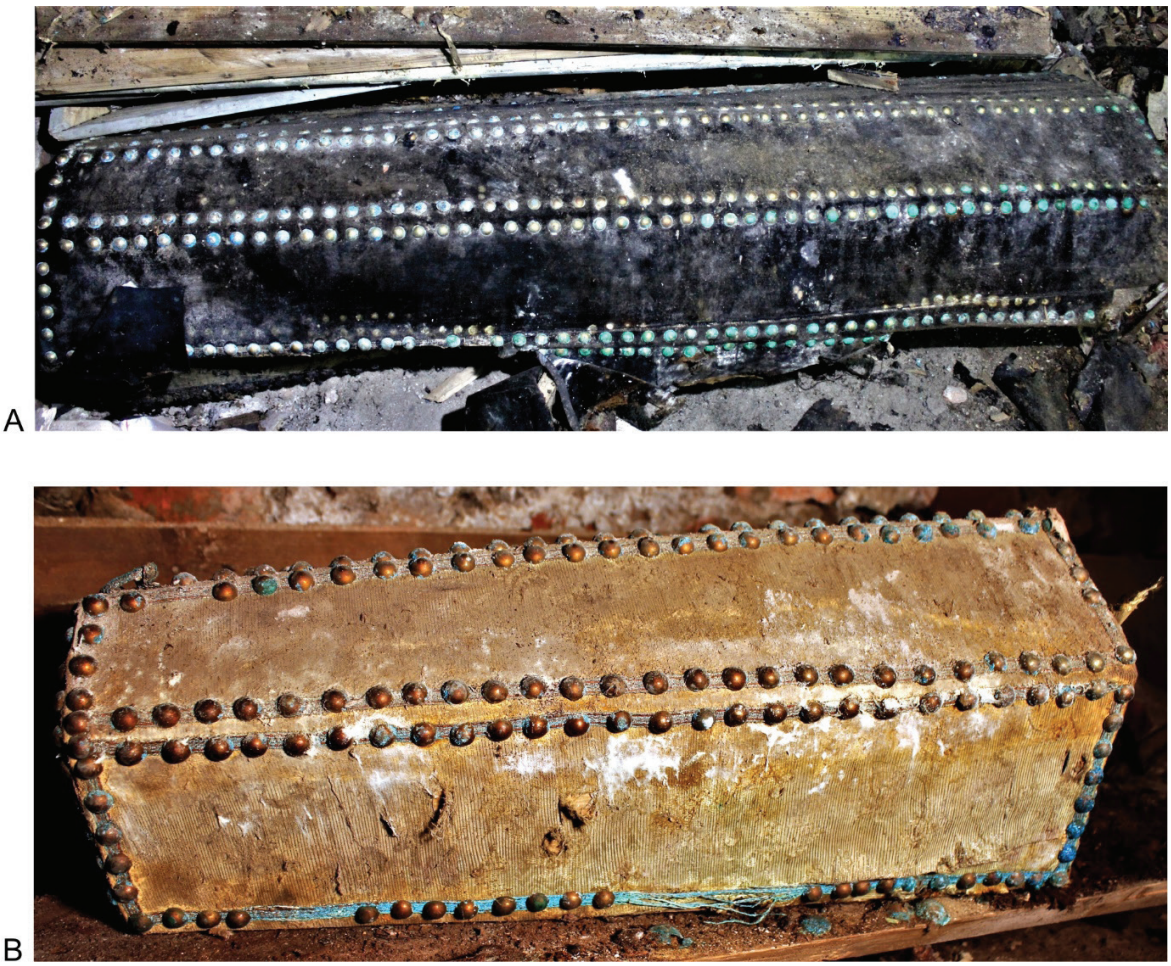

Fig. 58. Upholstered coffins: A) large coffin covered with black velvet, with double rows of metal studs along the edges, crypt B5 burial 1; B) child coffin, upholstered with silk damask, crypt B8 burial 1, photo M. Łyczak

wood shavings from the planing of the planks the coffin was made of. In the Cracow church where the survey was performed, shavings were placed in ten chests located in crypts B5 (B5/23, B5/25, B5/26), B9 (B9/1, B9b/4, B9/5, B9/6, B9/7, B9/8, and in crypt K2 in the cloisters (K2/2). Lime was observed on the bottom of only one coffin (crypt B2/12). Plant remains placed directly on the bottom or filling the mattress are considerably more frequent finds in the coffins.[11] Of the analysed coffins most were ornamented by upholstery (Fig. 58–62) or painting (Fig. 63–66). As many as fifty-five chests were covered with fabric. Most of the textile-covered coffins were placed in crypt B5, located in the church. Of the twenty-six coffins found there, as many as sixteen were ornamented with fabrics. In crypt B2 under the chapel of Blessed Salomea almost all (thirteen out of fourteen) were upholstered. A similar situation was found in crypt B8, where, of eight chests, as many as seven had planks covered with textile. In crypt B7 all coffins were upholstered. Most of the analysed coffins were covered only on the outside (45), while nine coffins were covered on both sides. Thirty-one were covered with

[11] Detailed information is presented in the chapter about palaeobotanics.

silk fabrics, twenty-six with woollen fabrics, and with flax linen in only seven cases. Among the silks, the upholstery material includes: velvet, smooth taffeta, satin, damask, and textile with golden thread. Most of the fabrics were black (38). Currently, thirteen fabrics are ochre-coloured, five are white and three are red. Ochre-coloured silks were used mainly for covering chests containing children (crypt B2 and crypt B8, crypt K2). Only in one case was a light, yellow-tinted fabric used for the decoration of an adult (crypt B8/5). It is impossible to define the gender, because the skeleton is heavily damaged. We can only hypothesise that it was a young woman. Within the analysed set the coffins for men and women were usually black. One male was buried in a red-covered coffin (crypt B5\5). A priest buried in crypt B9, in the main nave in front of the entrance to the chapel of the Passion of Jesus, was buried in a chest covered with silk velvet which is currently red, but may originally have been amaranth (crypt B9/1).

The colours of covering cloths were not chosen randomly. They had symbolical meaning. Black expressed sadness and mourning – deep grief after losing a close relative. The whitest hues, pale yellow or ecru were reserved for children, and for young women and young men who had not managed to marry (Drążkowska 2014, p. 312; Niedźwiadek et al. 2015, p. 67). Red-tinted chests were prepared mainly for important public officials and people fighting for the country. To be buried in such a coffin was a part of the last will of Stanisław Żółkiewski: "instead of black velvet, that means mourning, let [his] coffin be covered with scarlet, as a sign of blood spilled for the country, not for any fame, but for encouragement to virtue" (Łoziński 1978, p. 216). Amaranth-tinted fabrics were used to ornament bishop's coffins (Drążkowska 2014, p. 295–316). Almost all of the coffins from the analysed set had the lower chest and the cover covered separately with fabrics. Only in two cases were they covered together, with one piece of fabric. A child coffin (crypt B8/1) was wrapped with aureate fabric, and male remains found in crypt B5 were covered with black silk velvet (crypta B5/14). They looked as if somebody has wrapped them in "precious" expensive fabrics fitted with studs. The cover was thus fixed and could not be lifted without cutting the fabric. For to this reason, some curious person who once visited the crypt made a hole in the head end of the coffin to look inside.

Silks, especially thick velvet and satin, are the best preserved materials on the planks. Woollen and flax textiles usually remain only as small fragments. In the case of child coffins, the same textile was used for covering the outside of planks and for the inside of the chest. Most of the adult coffins had no fabrics of the same colour on both sides. For instance, one of the chests in crypt B5 was covered with black velvet on the outside, while internal walls were covered with smooth ochre silk (crypt B5/17). Similarly, in crypt B9 in coffin 7, which contains probably female remains, the outer side of the planks was covered with ochre silk, while the inner side was covered with white linen. Only one chest was covered on both inside and outside with black woollen fabric (crypt B9/13).

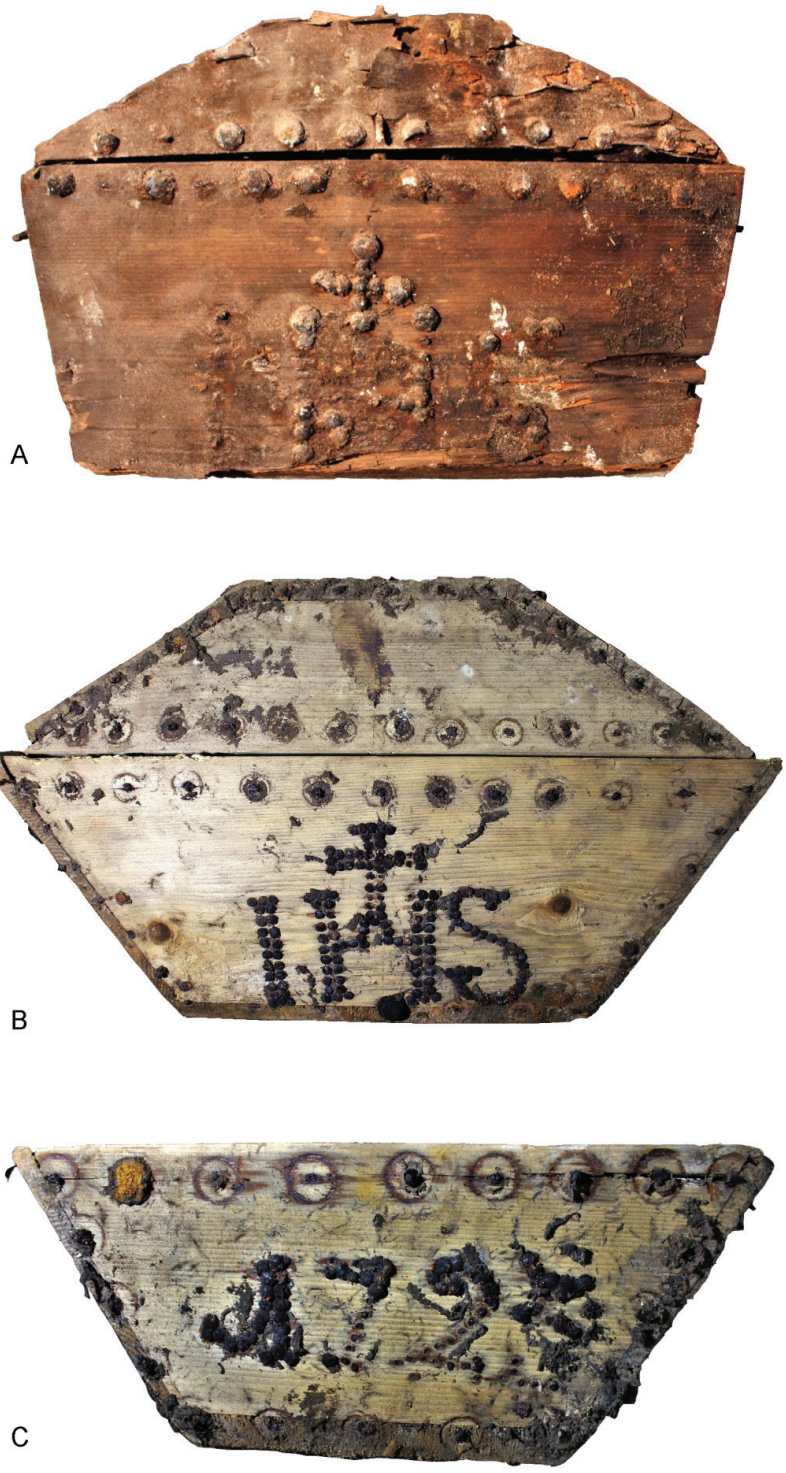

Fig. 59. Upholstered coffins: A) crypt B6 burial 5; B, C) crypt B5 burial 6, photo M. Łyczak

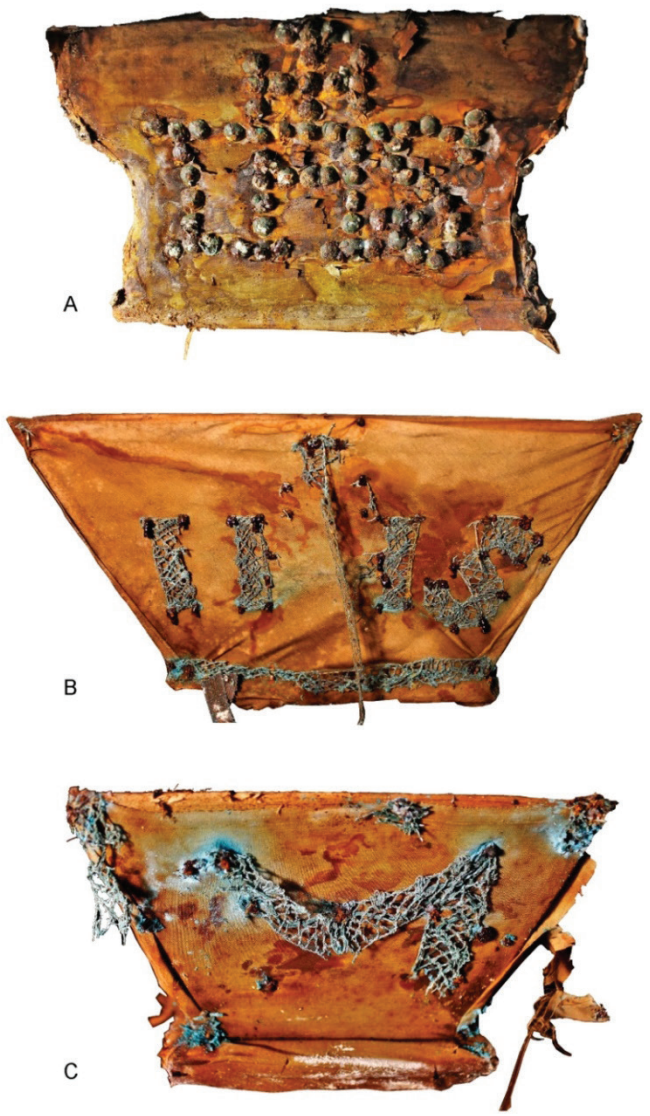

Fig. 60. Upholstered coffins from crypt B2: A) burial 4; B, C) burial 7, photo M. Łyczak

Upholstered coffins were more expensive, since textiles were costly, and especially silks. The cost of upholstery studs and sometimes also trimmings had to be added. Ornamenting a coffin in such a way was more time consuming. Placing fabric inside the coffin made it even more expensive. Still, these aesthetic improvements to the interior brightened the confined space containing the corpse. This deepened the atmosphere of occasion. Two child coffins from crypt B2 were covered with silk velvet and the burial clothes for the children were made of the same material (crypt B2/7, B2/5). This situation appears also in adult burials, where the corpses are dressed in expendable clothes made especially for the funeral ceremony. For instance, in the Przemyśl archcathedral a child coffin was covered with striped silk that was also used for the dress and the pillow (Drążkowska 2014, p. 312). Within the discussed set, iron and brass studs of different sizes were used for upholstery (Fig. 58–61). They had three functions: fix-

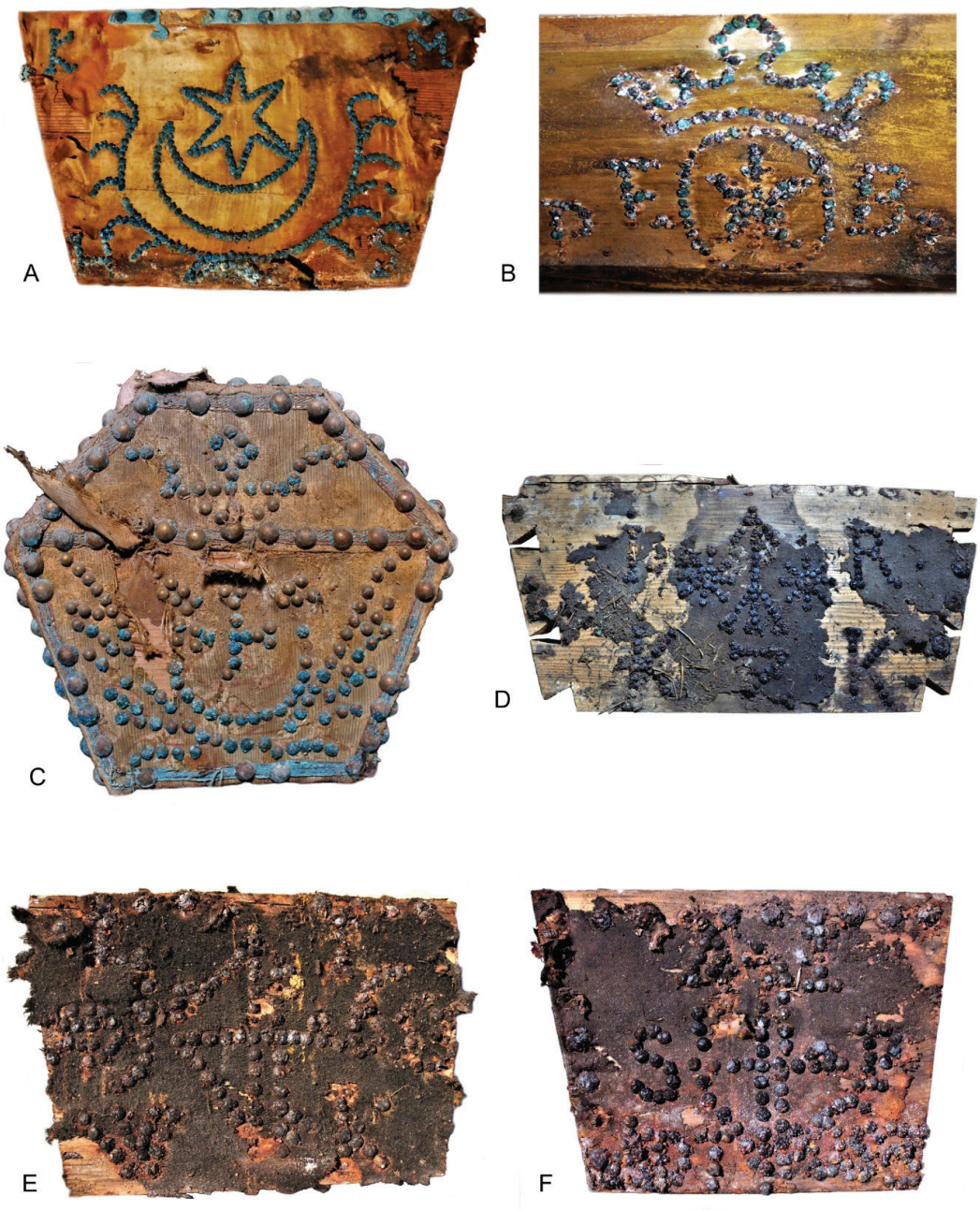

Fig. 61. Ends of coffins, with coats of arms: A) Leliwa coat of arms, crypt B2 burial 13; B) Ostoja coat of arms, crypt B3 burial 2; C) Jastrzębiec coat of arms, crypt B8 burial 1; D) Sas coat of arms, crypt B9 burial 13; E) probably Odyniec coat of arms, crypt B6 burial 5; F) probably Odyniec coat of arms, crypt B6 burial 1, photo M. Łyczak

ing, decoration and information. They fixed textiles, and sometimes a trim, to planks. Tightly placed studs glittered nicely along the edges on a dark fabric background and reflected candle lights. They usually ran in a single row along the plank edges, emphasising the shape of the coffin. In a few cases large, decorative upholstery stud heads created double rows (crypt B5\7, B5\13). Since the front end of a coffin had an important, representation function, the studs formed various inscriptions identifying the person: initials, dates of birth and death, full names and surnames, as well as official functions. A full name was formed with studs on coffin 2 in crypt B3 under the chapel of the Passion of Jesus. It contained the remains of (Woiewodziwic[a] Poznaski[ego] (son of the Poznań voivode)," Fran.[ciszka] Bentkowskiego) who died in 1789. Studs were also used to form the initials of the Virgin Mary and the Christogram IHS (more properly IHΣ, from the Greek abbreviation of IHΣOYΣ [Jesus]) (Fig. 59A,B, 60A). The name MARYA is found only on four upholstered coffins, while a Christogram is found on twenty-one. Of all the analysed coffins, these were always applied to one of the end faces of the lower chest or the cover. No accepted rule was observed for placing it on either the head or leg end of either the cover or the chest. The chest was chosen more frequently. In some cases, initials symbolising Jesus Christ were drawn into a cross, with its base standing on the crossbar of the letter H (crypt B2/4, B3/2, B5/6, B6/1, B6/5, B9/1, B9/4, B9/7, B9/14, K1/1).

Only one chest end was inscribed INRI (crypt B6\1), being an acronym of IESVS NAZARENVS REX IVDÆORVM (Jesus of Nazareth, King of the Jews). The studs were also used to depict large crosses whose arms embraced the side walls of the covers. Metal stud decorations had various shapes: small hearts, crowns, crescents, hooves, stars, arrows and flowers. Some of them, like flowers, were independent patterns distributed on the planks (crypt B9/4, B9/13, K1/1). Other motifs were part of larger compositions, such as coats of arms and Christograms. Coats of arms appeared on seven coffins. It was possible to identify some of them: (crypt B2/1 – Leliwa, B3/2 – Ostoja, B6/1, B/5 – probably Odyniec, B8/1 – Jastrzębiec, B9/13 – probably Sas). Unfortunately, not all are legible today (Fig. 61) because some of the studs were highly corroded and had fallen apart. One coat of arms remains only in a fragment (crypt B7/1). Among the analysed set, symbols of noble family were only found on upholstered chests. Some of the inscriptions and decorations were made very carefully and the layout of studs ideally reflected the shapes of letters, numbers and specific patterns: crowns, arrows, stars or hearts.

Depicting of such shapes with closely nailed stud heads was certainly not an easy task. It required much skill and experience. But not all the inscriptions were made to such a high standard. Other numbers and letters are crooked and highly simplified, making some of them hard to read. Metal galloons (Fig. 62) or laces were small decorative elements, greatly increasing upholstered coffins' aesthetics and the impression of richness they made. The elements were quite narrow, between 0.8 cm and 1.8 cm. The ribbons were covered with lines of small geometrical patterns: rhombi, zigzags and stripes. Just one coffin for a small child was decorated with bobbin lace (Fig. 60B,C), in crypt B2 (crypt B2/7). The lace was used to decorate the coffin edges, emphasising its shape.

Also, on the lower chest it formed the letters of a Christogram at the head end and a large letter M at the leg end. The same lace formed a cross, nailed to the cover. All these details, fixed with brass, golden-gleaming studs and silk velvet that is currently ochre-tinted, created a beautiful decoration. The lightness of the lace corresponded with the small size of the child coffin and did not dominate it. All elements were well-balanced. The high level of artisanship proved the wealth of the parents, but also the parental care for the best possible equipping of the child on its final journey. It expressed their love and sadness. Within the analysed set, some covers

Fig. 62. Upholstered coffins: A) crypt B2 burial 1; B) crypt B3 burial 2, photo M. Łyczak

were decorated with large crosses made of metal galloons (B8/1, B9/8) or just of studs (B5/10). The pillar of the cross ran along the cover, occupying its major part, while the arms wrapped around the side walls, embracing it. Coffin upholstery and decoration with shiny, metal studs and trimming details were costly, but gladly availed of among the social elite. Such decorated coffins appear in various crypts, such as: the archcathedral of John the Baptist and John the Evangelist in Lublin (Niedźwiadek 2012, p. 128; Niedźwiadek, Drążkowska et al. 2015, p. 36); the Jasna Góra Basilica crypts (Młodkowska-Przepiórowska, Przepiórowski 2013, p. 160); the archcathedral of John the Baptist and the Assumption of Mary in Przemyśl (Drążkowska 2014, p. 297–314); the church of the Immaculate Conception of Mary in Dubno, Ukraine (Niedźwiadek, Drążkowska et al. 2015, p. 58); the church of the Assumption of Mary in Opole Lubelskie; St Stanislav Church in Modliborzyce; Jesus' Creche Church in Wschów

(Niedźwiadek, Drążkowska et al. 2015, p. 59–62, p. 67); and the church of the Name of the Holy Virgin Mary in Szczuczyn (Majorek, Grupa 2013, p. 78). Within the discussed set, thirty-eight chests were covered with painted decorations. Painted coffins were represented most numerously in crypt B5, located in the church: of twenty-six coffins, ten were finished with paints. In crypt B3 under the chapel of the Passion of Jesus almost all were painted – six out of seven. And in crypt K2 located in the cloister, eight out of ten were painted. In crypt B6, all six coffins were covered with paint. Most of the coffins were painted on the outside only. The painted motifs basically included two categories. Part of the chests were wholly covered with paint. Most (23 of 38) were black and only one was red (crypt K2\7). Such finishing of planks may have been a decoration in its own right, or a background for various patterns and inscriptions. Motifs appeared also on fifteen unpainted planks, where the background was formed by the wood's natural texture – wood grain or sometimes even knots. On black chests the inscriptions and motifs were painted white (crypt B1/1, B1/4, B1/6, crypt B5/8, B5/21, crypt B3/4, B3/7, crypt B6/4, crypt K2/3, K2/4, K2/5, K2/7), which has now changed colour and yellowed. The white contrasted well with the black plane. Rough planks usually bear black patterns (crypt B3/1, B3/3, B3/7, crypt B6/3, B9/3, K2/9). Single motifs were white (crypt B9/2) and green (B9/12). During the survey several coffins from damaged burials were found (and described as independent finds); these appeared with three colours also: blue, and a red that is currently discoloured to an orange tint. Within the analysed set, the short ends of the chests usually bear a Christogram (in fourteen cases), sometimes supplemented with small details, such as a small heart, a heart pierced by three arrows or a cross resting on the crossbar of the H letter (Fig. 63A, B, C, G, 64). Mary's monogram (Fig. 65) appeared only on six coffins (crypt B3/1, B3/3, B3/4, crypt B5/3, crypt B9/2, B9/12). On one of the coffins the monogram MARYA was written into the Christogram (crypt B9/9). On front ends also, initials and dates were painted (crypt B1/1, B1/2, B3/1, B3/3, crypt B5/3, crypt B9/, B9/3, crypt K2/5). Only one chest (crypt B1/1) had a whole name and surname written: *R.P.M. TEOFIL NOWAKOWSKI GWARDIAN* (Fig. 63F). The use of a narrow brush for the writing allowed individual features to be included. Different characters can be seen: some look like printed, while others are in a carefully calligraphed handwritten style. Some of the writings are so precise that they create the impression of having been made from a template. On another, the light and skilful hand of the artist can be seen. A coffin from crypt B5 located in the church (crypt B5/3) is worth emphasising. The inscriptions are made with two types of letters. Some of the letters are printed, while others, like the ones in the monogram of Mary, are intertwined and calligraphed.

In order to achieve the impression of three dimensions the letters are widened and are shaded. The letters on the cover are white, and the shadows are dark, while on the chests the opposite is true: the letters are painted black, while the shades are light. Another interesting decoration method involved painting straight white lines along the plank edges. This was to correspond with trimming decorations on upholstered chests (crypt B9/2, B9/6, crypt K2/3, K2/4, K2/5, K2/7). In some cases dots imitating upholstery studs were painted. Such imitations are more numerous on the coffins covered completely by black paint (crypt B9/2, crypt K2/3, K2/4, K2/5, K2/7).

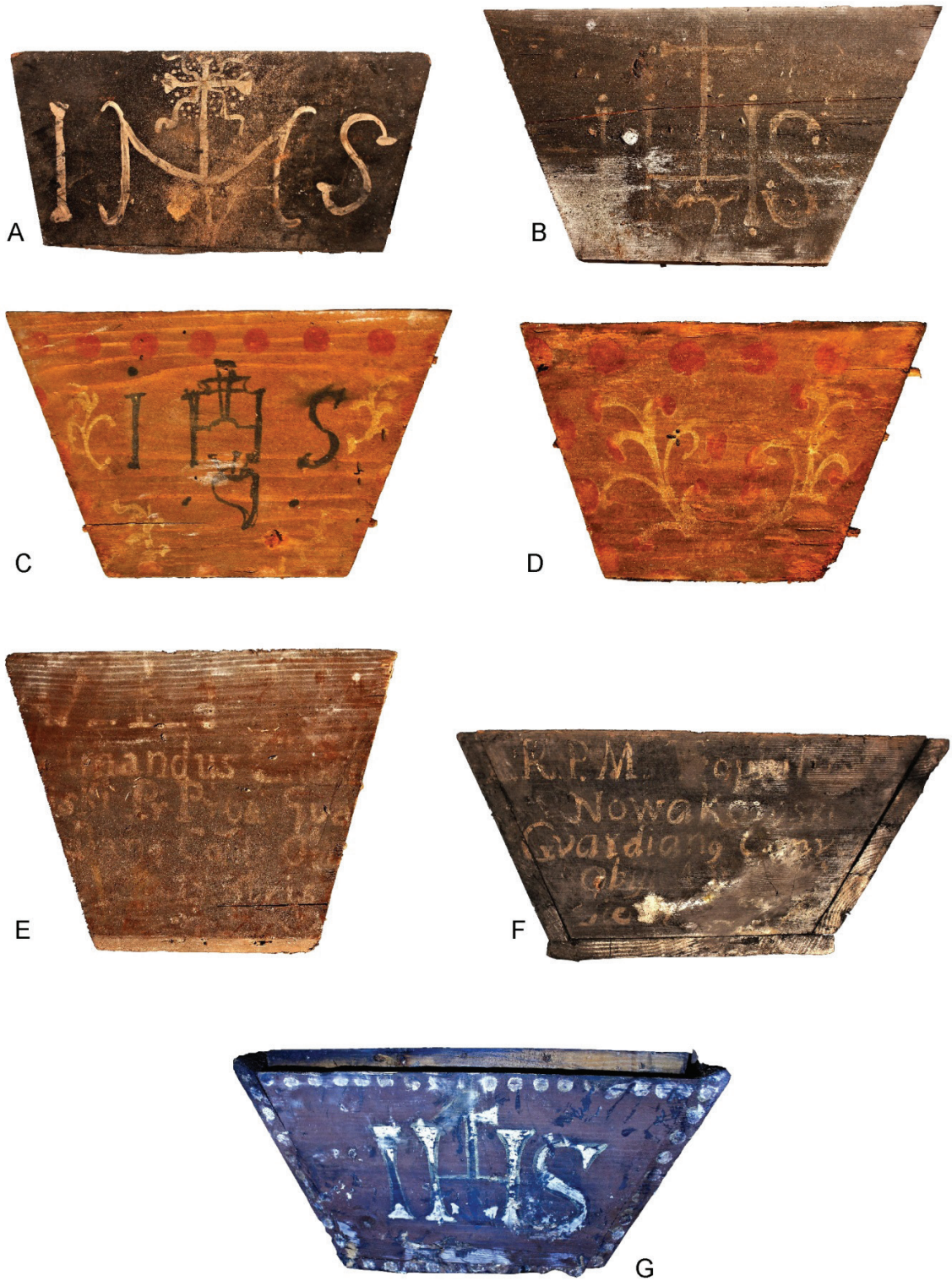

Fig. 63. End faces of bottom chests of coffins decorated with painting: A, B) crypt B1, independent find; C, D) crypt B3, independent find; E) crypt B1 independent find; F) crypt B1 burial 1; G) crypt K2 burial 7, photo M. Łyczak

Fig. 64. End faces of coffins decorated with painting; A) crypt B5 burial 3; B) crypt B3 burial 3; C) crypt K2 burial 5, photo M. Łyczak

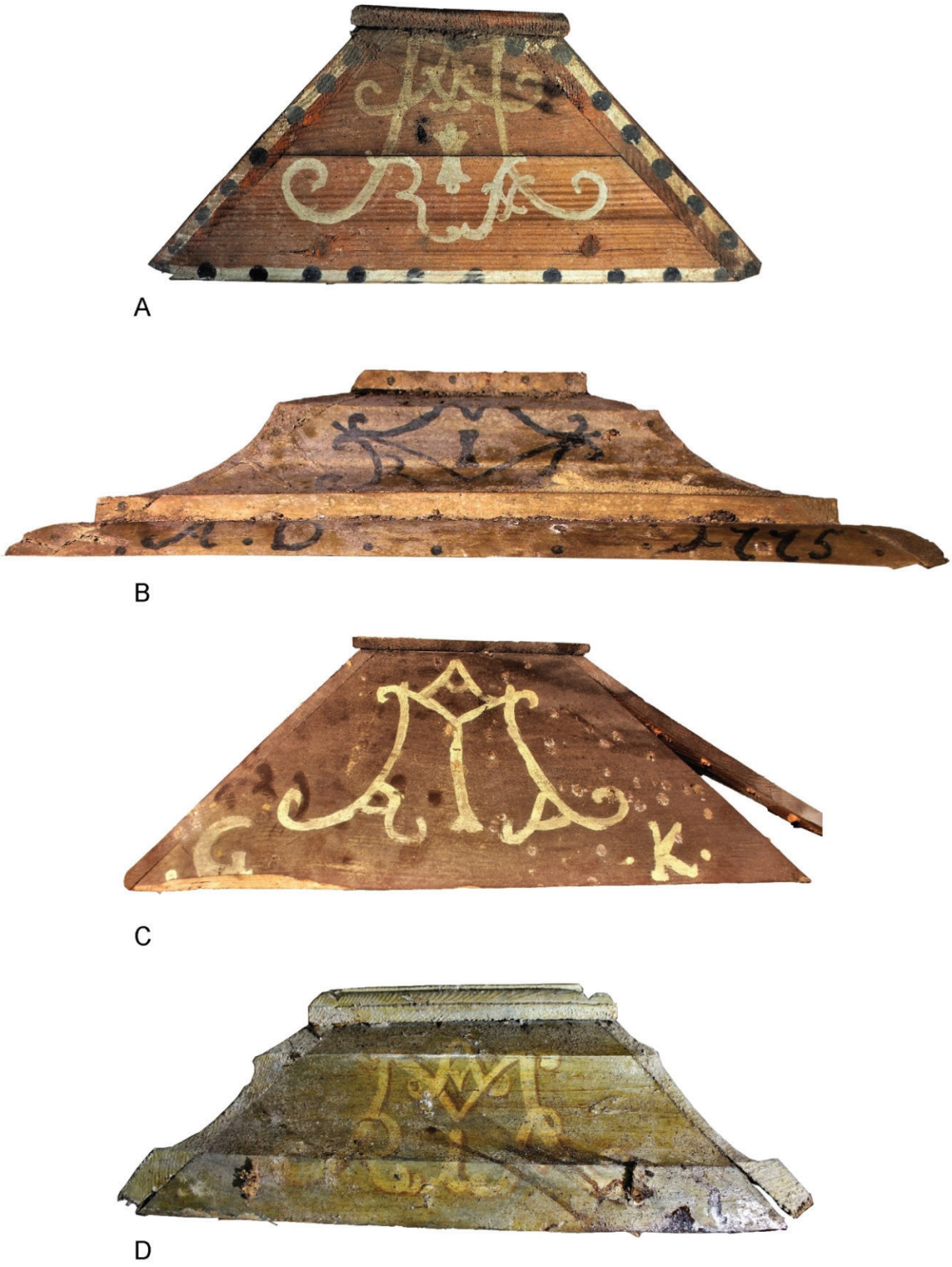

Fig. 65. End faces of coffin covers with painted decorations: A) crypt B9 burial 2; B) crypt B3 burial 3; C) crypt B3 burial 4; D) crypt B5 burial 3, photo M. Łyczak

Large white, yellow or black dots emphasise the shape of the coffins and create the illusion of a more richly crafted coffin. On the longer sides of only one coffin, two large skulls were painted in white paint on a black background (crypt B1/4). Vanitative[12] motifs are not commonly used as coffin decorations, but have been found at several sites, including the church of Archangel Michael in Kańczuga, where clepsydras are depicted on the coffin ends (Niedźwiadek, Drążkowska et al. 2015, p. 63). Of the discussed coffins, some had large white, black and red painted crosses on the covers (Fig. 66).

Fig. 66. Painting of child coffin covers from crypt B6: A) burial 7; B) burial 4, photo M. Łyczak

Their arms descended onto the side planks of the cover, embracing them (crypt B3/7, crypt B5/8, B5/21, crypt B6/3, B6/4, B6/7, crypt B9/9). In most analysed cases they were painted carefully by a skilled hand. Only one coffin bears a black cross made without much care by a not particularly skilled artisan (crypt B9/9). The lack of proportions and the unequal width of the arms suggest it was painted in haste. This cross has straight-cut arm edges and is pierced with studs.

[12] Vanitative motifs expressing the transience of earthly life and pleasure.

Most of the painted crosses have a triple-leaf form, with arms ending with clover leaves (crypt B3/7, crypt B5/21, crypt B6/4, B6/7), while two more crosses within the analysed set have decoratively widening arms (crypt B5/8, crypt B6/3). The monogram INRI appears above the crosses. Interestingly, large crosses appear on the covers of both child and adult coffins. Multicoloured plant decorations appear only on the planks of three child coffins. One of the coffins from B3 crypt was ornamented with red flowers on light branches. The plants are presented in a very simplified form. Flowers, or possibly buds, are marked only as red dots. On the second chest willow catkins set on branches collected into bunches are painted, resembling small bouquets. Flowers with heart-like petals and stars cover planks of a chest from crypt B6. Painted decorations used to be a cheaper decoration method in historical ages, and were thus very popular. They have been found, among other places, in: crypts of the post-Bridgettine church in Lublin; the church of the Discovery of the Holy Cross in Końskowola; the archcathedral of John the Baptist and John the Evangelist in Lublin; the church of Assumption of Mary in Szprotawa (Niedźwiadek, Drążkowska et al. 2015, p. 31–64); and the Name of the Holy Virgin Mary church in Szczuczyn (Majorek, Grupa 2013, p. 76–80). Wood carving was a more expensive method of chest decoration. Within the analysed set there were twelve such coffins. The method was applied to both upholstered and painted coffins. In the majority of cases, small slats in the form of quarter- or half-cylinders were nailed along the upper edge of the lower chest where it touches the cover. Furthermore, decoratively profiled, milled planks and slats cut into fancy patterns were used for finishing the end faces. All these elements, which are used also in furniture manufacturing, made the coffins look more decorative and celebratory. The coffins became larger, more stately and elegant. Woodcarving elements were usually accompanied by tall covers, usually from the second half of eighteenth century onwards. In one case, only supports were used in the form of a rack cut from a piece of wood. Two connected legs were cut from it, and the space between them was decoratively cut in the shape of a heart. A red silk velvet was nailed to the leg surface. The same material covered the whole coffin.

In the Cracow church crypts, however, most coffins had straight edges and a trapezoidal section. The same situation can be seen at other sites, and the popularity of this shape suggests it had a timeless quality to it that withstood the appearance of other trends and coexisted alongside them. Such coffins can be found in almost every crypt. Surveys revealed them in, among others: the church of St John the Baptist and the Assumption of Mary in Przemyśl (Drążkowska 2014, p. 297–317); the Holy Virgin Mary church in Toruń (Trybuszewski 2005, p. 64–65); the Jasna Góra Basilica in Częstochowa (Młodkowska-Przepiórowska, Przepiórowski 2013, p. 56–57); the church of the Name of Holy Virgin Mary in Szczuczyn (Majorek, Grupa 3013, p. 73); the archcathedral of St John the Baptist in Warsaw (Drążkowska 2014a); the church of St Archangel Michael in Kańczuga; the church of the Discovery of the Holy Cross in Końskowola (Niedźwiadek 2013, p. 46); the church of Assumpton of Mary in Kraśnik (Gołub 2013, p. 18–19); the church of the Holy Spirit in Vilnius (Matuzevičiūtė 2013, p. 5); the church of the Immaculate Conception of Mary in Dubno, Volhynia; the church of the Discovery of the Holy Cross in Antalieptė (Matuzevičiūtė 2013a, p. 3); St Jacob Church in Kurtuvėnai (Matuzevičiūtė 2013a, p. 7); and St Jacob Church in Janova (Matuzevičiūtė 2013, p. 5).

In Modern times coffins became an important element of funeral celebration, directly related to death. Large sums of money have often been spent on preparing the container for a corpse. Placed on the catafalque, it was used for the presentation of the body during the funeral. The chest isolated the deceased, locking his or her worldly life into a confined space delimited by the planks (Drążkowska 2014, p. 307). Installing the cover was the symbolical end of

a person's existence in this world: the person was entering the world of the dead (Drążkowska 2014, p. 307). The high significance of coffins in the funeral rite is confirmed by failed attempts to limit their use, such as those undertaken by the emperor Joseph II. In 1783 he issued a ban on single-use coffins and introduced multiple-use containers called the "Josephite economical coffin" (Kizik 1998, p. 98; Drążkowska 2014, p. 313). Such a rented coffin was used during the transport of the body to the church. After the mass it was moved to the cemetary and placed over the grave, where the bottom or side wall was opened and the body was dropped into the tomb (Šolta 1895, p. 114–116). After the ceremony the coffin was returned to the church to be used by the next person. This policy aimed to limit deforestastion and quickening the decay of bodies placed in graves. This "invention", however, was not well received and the burying of the dead in single-use coffins was restituted. The taking away of the last, personal space protecting the body of a person leaving this world forever was hard to accept.

Burial furnishing

Marcin Nowak, Anna Drążkowska, Monika Łyczak

Among the ninety-five coffins with ninety-six burials surveyed in the Cracow crypts, only thirteen completely lacked any burial furnishing (Nowak, Drążkowska, Łyczak 2020, p.179–281). The fewest artefacts relative to number of burials (6) were found in crypt B1 under the presbytery (Table 3). Nor was any clothing fragment preserved there. This situation is not surprising, since access to this crypt was relatively easy and many people could have visited it. This was a key factor in such a small number of finds having been made. While analysing burial furnishing from various crypts it was stated that clothing and accessories constituted the most numerous set (127), recorded with sixty-two burials. Pillows placed under the heads of corpses were the most numerous subset of this group. They were recorded in forty-six coffins, but this does not imply that the same number of textile pillowcases was found. Their presence was often proven only by plants or other types of filler placed under the skull in a specific manner. A similar situation pertained to mattresses, which were recorded in twenty-three chests. Rosaries and scapulars comprised the most numerous set of religious articles. As many as twenty-six specimens were found. Furthermore, seventeen wooden crosses, seventeen medallions, eight metal crosses (including six Caravaca crosses), four rings and only one picture and one reliquary were found. Additionally, in four child burials and one adult female burial, fresh herb wreaths/crowns were confirmed. In sixteen coffins, fresh plant bouquets were placed and gathered into smaller or larger bunches. They were dried out when discovered, but their form suggested that when placed in the tomb they had been made of fresh plants and were tied with some type of a tie. All furnishing items are presented in Table 3, where they are divided into crypts and separate burials.

Table 3. Burial furnishing items

BURIAL FURNISHING													
BURIAL N°	clothes or accessories	rosaries	rings	scapular	wooden cross	metal cross	Caravaca cross	medallions and reliquary	picture	herb crown	bouquets	pillows	mattresses
THE CHURCH													
CRYPT B1													
1													
2													
3					1								
4													
5													
6													
damaged burial				2									
CRYPT B2													
1	2			1			1				1		1
2	2												
3	2											1	
4	1										1	1	1
5	1											1	
6	1										1	1	
7	1											1	
8	2											1	1
9	4				1						1	1	
10	2											1	
11	1											1	
12	1												1
damaged burial								1					
CRYPT B3													
1	1	1			1							1	
2				1	1							1	1
3	3	1		1							1	1	1
4	3	1	1	1	1							1	1
5	2											1	1
6												1	
7												1	1
damaged burial	1	1		1	2			3					
CRYPT B4													
1												1	1

Table 3. Burial furnishing items (continue)

BURIAL FURNISHING													
BURIAL N°	clothes or accessories	rosaries	rings	scapular	wooden cross	metal cross	Caravaca cross	medallions and reliquary	picture	herb crown	bouquets	pillows	mattresses
CRYPT B5													
1				1				1				1	1
2	1			1				1				1	
3	3											1	1
4	3				1							1	1
5	4			1			1						
6	4	1										1	
7	4											1	1
8	2	2		1				1				1	
9	2			1			1					1	1
10	3	1		1	1							1	
11	2	1										1	1
12	1	1			1			1			1	1	1
13	1												
14	2	1		1				1				1	
15		1		1				1				1	
16	1												
17												1	
18											1	1	
19	3			1	1								
20	1											1	
21					1							1	
22											1		
23	1											1	
24	1											1	
25	1			1								1	1
26	1	1										1	
CRYPT B6													
1	2											1	
2			1	1								1	
3	1									1	1	1	
4	1	1					2	1					
5		1											
6	1											1	1
CRYPT B7													

Table 3. Burial furnishing items (continue)

BURIAL FURNISHING													
BURIAL Nº	clothes or accessories	rosaries	rings	scapular	wooden cross	metal cross	Caravaca cross	medallions and reliquary	picture	herb crown	bouquets	pillows	mattresses
1	3	1	1	1				1					
2	1			1									
3	1	1											
4	2												
CRYPT B8													
1	1												1
2	1										1	1	
3	1										1		
4	2												
5				1								1	
6	4	1											
7		1									1	1	
8	1	1											
damaged burial		1											
CRYPT B9													
1	7											1	
2										1	1		
3	1									1	1	1	
4	3				1							1	
5					1							1	
6	2									1		1	
7	4				1							1	
8	3											1	
9													
10	2	1											
11	3	1	1		1			2				1	
12								1[a]		1	1	1	
13	5										1	1	
14	3											1	1
CLOISTERS													
CRYPT K1													
1				1									
CRYPT K2													
1													
2													

Table 3. Burial furnishing items (continue)

BURIAL FURNISHING													
BURIAL N°	clothes or accessories	rosaries	rings	scapular	wooden cross	metal cross	Caravaca cross	medallions and reliquary	picture	herb crown	bouquets	pillows	mattresses
3													1
4													
No 5	1	1		1	1								
No 6													
7													
8													
9	1												
10									1				1
damaged burial	1	2		3			1	3					
	clothes or accessories	rosaries	rings	scapular	wooden cross	metal cross	Caravaca cross	medallions and reliquary	picture	herb crown	bouquets	pillows	mattresses
TOTAL	127	26	4	26	17	2	6	18	1	5	16	46	23

[a] Reliquary found under coffin No 12.

Scapulars

The excavation survey provided a vast set of confraternity scapulars and their relics, including single petals and their fragments, as well as embroidered decorative elements. Of the recorded relics, twenty-six specimens underwent analysis (crypt 1B\damaged burial, 1B\damaged burial, 2B\1, 3B\2, 3B\3, 3B\4, 3B\damaged burial, 5B\1, 5B\2, 5B\5, 5B\8, 5B\9, 5B\10, 5B\14, 5B\15, 5B\19, 5B\25, 6B\2, 7B\1, 7B\2, 8B\5, 1K\damaged burial, 2K\damaged burial – 3 specimens, 2K\5). They were relics of textile scapulars worn by the faithful. The scapulars are not to be treated as tomb furnishings *sensu stricto*. They were primarily objects of everyday use that almost completely governed conduct and in some cases the daily schedule or liturgical calendars, reminding the men who voluntarily bore them about their obligations. The last earthly deed, when the soul was leaving the body and when placing the corpse in the tomb, required that the symbol be kept close to the body. It was to be placed on the chest and the back.

Due to the complexity of confraternity symbols, their image has been presented and specific elements named in this paper. The evolved and officially accepted scapulars, being a smaller version of the monastic scapular, can be generally described as having the form of two petals linked

with two ribbons or cords (Fig. 67). The method of linking allowed it to be put on over the head such that the bearing elements rested on the shoulders, while the petals rested one on the chest and the other on the back (Szkopek 2005, p. 13–14). This description is the baseline for all scapulars. The sets recorded inside churches, both under the floors and in the tombs or crypts, are the main source of information about confraternity symbols. The specific microclimate allows the better preservation of historical fabrics. At the same time this is an image related to a specific social group, including wealthy persons and clergy. Both cases involve the presence of luxurious raw materials and products, such as silk, which has retained its character to the present day.

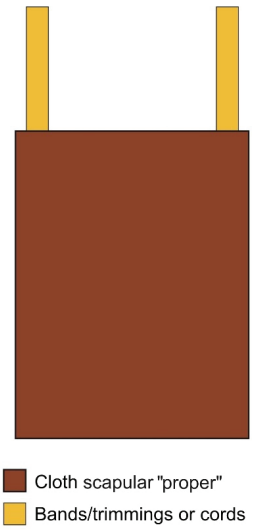

Fig. 67. Type I scapular, drawing by M. Nowak

Based on the discovered specimens, several basic types are distinguished. Studies focusing on this topic began in 2015 (Nowak 2015, p. 39–44). The mentioned basic structure includes four elements, namely two pieces of woollen cloth (hereafter also referred to as the "scapular proper") and two bands or cords (Fig. 67). Type II is more complex. On the underside of the cloth, additional fabric is stitched. This element is here defined as the base and was made of a slightly larger piece of material with stitched edges and affixed to the scapular proper. Two subtypes were defined. In one the cloth was fixed by the base being folded over it (Fig. 68 – type IIA), while in type IIB the scapular proper is stitched onto the base, which it covers completely or almost completely (Fig. 68 – type IIB). In such cases the decoration was made directly on the cloth by embroidery stitching, and the scapular itself might be described as a two-part object. In type III another element called a veil is added to the petal (Fig. 69). It is made of a piece of fabric slightly larger than the cloth, usually closer to the base in size and similarly folded along the edges. The veil was fitted on the outer side of the petal and usually covered by decoration on its outer side. There were two methods of fixing this element: it was placed inside the folds or outside the folds. The scapular proper had to be made of woollen cloth. The Cracow set reveals that silk was the main material used for the other components of the petals. The Cracow set fully corresponds to the typological division proposed above, including all three basic structural forms.

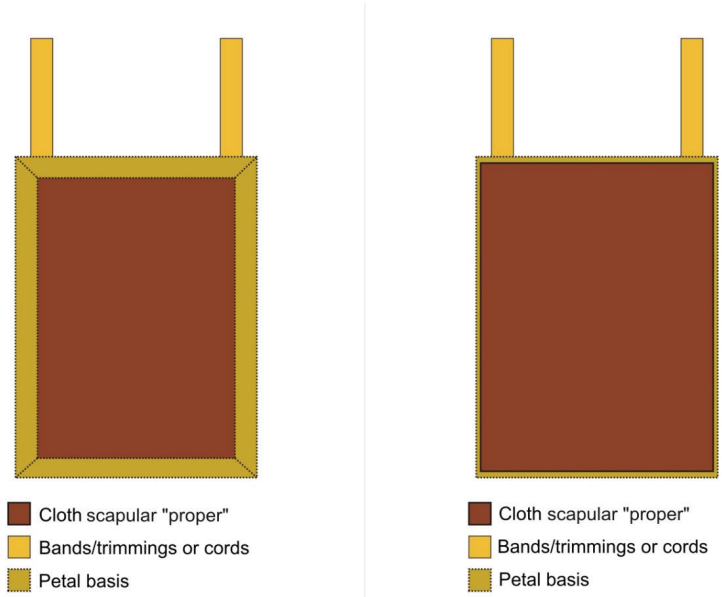

Fig. 68. Scapulars of type II: type II A left, type II B right, drawing by M. Nowak

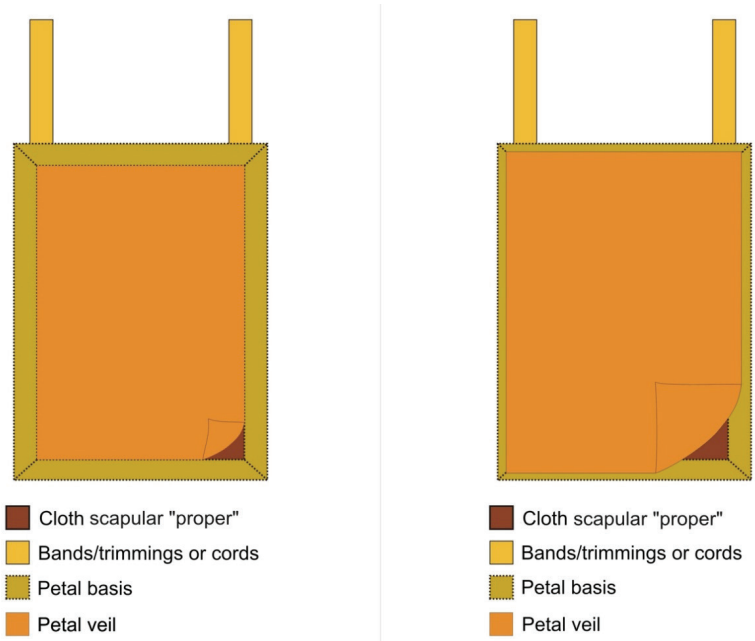

Fig. 69. Scapulars of type III: type III A left, type III B right, drawing by M. Nowak

Type I is the simplest and also the rarest in excavations. It is represented by one specimen from crypt B5, burial 14 (Fig. 70). It measures 9.9×8.3 cm and bears an embroidered Mary sign. Two-part structures constitute the most numerous group of specimens (Fig. 71). The proposed division places twenty-one specimens in this set (crypt 1B\damaged burial, 1B\damaged burial, 2B\1, 3B\2, 3B\3, 3B\4, 3B\no data, 5B\1, 5B\2, 5B\5, 5B\8, 5B\10, 5B\15, 5B\19, 5B\25,

Fig. 70. Scapular petal from crypt B5 burial 14, photo M. Nowak

6B\2, 7B\2, 8B\5, 2K\from damaged burial, 2K\5, 2K\damaged burial[13]). They can be further divided into two main categories, depending on the make: type IIA – where the cloth was place under folds (16 specimens) and type IIB – where the woollen scapular proper had dimensions identical to the whole base after folding of the edges (5 specimens). Despite this small structural difference, the distinction between the forms seems to be justified mainly by the size and decoration pattern of the petals being restricted by the choice of technique. Within the whole set, the decorations were made directly on the cloth scapular proper by silk thread embroidery using the following stitches: chain, rope, laid and satin. Some motifs were prepared with threads with metal braiding, by laid and piercing embroidery. The decorated cloth was placed in the folds created by the bases. This protected the edges of the scapular proper but also created a decorative framing of sorts on every side. This arrangement required that the whole decorative design be adapted to the created area. The frame created the impression of a symbolical picture. The colours of textiles used for the bases vary. Many objects are currently tea-brown, but some scapulars still bear traces of their original colours. For instance, a satin base (crypt B3\3) was dyed red, while a scapular in burial 10 from crypt B5 shows green dye in a few places. They might have been used to supplement and emphasise the decoration made on the cloth. Within the discussed type, small bags attached to the scapulars were found (Fig. 72D). They were used for protecting and concealing various objects, including fragments of paper folded multiple times, medallions, metal crosses or elements made of organic materials, which are undefined due to their poor state of preservation. On the surfaces of the scapulars additional objects of devotional or symbolical character were stitched, They include: medallions (all stitched directly to the cloth scapular), a small symbolic rosary and single sets of beads on a silk thread, stitched to the petal base. A small, heart-shaped medallion from crypt K2 in the cloisters, two cases of rectangular medallions (crypt B5\1, crypt B5\2) of complex structure

[13] One of two petals found in the bag.

(metal, paper image and glass), and glass beads on a thread (crypt B5\2) (Fig. 72A,D,E) were all stitched on petals with an embroidered Christogram. In the discussed cases the elements do not constitute part of the decorative composition of a petal. Their presence on the scapulars might have been a reminder of a pilgrimage or of developments in the religious life of the person. They may be related to the receiving of subsequent sacraments or to strengthening the protective properties of the scapulars.

Fig. 71. Examples of scapulars of two-part composition, type IIA: A) scapular, crypt B1 found under the coffin 6, B) scapular petals, crypt B3 burial 2, C) scapular petals, crypt B5 burial 15, D) scapular, crypt B5 burial 14; after conservation, photo M. Nowak

The last category, type III, included four artefacts (5B\9, 7B\1, 1K\damaged burial, 2K\damaged burial[14]) (Fig. 73). The form of three-part scapulars deviates from the basic structure by supplementing it with additional elements. On the underside of the linen, bases were placed, while the upper part was covered with a veil. This element appeared in three cases in Cracow and was mainly decorative. This type of scapular can also be divided into two subgroups: type IIIA – with a veil supported by the folded edges of the base (2 specimens) (see Fig. 73A–B) and type IIIB – with a veil of the size of the petal covering the whole base (2 specimens) (see Fig. 73C). Complete covering of both sides of the scapular proper, even enclosing it in a bag-like fashion, is a typical feature of this structure. Petal veils were made of various types of textiles and their surface was decorated with various embroidery stitches and applications made with silk thread and metal-braided threads.

Fig. 72. Scapular, crypt B5 burial 2: A) outer side of the scapular; B) trimming with floral pattern; C) microscopic photo of trimming; D) outer side of a petal, pockets, deposit; E) microscopic photos of ornamentation details of cloth surface: embroidered letter "M", beads on a silk thread, after conservation, photo/study M. Nowak

[14] One of the two scapular petals deposited in a shared silk bag

The confraternity scapular is related to monastic scapulars and originates from them directly. Its name has a source in the Latin *scapulare* (derived from the word *scapulae* – shoulders, arms) and was related to *scepularium/scapularis* (a type of robe covering the back).

Fig. 73. Examples of three-part scapulars, type III: A) outer side of scapular petal from crypt K1 in monastery cloisters; B) scapular petal, crypt B7 burial 1; C) scapular crypt B5 burial 9; after conservation, photo/study M. Nowak

The name "scapular" reflects the character of this item of clothing and how it was worn (Kopaliński 1990, p. 1138; Turnau 1999, p. 177; Cross, Livingstone 2004, p. 905; Drążkowska 2005b, p. 60; 2007d; Kwiatkowski 2005, p. 31). A monastic apron, also called a scapular, was quite precisely defined both in terms of form and size (about 45–55 cm), and in terms of how it was manufactured and worn. It was determined to be made of woollen cloth. Some convents adopted the scapular as a permanent part of the monastic clothing that was additionally worn by brothers at night (Turnau 1999, p. 177; Cross, Livingstone 2004, p. 905; Drążkowska 2005, p. 60; Szkopek 2005, p. 10–13; Nowak, Przymorska-Sztuczka 2013, p. 53, Nowak 2015, p. 20–21). The history and function of the monastic apron changed after the events of the night of the fifteenth to the sixteenth of June, 1251, when the general of the Order of Brothers of the Blessed Virgin Mary of Mount Carmel experienced a vision of Mary surrounded by angels. Pointing at the scapular, she said, "This will be the privilege for you and all the Carmelites – whoever dies in this, shall be spared from hellfire." In this way a simple piece of cloth was given the symbolical meaning of entrusting one's life and spiritual development to the Virgin Mary. Within a few years the Carmelites began distributing confraternity scapulars in the form of smaller monastic scapulars. A reduced apron received the status of a symbolical coat-shield, becoming a sign of the covenant that those faithful wearing had made with the Virgin Mary. It confirmed having entrusted one's life to Mary, and the desire to follow her deeds and be under her protection (Szkopek 2005, p. 84; Starczewska, Praśkiewicz 2011, p. 12–13; Nowak, Przymorska-Sztuczka 2013, p. 54; Nowak 2015, p. 20–25). The literature on the topic informs us that the scapular rite was quickly adopted by rulers, starting from the French king, Louis IX (later to become a saint of the Catholic Church), who received a scapular in 1254 at Mount Carmel, through the English kings to the first kings of Poland: Władysław II Jagiełło and St Jadwiga (the royal couple brought the order to Cracow in 1396 or 1397) (Szkopek 2005, p. 88; Nowak, Przymorska-Sztuczka 2013, p. 54; Grupa et al. 2015, p. 137; Nowak 2015, p. 20––25). The spread of the rite, the cult of Virgin Mary of Scapulars and the scapulars themselves required that the rules be confirmed and clarified. In subsequent documents, starting from 1322, when Pope John XXII issued the so-called *Sabbatine (Saturday) Bull*, through the bull of the Pope Clement VII *Ex clementi* (1530) and another one written by Gregory XIII in 1577, the heads of the Church confirmed the graces and privileges, as well as obligations, resulting from this form of participation in the life of the Catholic community.

Most of the Cracow scapular petals are rectangular. Only a few of them are roughly square. This is in line with the accepted guidelines. The only deviation, resulting from the way the petals were connected, can be observed on an object from burial 2 from crypt B5. The use of such a structure primarily influences the number of elements needed to make the scapular. At the same time, the change of form influenced two other aspects of the scapular proper – the entitlement to receive indulgence. One band resulted in the scapular being worn on only one side of the body, probably on the chest, and it did not look like a reduced monastic apron: it did not imitate its layout on the body/habit of a monk. Its form deviates so much from that described in the regulations that it might be possible to state it is incomplete, and thus an improper, invalid scapular. The analysed set is dated within quite a wide time span, from the second half of the seventeenth century till the end of the eighteenth. Of the well dated objects (those with dates remaining on the coffins) that constitute about twenty-five percent of the whole scapular set (6 coffins) the oldest one comes from burial 1 from church crypt B7 (Fig. 73C), and bears the date 1700. The newest was found in a coffin with the date 1789 (crypt B3\2) (Fig. 71B). Most of the finds are from the eighteenth century. The sizes of the petals of Cracow scapulars

vary between 5×5 cm (the smallest) and 12.7×12.7 cm (the largest). The cloth colours used for separate types of scapulars varied and most likely followed the colours of monastic scapulars for specific convents. In seventeen cases relics of woollen cloth remain (1B\no data at No 6, 2B\1, 3B\2, 3B\4, 5B\1, 5B\2, 5B\5, 5B\8, 5B\9, 5B\10, 5B\14, 5B\15, 5B\19, 5B\25, 6B\2, 2K\damaged burial, below the coffin from 1704, 2K\no data). Nine of them (53%) were made of black wool, seven (41%) of brown wool and one (6%) was most likely red. Due to the poor state of preservation and illegibility of some images, as well as the lack of distinctive features, it is impossible to associate any of the objects with a specific scapular type.

Church regulations did not precisely define the size of the cloth. A scapular was to be made in a way that made it identifiable by other members of the community (this meant, among other things, that if could not be hidden beneath too complex an ornamentation pattern). The legibility is related to the way the petals were made. The analysis shows that compliance to this rule dominates within the whole set. Of the set of twenty-six scapulars from Cracow only in four cases (*ca* 15%) did the cloth probably remain illegible to the other faithful, as well as to the bearer. This resulted from the use of an additional element – a veil covering the wool inside the structure. This situation is not uncommon. This way of preparing the petals can be seen in, for example, sets of finds from Chełm (Jędruszczak 2016, p. 274), Gniew (Niedźwiadek, Drążkowska et al. 2015, p. 100; Nowak 2015, p. 77–89) or Szczuczyn (Nowak, Przymorska-Sztuczka 2013, p. 53–67; Nowak 2015, p. 145–62). In all these cases the appearance of the veil and the covering of the cloth was grounds for invalidating a scapular and prevented the receiving of indulgence. The item was becoming more of a decoration that emphasised the wealth of the bearer. Type III scapulars do not account for more than thirty percent of all scapulars in the discussed chronological period. The percentage of scapulars with the cloth visible is similar. The cloth was visible in twenty-two artefacts (85%), of which, one specimen (about 4% of the total) was most likely made in the simplest form without a base (type 1). The rest, more than eighty percent of the scapulars (type II), match seventeenth- and eighteenth-century forms discovered not only in the aforementioned sites in Gniew or Szczuczyn, but also in Lublin (Niedźwiadek, Drążkowska et al. 2015, p. 70–97) and Dubno (Niedźwiadek, Drążkowska et al. 2015, p. 104–16). Analysing the scapulars in terms of decoration and iconographic content, it can be stated that an IHS monogram or Mary symbol in the central area were common. Their joint appearance on the counterpart petals seems to be the basis of the decorative composition of the scapulars. Only a few documents relating to some of the scapulars include precise guidelines on the obligation to decorate the other side of the cloth. For instance, the scapular of the Passion of Jesus (black), worn by the faithful of the Confraternity of the Holy Cross and the Bitter Passion of Jesus should bear a decoration of symbols stitched with white thread on monastic habits but only on the chest petal, while the back petal could be left without decoration (Szkopek 2005, p. 51–54).

Compared to other sites, the Cracow set shows more frequent decoration of petals in the form of prayers placed on the border. This was observed on eleven specimens (2B\1, 3B\2, 3B\4, 3B\no data, 5B\1, 5B\2, 5B\10, 5B\15, 5B\19, 5B\25, 7B\1). Due to significant damage to the embroidery, it is possible to read the content on only three specimens (crypt 2B\1, 3B\2, 7B\1) (*ca* 27% of the scapulars on which prayer relics were recorded). On two scapulars (crypt 2B\1, 3B\2), on the petals with the IHS symbol, the prayer *VERBUM CARO FACTUM EST* (Fig. 71B) was placed, and in one case (crypt 2B\1) the Mary symbol was surrounded by the prayer *ECCE ANCILLA DOMINI*. Another type of prayer was made on a petal with a Mary mon-

ogram in burial 1 of crypt 7 in the church. It was embroidered with the sentence *O MATER DEI MEMENTO MEI* (Fig. 73B).

During the study it was possible to link nineteen of the twenty-six scapulars with specific persons in separate crypts within the church and cloister of the Franciscan complex. Of these, in only fourteen cases could the gender of the persons buried with scapulars be determined. Of them, four (29%) were identified as females, and ten (71%) as males. For both genders, silk fabric with a prevalence of simple linen weave textiles were used.

The presence of silk in scapulars results from, among other things, the social standing and wealth of the persons buried in the crypts. From the point of view of the faithful, the meaning and role of a scapular in their life required that its most important element – the cloth petal – be protected. The use of silk bases isolated the wool from the harmful effects of sweat and dirt, as well as securing the edges against tearing. It is possible that by covering the woollen scapular with noble, expensive silk the faithful emphasised the significance of a plain product of great spiritual value. The scapular from crypt K2 that was stored in silk bags completely covering the petal deserves attention. The added bands allowed it to be carried, but also invalidated it by covering the cloth. The answer to why it was isolated can be found in the following sentence: "(...) to bear the scapulars on the naked flesh; but hard it is to wear it in this manner, only on the shirt, because of the worm that breeds there" (Kitowicz 1985, p. 35). The silk introduced to the structure of scapulars might have protected the body from chafing by harsh cloth, improving the wearer's comfort. Equipping scapulars with additional elements seems to be common and is recorded at various archaeological sites. Pockets with contents that were hard or impossible to recognise were found in Gniew and Szczuczyn, among other places. Devotional articles have been found at many more sites. The objects were stitched to the scapular petals or even bound to the bands resting on the bearer's shoulders. Each of the objects can be considered a result of the tendency to independently shape the image of the petal, or proof of a development in spiritual life, with specific objects symbolising different stages. The presence of scapulars in the crypts of the Cracow church might be considered evidence of the intensity of spiritual life among the city's upper social classes.

Rosaries

After scapulars, rosaries are the most numerous type of object found. The survey revealed the remains of twenty-six prayer bead ropes (crypt B3\1, B3\3, B3\4, crypt B5\6, B5\8 – 2 items, B5\10, B5\11, B5\12, B5\14, B5\15, B5\26, crypt B6\5, B\4, crypt B7\1, B7\3, crypt B8\6, B8\7, B8\8, crypt B9\10, B\11, crypt K2\5 and 4 specimens within damaged burials in crypts B3, B8 and K2 – 2 specimens), both as complete and easily recognisable loops, and as highly degraded sets or even single beads. Rosaries preserved in fragments were identified mainly based on the position of their components within the coffin and their co-appearance with other devotional objects: medallions and crosses. Most were found around the pelvis or lower limbs. In one case, crypt B5, burial 14, the rosary was wound around the person's hands, and the remaining beads were distributed towards the legs. Prayer ropes were found in both male coffins (9 specimens – 33%; crypt B3\1, B3\3, B3\4; crypt B5\10, B5\12, B\14, B\26; crypt B8\6; crypt B9\11), and female coffins (3 specimens – 11%; crypt B5\6, B5\11; crypt B7\1). Furthermore, in one case a rope was wound in child coffin (4%; crypt B6\4). Other objects in various states of preservation were found in archaeological strata deposited in the lower parts of the crypts and

originating from damaged burial remains or in coffins containing remains that were decayed to an extent preventing gender identification.

The relatively high percentage of rosary-type objects[15] present in the materials from the Franciscan church relative to other furnishing items (except clothes) is worth noting. As many as twenty out of the twenty-six discovered rosaries or rosary remains can be linked to specific burials (crypt B3\1, B3\4, crypt B5\6, B5\8 – 2 items, B5\10, B5\11, B5\12, B5\14, B5\15, B5\26, B6\5, B6\4,B7\1, B7\3, B8\6, B\7, B\8, B9\10, B9\11, K2\5). At the same time, it is impossible to state what number of rosaries made of organic materials (seeds, bones, wood) had been completely decayed by post-deposition processes. However, considering the relic character of some discovered specimens (only a few elements remaining) it can be assumed that a number of objects might not be traceable by an archaeologist and evade statistical estimation. Thus, the fact that prayer ropes constitute at least twenty percent of the tomb furnishings of the Franciscan crypts may suggest that the custom of granting the dead such objects was especially popular among the communities of seventeenth- and eighteenth-century Cracow (Chudzińska 1998, p. 10–11; Pankiewicz, Witkowski 2012, p. 52).

Most of the rosaries (18 specimens) were made completely of wood, and only in six cases was this material combined with other materials (crypt B5\6, B5\11, B5\14; crypt B7\3; crypt B8\7, crypt K2 in the cloisters, among the damaged burials). Additional objects usually included glass beads. Single beads of amber, *Staphylea pinnata* seed, jet, and even one fish vertebra, also appear. The only rosary made completely of material other than wood was the object from the child tomb (crypt B6\4). Its parts were made of multicoloured glass mass (Fig. 74C). It is interesting to note that production waste from bone beads, in the form of bone plaques with holes, appears quite frequently in historic material from mediaeval and modern city centres, including Cracow. Rosaries made of this material are often found at cemeteries inside and outside churches (Dryja et al. 2009/2010, p. 162–3; Kraków 2007, p. 562; Pankiewicz, Witkowski 2012, p. 49; Jaworski 2012, p. 171–9; Łyczak, Książyńska 2017, p. 164, Fig. 22; Młodkowska-Przepiórkowska 2018, p. 224–5), such objects did not appear in the church crypts. Lace made of luxurious materials including coral is not present, either. According to traditional beliefs coral had apotropaic and thaumaturgic properties.

Still, they appear very frequently in Renaissance and Baroque portrait images and in burial furnishing of nobles and burghers (Knapiński 2004, p. 99; Letkiewicz 2006, p. 264; Nowacki et al. 2011, p. 12–13, 112–14, 284–5; Molenda 2012, Fig. 73). We should not assume that the Cracow elite received "cheaper versions" of the devotional objects that they used during their lifetime and to which they were emotionally attached. Thus we can propose the hypothesis that the relatively modest rosaries were related to the specific spiritual gifts of Friars Minor, which also influenced the laymen associated with the Order and which resulted directly from the first sentence of the order's rule: *The Rule and life of these brothers is this: namely, to live in obedience and chastity, and without property*[16] (author's underlining).

Among the beads from the Cracow prayer ropes the simplest forms prevailed: round, oval, barrel and spindle (resembling grains, such as rice). The beads for the *Pater Noster* prayer were usually distinguished only by a slightly larger diameter, sometimes linked with the presence of single- or triple-turned grooves on the surface. The basic beads were supplemented with spec-

[15] This term is deliberately generalised because the original form and function of a discovered prayer rope with beads, or of beads alone, could not be defined in all cases.

[16] Translation after *The Writings of St. Francis of Assisi, Paschal Robinson*, transl., Philadelphia: Dolphin Press, 1906.

Fig. 74. Compilation of rosaries (on the left, a complete object, on the right a detail shown as macroscopic and microscopic photos): A) rosary from crypt B5 burial 14; B) symbolic rosary attached to a scapular from crypt B5 burial 8; C) rosary crypt B6 burial 4; after conservation and reconstruction, photo M. Nowak

imens of more sophisticated shapes – richly profiled, barrel-shaped, of trapezoid section, or shaped as flattened ovals or discs. They functioned as markers of the link of the rosary loop with its end or with separators of "tens" of the *Ave Maria* prayer, or even as single beads (crypt B5\14) (Fig. 74A). Beads constituting a cross closing the chaplet often had a distinctive, individual form. They were usually formed as richly profiled balusters (preserved – partially or completely – in 16 cases: crypt B3\1, B3\3 from damaged burial, crypt B5\6, B5\8, B5\10, B5\11, B5\12, B5\14, B5\26, B6\5, B7\1, B8\6, B8\7, B8\8, 9\10) (see Fig. 74A, 76A). Of the studied

set, beads of medium sizes predominated (i.e. ±0.5 to ±1 cm in diameter). In these categories two items were clearly distinguished: a large rosary of the Archconfraternity of Good Death with beads of an unusual shape (crypt B3\1) (Fig. 75) and a rosary of very small beads found within a scapular (crypt B5\8). Rosaries made on ropes of braided or twisted silk threads were preserved in better condition (15 specimens; crypt 3 – damaged burial, crypt B5\8, B5\11, B5\12, B5\14, B5\15, B5\26, B6\5, B7\1, B7\3, B8\6, B\8, B9\10, crypt K2 in cloisters – damaged burial). Scattered beads had probably been threaded on flax or hempen ropes. In one case the beads were linked with a copper or bronze wire forming small links; only two of them were preserved, but it can be assumed that the remaining elements were linked in a similar manner (Fig. 71C).

Fig. 75. "Confraternity" rosary, crypt B3 burial 1 (top – complete scaled photo, bottom – components), state after conservation and reconstruction, photo M. Nowak

Fig. 76. Compilation of "Dominican" rosary examples (on the left, a complete object, on the right a detail shown as macroscopic and microscopic photos): A) rosary, crypt B7 burial 1; B) rosary crypt B7 burial 3; C) rosary, crypt B3 burial 3; after conservation, photo M. Nowak

In some cases the rosaries were equipped with additional elements, possibly elevating their religious value (such as pilgrimage memorials) or related to specific intentions: medallions (such as St Benedict, one of the patrons of good death) and crosses (such as Caravaca crosses protecting against plague) (see Nowacki 2011, p. 112, 284; Molenda 2012, Fig. 200). Of the retrieved rosaries, five were fitted with various types of crosses (simple, wooden, two-piece cross – crypt B3\1; wooden, decorated with intarsia – crypt B5\10; single-piece, made of jet – crypt B7\3 (Fig. 76B); metal, of knight's cross type, decorated with cell enamel and a painted medallion – crypt B5\15; and a Caravaca cross with inscription and image of the tools of the Passion of Jesus, crypt B6\40). Another six crosses were supplemented with medallions (crypt 3 – damaged burial, crypt B5\8, B5\12, B5\14, B6\4 and crypt K2 in the cloisters – damaged burial). The images included: the Black Madonna of Częstochowa, Madonna with Child, St Anna, St Benedict, St Peter and Paul, crucifix and the so called House of Loreto. In six cases the chaplet was closed with a large or small pendant with beads (crypt B5\26, B7\1, B7\3, B8\7, B8\8, B9\10) (see Molenda 2012, Fig. 58, 171).

One artefact from tomb 1 crypt B7 is an example of a Dominican rosary (Fig. 75A). This was a burial of a woman who died in 1700. Her rosary was preserved in virtually perfect condition. Oval, wooden *Ave*... beads were separated with slightly larger, oval, triple-grooved *Pater*... beads. The loop consisted of fifteen mysteries, ten beads each, and the first (or last) "ten" includes only nine smaller beads supplemented with one larger one. This composition may not be intentional, and a mistake (or possibly a specific component lacking during manufacture) cannot be excluded. The rosary was closed, with one larger bead constituting the upper beam of the cross, while its remaining elements were made of balusters. It can be assumed, with high probability, that such prayer ropes were also placed in two other coffins (crypt B3\3 and crypt Z B7\3) (Fig. 76B,C).

The rosary from coffin 6 crypt B5 (Fig. 77) is an example of a structurally elaborate specimen. It belonged to a woman buried in 1728. Seventy-eight beads made of various materials: wood, amber (2 items), *Staphylea pinnata,* (7 items) and a fish vertebra identified as the chest vertebra of a pike[17] were retrieved. Individual beads vary significantly in shape. They include balls, barrels, rings, double-cones with oblique central rings, and strongly profiled cylindrical shapes. The whole rosary was most likely closed by a pike vertebra. Considering the low aesthetical value of this element, its presence should be considered as symbolical.

It may symbolise the contradictory notions of life and death, immortality and resurrection, chastity and fertility, but also the beginning, salvation, sacrifice, faith, baptism, Eucharist, Christ or Mary. In the New Testament, Christ and the apostles are fishermen who, according to Luke, are fishers of men, and thus the original baptism rites required submersion in a river or lake, while the Greek word for fish, *ichtys*, was translated as *Iesous Christos Theou (H)Yios Soter*, which means "Jesus Christ, Son of God, the Saviour". Whether the vertebra was used in such a context remains speculative, since this find is an extraordinary one. It is also possible that the variety of materials and bead shapes used for this specific rope is the result of its repair with the use of available materials (such as a grain of *Staphylea pinnata* replacing a damaged wooden bead).

There is one special prayer rope among those from the crypts of St Francis church in Cracow. It is the specimen from coffin 1 crypt B3 (Fig. 75). The burial from 1796 belongs to a member of the Archconfraternity of the Lord's Passion. For his last journey he was dressed in

[17] Species identification by Prof. Dr hab. Eng. Daniel Makowiecki of the Archaeology Institute of NCU Toruń

Fig. 77. Rosary from crypt B5 6 burial (top – complete photo, bottom – selected components), after conservation and reconstruction, photo M. Nowak

clothes resembling a habit and tied with a rope. He was also furnished with a scapular, a wooden crucifix with a skull beneath Jesus' feet and a rosary of a unique form. The beads for *Ave Maria*, *Pater Noster*, and the elements of the stylised cross were all made of highly branched shoots of trees or bushes. In this case the initial selection of the material must have been extremely important, since all beads of a specific category are of similar transversal dimension, and have at least four branching shoots, placed cross-wise or star-wise at a similar level. The

rope was supplemented by a two-part, wooden cross and a small (3.6×3×3.8 cm) wooden skull. The whole, resembling a spinal cord with a skull on top, certainly was a representation of the specific, Baroque idea of *vanitas* (the vanity of all goods, especially of life itself, originating from the medieval motif of the *dance macabre*). Renaissance and Mannerism developed a specific set of symbols that emphasised the contrast between the grandeur of material objects and traces of decay. Baroque iconography was especially fond of skulls, skeletons and decaying bodies that symbolised the vanity of life, in line with the popular sentences *memento mori*, *carpe diem* and *vanitas vanitatum et omnia vanitas*. The skull, as a symbol of Adam, the forefather, of Golgotha and of repentance and the attribute of St Francis of Assisi was and still is an important element of the rites of the Archconfraternity of Good Death. Despite that fact, rosaries resembling the discussed specimen are rare. For instance, in the Premonstratensian monastery in Strzelno a prayer rope made of ceramic and wooden beads separated with a miniature stone or bone skull was found (Kołyszko 2013, p. 167–8). A bone rosary bead depicting a male face on one side and a skull on the other, dated to the late fifteenth to early sixteenth century was found during an archaeological survey in Gloucester cathedral in England (Archaeology, https://www.archaeology.org/issues/264-1707/artifact/5652-artifact, accessed 12 Nov. 2019). A very similar, large bead, also made of bone, was found in the relics of St Oswald church in Płonkowo. There is, however, no detailed information concerning this item. We know only that the face of Christ was sculpted on one side, and a skull on the other (Grupa et al. 2015, p. 46).

The tradition of multiple repetition of prayers as a form of religious meditation using a rope with knots or threaded with beads has a very long history. The oldest such specimen was found in Nineveh, in a female tomb dated to the ninth century BC (Kołyszko 2013, p. 153). This type of contemplative prayer appeared in Europe in the early Middle Ages, brought by Muslims, who even today use a rope with beads called a *subha*, *misbaha* (Arabic) or *tasbih*, *tespih* (Turkish) to recite the ninety-nine names of Allah (Laszczak 2005, p. 15; Kołyszko 2013, p. 152). Crusader knights, inspired by this kind of devotion, popularised the use of prayer ropes in the Christian tradition in the eleventh and twelfth centuries (Saczyńska 2011, p. 49; Kołyszko 2013, p. 152). Irish Christian monks, accustomed to reciting a psalter (i.e. the multiple repetition of 150 Psalms), appreciated the contemplative meaning of such a rite, and linked a rope with 150 knots with the prayer most familiar to laymen (especially the poor and uneducated). The prayer was usually the *Our Father* (*Pater Noster*). In this way the so called *Poor Man's Psalter* was created (Laszczak 2006, p. 44). Ropes of this kind gained popularity quite quickly and were commonly called a *paternoster*. In the early Middle Ages they were called *praeculae* or *computum*, while in the fourteenth century the name *Ave Maria* appears, proving a repetitive recitation of the *Hail Mary* (*Ave Maria*).[18] Other names were also used: *numerale*, *sertum*, *signakulum* and *psalterium* (Saczyńska 2011, p. 49). In the fifteenth century the name "rosary" was widely adopted, relating directly to the rose garden or rose wreath (*rosarium*), the oldest symbol of the cult of Mary. The term "rose wreath" has been used since the twelfth century to describe a collection of prayers devoted to Mary, for example *florilegium* (Laszczak 2006, p. 112; Saczyńska 2011, p. 49–50; Kołyszko 2013, p. 153). The prayer rope has functioned for many years in the Catholic Church without a defined number and arrangement of beads. Numerous sequences of short, simple, repeated prayers meant that ten, thirty-three or even one hundred

[18] The first traces of recitation of the *Ave Maria* prayer are related to the Synod of Łęczyca, gathered in 1285 by archbishop Jakub Świnka. It remained incomplete and frequently paraphrased till the 14th century (Królikowski 2004, p. 250).

and 150 beads were thread on the ropes. The so-called St Bridget's (of Sweden) rosary of the fourteenth century comprised sixty *Ave* beads, separated with *Pater Noster* (7), with three additional *Ave* at the end and a cross, on which the *Credo* was recited, while sixty-three *Ave* were related to Mary's sixty-three years on Earth. Bernardine and Franciscan monks knew a repeated prayer including seven parts, related to the Seven Joys of the Virgin (in other versions five, twelve, fifteen and more joys), often linked to the cult of the Seven Sorrows of Mary. Such collections of prayers, and prayer ropes for their recitation are currently called chaplets (*corona*) (Królikowski 2004, p. 254). At the turn of the fifteenth century a Carthusian monk, Henry of Kalkar, created the *Psalter of Blessed Virgin Mary*, including 150 *Ave* divided into fifteen tens, and before each ten, the *Pater Noster* had to be recited. In around 1409, Dominic Helion, a Carthusian novice from Trier, merged the recitation of the *Hail Mary* with contemplation of the life of Jesus and Mary, creating the prayer *Clausulae vitae Christi*, which was a recitation of fifty *Ave* (later extended to 150), with each being linked to one act of Jesus' life. The Prior of the Trier monastery, Adolf of Essen, in 1434 named this very prayer (which was previously known) a *rosarium* (Moisan 1987a, p. 44–46, 62–72; Laszczak 2006, p. 98–125; Saczyńska 2011, p. 51–53). In the latter fifteenth century a Dominican, Alain de la Roche – creator of the legend about Mary granting the miraculous rosary to St Dominic – divided the recitation of the rosary (which he called a *psalterium*) into three parts. They related to contemplation of a sequence of the Embodiment, Passion and Resurrection of Jesus. He became the founder of the first rosary confraternity in Douai in Flanders. The complicated form of the prayer was quickly simplified. In 1483, *Unserer Lieben Frauen Psalter* was published. In this work the number of mysteries for contemplation was decreased from 150 to fifteen. This shortened form was popularised among the faithful and became the origin of the modern rosary, established with the emergence of rosary activities (Moisan 1987, p. 44–46, 62–72; Laszczak 2006, p. 98–125; Saczyńska 2011, p. 51–53). Rosaries were especially popular in the era of the counterreformation, since they linked a ritualised prayer with contemplation, repeatability and personal reflection, community and privacy, joy and compassion (Ardissino 2019). They became a permanent accessory – not only monastic ones, but mainly lay ones: men wore them at the belt, women on the neck (except women from royal families, who wore them in "the men's fashion"). In the sixteenth century the custom of tying a dead person's hands with a rosary appeared. It became very popular in the following century (Chudzińska 2008a, p. 289).

Wooden crosses and crucifixes

A set of seventeen wooden crosses and crucifixes was found among the tomb furnishing in the crypts of St Francis of Assisi church (1B\3, 2B\9, 3B\1, 3B\2, 3B\4, 3B\damaged burial, 5B\4, 5B\10, 5B\12, 5B\19, 5B\21, 9B\4, 9B\5, 9B\7, 9B\11–11A, 2K\5). They can be divided into three basic categories: personal (independently functioning) – 82% (1B\3, 2B\9, 3B\1, 3B\2, 3B\4, 5B\4, 5B\12, 5B\19, 5B\21, 9B\4, 9B\5, 9B\7, 9B\10–10A, 2K\5); those at rosary ends (made of two linked pieces of wood) – 12% (3B\1, 5B\10); and external coffin decorations – 6% (3B\damaged burial).

Crosses and crucifixes are the most important symbol of Christianity, showing the religious identity and the most important item of faith. They were a personal accessory placed in the tomb together with earthly remains. They were found only in adult burials, including

23.5% female burials, 47% male burials, and 29.5% undefined due to the poor state of preservation of the remains.

The analysed set can be divided into two basic categories: crosses (simple extended forms of *crux immissa*, made of a vertical beam [*stipes*] and a horizontal beam [*patibulum*]) and crucifixes (a Latin cross with a representation of the crucified Jesus, sometimes with additional decorative elements extending the iconographic programme). Crosses constitute 23.5% of the artefacts, and crucifixes about 76.5%.

The set of wooden crosses consisted of four items (Fig. 78). Half are rosary ends, and the others are personal crosses. The distinctive, Baroque method of closing the prayer ropes with

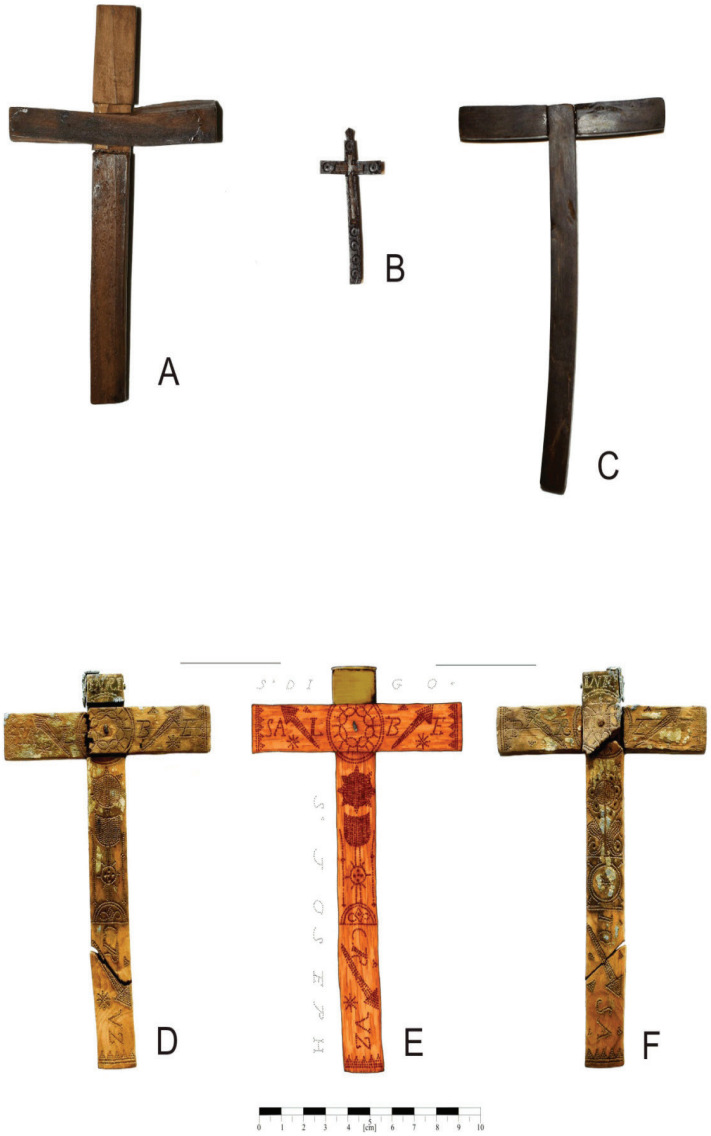

Fig. 78. Wooden crosses: A) wooden cross closing a rosary, crypt B3 burial 1; B) wooden cross closing a rosary, crypt B5 burial 10; C) relics of wooden cross, crypt B1 burial 3; D) wooden cross, crypt B2 burial 9 (averse); E) attempt at graphic reconstruction of wooden cross, crypt B2 burial 9 (averse); F) wooden cross from crypt B2 burial 9 (reverse); after conservation, photo/study/drawing M. Nowak

compositions of round or barrel-shaped beads forming a cross is not maintained in two artefacts found with remains of adult males (crypt B3\1, B5\10). A large cross[19] from crypt B3 (Fig. 78A) is probably the ending of a rosary of especially large beads. A wooden cross with a metal fitting on the upper end is the most interesting artefact in this category. It was a part of furnishing of burial 9 in crypt B2 (Fig. 78D–F). The object was found fragmented in a female burial. It is decorated on both sides with an extensive iconographic programme that also included the side edges of the vertical beam and upper edge of the horizontal beam. On one side, at the crossing of the beam, the HIS monogram is placed. Below the Christogram, a stylised heart is placed. The transversal arm is decorated with two stylised, obliquely oriented nails. Below, another stylised nail is placed. Between the symbols, letters are placed: P/R//E/Z on the horizontal beam and IO/SA on the vertical beam. On the other side, in the central point a stylised crown of thorns is placed. On both sides, the same nail arrangement is copied. Below the link, a chalice with a node is presented in the form of a medallion. Above the goblet, a wheel with triangular rays is suspended. It can be interpreted as the sacramental bread. On this side of the cross, between the symbols are placed the letters SA/L//B/E (horizontal beam) CR/VZ. By compiling the letters from both sides a sentence can be read: *SALBE CRVZ PREZIOSA* (*SALVE CRUZ PRECIOSA*), being most likely a mixture of Italian and Spanish languages, meaning: SAVE THE PRECIOUS CROSS. This sentence should probably be linked with the first verse of the Spanish chant *Dios te salve, Cruz preciosa* from the second half of the fifteenth century (http://www.cancioneros.wiki/index.php.Dios_te_salve,_Cruz_preciosa: access date 2nd Nov. 2019). The upper part of the horizontal beam is ornamented with the letters S·DIGO, while the side edges of the vertical beam are marked with S·MARIA (left) and S·JOSEPH (right).

The crucifix group is represented by thirteen artefacts (3B\1, 3B\2, 3B\4, 3B\damaged burial, 5B\4, 5B\12, 5B\19, 5B\21, 9B\4, 9B\5, 9B\7, 9B\10–10A, 2K\5) (76.5% of the whole set) of various preservation states, and methods and quality of make. This group can be subdivided into two basic sub-categories: crucifixes with a wooden cross and metal Passion figure (5B\4, 9B\4, 9B\5, 9B\7, 2K\5) (Fig. 79) (constituting 38.5%), and a wooden cross with a wooden Passion figure (3B\1, 3B\damaged burial, 5B\12, 5B\21, 9B\10–10A) (Fig. 80, 81) (also 38.5%). The group of crucifixes also included items (3B\2, 3B\4, 5B\19) that could not be classified into any other of the above groups due to the lack of sufficient data. This set constitutes 23% of the crucifix set, identified based on traces of fixtures of the figure of the crucified Christ. The wooden artefacts in the form of crosses that were retrieved during the archaeological survey in the crypts of St Francis of Assisi in Cracow represent only the Latin cross type (*cruz immissa*).

Despite the unified form, the structure of the crosses shows a tendency for the lower part of the vertical beam to be elongated (crypt B5\12, B5\21, crypt B9\4) (see Fig. 80). This allowed the cross to be held in the hand without covering other decorative elements. Crosses were easier to be set in a dead person's hands. Such beam proportion in crosses has also been recorded at other sites, such as Maniowy (Chudzińska 1998), Opawa (Furmanek, Michnik 2004, p. 399–420) or in the crypts of the church of the Name of the Holy Virgin Mary in Szczuczyn (Dudziński, Grupa, Nowosad 2017). Only about 18% of crosses were additionally secured with a metal nail at the crossing of the beam. In other cases a careful carpentry joint was considered to be enough. Both crosses and crucifixes made of wood alone are relatively rare at archaeological sites. Examples include finds from the church of the Assumption of Mary the Victorious in Lublin or in the church of Immaculate Conception of Mary in Dubno (Niedźwiadek, Drążkowska et al. 2015, p. 70–125).

[19] The vertical beam is 143 mm long; the horizontal beam is 88 mm long.

Due to the material properties of wood, the relics of metal objects used for decoration of crosses and crucifixes are more common at archaeological sites. Metal Passion figures are the most numerous finds to confirm the presence of crucifixes in tomb furnishings.

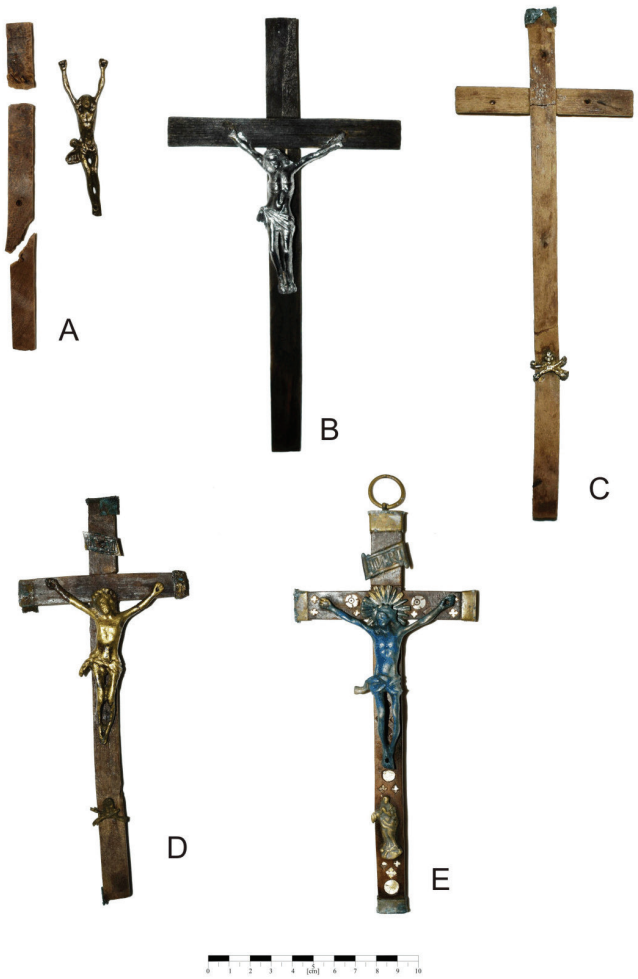

Fig. 79. Crucifixes with metal Passion figure: A) crucifix relics, crypt K2 burial 5; B) crucifix, crypt B5 burial 4; C) crucifix relics, crypt B9 burial 4; D) crucifix, crypt B9 burial 5; E) crucifix, crypt B9 burial 7 (averse), after conservation, photo/study M. Nowak

In addition to the sites mentioned above such as Chełm, Gliwice, Opawa, Maniowy or Szczuczyn, such artefacts are discovered at almost every modern burial ground. At first glance the image of the crucified Christ is shaped according to the generally accepted scheme, with a crown of thorns on the head or a beard, which was accepted probably in the sixth century (Oldstone-Moore, p. 103–26). But the growing number of artefacts allows separate types to now be distinguished, based on the form of details. The way the arms of the figure are placed is the most distinctive difference. Almost all Passion figures from the Cracow set present the arms stretched wide, so that the head is placed on or slightly below the beam link. Only the Passion figure from burial 5, crypt K2 in the cloisters deviates from this scheme (see Fig. 79A).

Fig. 80. Crucifixes with wooden Passion figure: A) crucifix relics, crypt B5 burial 12; B) crucifix, crypt B5 burial 21; after conservation, photo M. Nowak

Fig. 81. Crucifix with wooden Passion figure, crypt B9, burial 11A/11B; A) outer side with the Passion figure (averse); B) microscopic image of *titulus* with painted inscription: INO I; C) microscopic image of feet fixed with a small iron nail; D) microscopic image of painting decoration showing blood pouring from the wounds on the feet, photo/study M. Nowak

The arms and hands are placed almost parallel to the torso and lower limbs, and the figure itself is placed much lower than in the other cases. Comparison of this object with the Opawa find, where the cross was preserved, shows that the figure was fixed to the cross almost at the location of the beam link, while the figure was suspended below. In addition to the mentioned artefact, metal Passion figures detached from crosses were recorded at that site. Apart from the general form of all discussed objects, which comply with the Cracow specimen, other common elements include: the shaping of the head arrangement (looking up); tying with a distinctive draped *perizonium* featuring a knot on the right side; and the arrangement of the feet, with the right foot resting on the instep of the left (Furmanek, Michnik 2004, p. 399–420). The almost identical execution of the image of Christ might suggest a common workshop or closely related workshops or distribution of moulds. It certainly proves long-range trade of devotional items. A process of stylistic analysis would require separate examination of each of the specimens. Metal ferrules or independent application items are more rare among finds. Besides a common motif of a skull and crossbones (Fig. 79C, D) one element draws our attention. This is a figure of Mary on a crucifix from burial 7, crypt B9 (Fig. 79E), related to the image of the Holy Virgin Mary of Immaculate Conception. This image presents Mary standing on a crescent, crushing a dragon or a snake (symbolising the devil and sin) with her feet, which was common in seventeenth- and eighteenth-century Polish sacral art. It originated from the verses of the Old Testament and the twelfth chapter of the Apocalypse (Biernacka 1987, p. 27–93). One should assume that the wooden and metal Passion figures for the crucifixes and the general form of the crosses were inspired by crosses and crucifixes present in monasteries, churches and sanctuaries visited by artisans.

One cannot exclude that some of the crosses, such as the one from burial 19 crypt B5, probably a reliquary, may have been used as decorations in the home of a nobleman or burgher. The mentions of the presence of sculptures and images of sacral character that appear in the inventories may suggest that the home space was arranged with the use of such items allowing private religious practices (Saczyńska 2014, p. 275–86).

Metal crosses

During the survey, a group of metal devotional pendants in the form of a cross was distinguished. It includes eight items (crypt K2 damaged burial – 2 items, crypt B2\1, crypt B5\5, B5\9, B5\15, B6\4 – 2 items). Six other objects included components of devotional items. These items, related directly to the martyrdom and death of Christ himself and to Christianity in general, were made of non-ferrous metal alloys.

Cross-shaped pendants are undoubtedly the most commonly used symbol of Christianity propagated in the material remains. The form appears in buildings and temple details, and is also the symbol of personal development and religious identity of lay individuals. The wide notion of devotional items, which includes crosses, should be analysed from the perspective of the items themselves and from the perspective of their iconographic programmes, basing on the main foundations of Christianity. Cross-shaped items related to Christ's martyrdom symbolise the most important mystery of faith, revealed through the sacrifice and pain of an individual for the sake of all of humanity. At the same time popularising the wearing of a personal "cross" was intended to bring a person closer to God, to remind the wearer of His mercy and man's own weaknesses and sins, and to save us from punishment through atonement

(Grensted 1920, p. 120–43; Pelikan 2009, p. 162, 169–76). Wearing of crosses, scapulars or rosaries in well-visible places allowed persons to be identified according to their different faiths or even their different standing within the specific structure of a given religious group (bearer's honours). This is well reflected by the colour differentiation in pectoral crosses worn by the higher hierarchy of the Catholic Church (Michalski 1989, p. 255–79, Bogacka 2008, p. 31, 37; Drążkowska 2014, p. 208–11, Wachowski 2015, p. 8).

The crosses from the Franciscan church crypts can be divided into three basic groups by shape: Greek crosses, Latin crosses and Caravaca crosses. The Greek crosses (*Cruz quadrata*) have arms of identical length; in Latin crosses (so called *Cruz immisa*) the vertical beam is longer than the horizontal one, and the lower part of the vertical beam is the longest element (measured from the arm crossing point); the shape of Caravaca crosses relates to archbishop or patriarch crosses (Lorraine) (Koch 1996, p. 452; Kołyszko 2013, p. 23–61).

The first category is represented by one object from a scapular (Fig. 82) recorded in crypt K2 in the monastery cloisters area. Unfortunately, it is a separated find documented among damaged burials and its coarse dating points broadly at the eighteenth century. But it cannot be excluded that it was produced and buried with a body in the seventeen century. The small cross of 26.21–26.51 mm relates to a Greek cross by the almost identical length of the arms, while a distinctive widening of the ends can be linked with forms of the Maltese cross (Koch 1996, p. 452).

Fig. 82. Cross found among human remains and coffin relics in crypt K2, after conservation, photo M. Nowak

The artefact is made of two elements (a massive base and a delicate cover) cast in silver. The form relates to reliquary and pectoral crosses. The surface of both sides is ornamented with a shallow relief. The forms of Greek and Latin crosses, initially popularised as outlines of Byzantine and Western European temples (Koch 1996, p. 452), might be found among vast collections of early-medieval engolpions, pectorals or cross-pendants both in Western and Eastern Christianity from the eighth and ninth centuries onwards (Szczepkowska-Naliwajek 1996, p. 94–97, Bogucka 2008, p. 31–41, Katalog 2011, p. 3–16). Pectorals (*cruz pectoralis*); crosses worn on the chest (Latin *pectus* – chest) and engolpions (objects of various shape worn on the chest or neck) were originally of aprotropaic character. The tradition of decorative cross

pendants among laymen and clergy emerged in the same period. The oldest forms of crosses followed altar and procession crosses and consisted of two crosses linked with a hinge. The prepared space was used for storing relics, mainly of the Holy Cross, *brandea*[20]-type or textile fragments (Szczepkowska-Naliwajek 1996, p. 94–95, Bogucka 2008, p. 31–41). The silver cross attached to the scapular from crypt K2 in the monastery cloisters can be stylistically linked to Baroque-Rococo objects (17th–18th century) – bishop pectorals. It can be classified as part of a group of engraved pectorals in which the Latin cross dominates and the Greek form was used sporadically (since no specimens remain of these forms, they are analysed basing on 17th- and 18th-century tombstones). By reference to objects in the form of a Latin cross from the same times, pectoral crosses possibly containing relics have the form of a relatively tall container with a flat plate cover (Bogucka 2008, see figures 73–83, 87–89). Due to their poor preservation status, no relics were recorded, but the literature on the subject suggests that bishop pectoral crosses did not always include relic particles (Szczepkowska-Naliwajek 1996, p. 94––95, Bogucka 2008, p. 31–41, 147–164; Drążkowska 2014, p. 200–212). An artefact of similar structure and also of Latin cross form was documented during an excavation survey in the church of the Immaculate Conception of Mary (currently the Orthodox church of St Nicolas) in Dubno, Ukraine (Niedźwiadek, Drążkowska et al. 2015, p. 104–16).

The Latin cross type is represented by two artefacts: the first from the infill of damaged burials containing human remains, crypt K2 in the cloister, and the other from burial 15, crypt B5. Both forms should be included in the group of one-sided cast crosses. The first was cast in an alloy with significant content of lead and tin, while copper dominated in the second. The cross from burial 15, crypt B5 (Fig. 83) is a closing element of a heavily damaged rosary of wooden beads on a silk rope. The artefact measures 41.59–27.83 mm and has the form of a *Cruz immissa*. At the beam crossing it was widened to a form of medallion, with four rays (with ends resembling the ends of a knight's cross). This element is supplemented by the image of Mary with Child Jesus placed in the central part and emphasises it. The colourful image of Mary and Christ was made on paper or parchment, most likely by hand. It presents the Madonna of Częstochowa (Jasna Góra). The image was placed under a polished piece of glass or crystal, with trapezoidal, finished edges set on a low flange. The decorative character of the composition is achieved by filling the cells of the cross beams with white, opaque glass.

Due to the state of preservation of the whole burial, the artefact dating timeframe is very wide and spans the seventeenth to eighteenth centuries. The item is characterised by a merger of aesthetical features (by the golden shine of a brass alloy and white glass mass) and theological features, with a Christological programme (the shape of the object) and a programme devoted to Mary (image of Mary with Child under the glass/crystal). Crosses of such character are not common among archaeological finds. Similar items were found in, among other places, St Nicolas church in Gniew (Pawlikowski 2017, p. 66–69). The central part of this item is also emphasised by the use of rays. The Madonna of Częstochowa, imaged on paper or parchment in this form, was presented also on rings, as was very popular in the eighteenth century. A similar representation can be found on an object dated to the eighteenth century in the Kórnik Castle Museum. A similar technique was used there not only for the image itself, but also for the method of closing the image of Mary with Child in a crystal capsule surrounded by a flange (Letkiewicz 2011, p. 328–9).

[20] *Brandea* – items that become relics after contact with a relic (Szczepkowska-Naliwajek 1996, p. 29, Kołyszko 2013, p. 44).

Fig. 83. Cross ending a rosary, obverse and reverse, at the bottom – microscopic photos of details, after conservation, burial 15 crypt B5, photo M. Nowak

The last, most numerous group of crosses comprises five items in the form of Caravaca crosses. Two subgroups can be distinguished there: ornamented (crypt B6\4) and unornamented (crypt B2\1; crypt B5\9). All the items, similarly to the groups mentioned above, should be classified as pendants with the eye in the plane of the cross, on the upper end of the vertical beam. The decorated Caravaca cross from burial 4 crypt B6 (Fig. 84) is ornamented by an extensive iconographic programme. Similarly to a reliquary cross, symbols related to the martyrdom of Christ are placed on both sides. Caravaca crosses are the most numerous group among the Cracow artefacts; they are characterised by a doubled number of vertical arms and thus should be classified as patriarchal crosses. The chalice-like, bell-like or agrostemma flower-like space of the cross beam ends is a distinguishing element (Kołyszko 2013, p. 41–61). The archetype of these distinctive crosses, often defined as "Spanish crosses" or "Caravaca crosses", is the reliquary cross kept in Caravaca, Murcia, Spain till the Spanish civil war between 1936 and 1939.

Smaller copies, following the form of a pectoral, grew in popularity in the sixteenth and seventeen centuries and their decorations often include: images related to the legend about the revelation of the cross in Caravaca; silhouettes of Christ, Mary or saints; or letters of St Benedict's prayer or the blessing of St Zachary (Chudzińska 1998, p. 31, 2008, p. 349, Kołyszko 2013, p. 43–45). They were treated as amulets worn on the neck but also often stitched to scapulars (Fig. 85) or added to rosaries. But in 1678 their production and distribution was banned by the Sacred Congregation of Indulgences. The apotropaic character emerged based on the belief that a cross rubbed against the original provides protection against enemies and spells, helps in farming works and protects from disasters, thus becoming a relic itself. Some of these features might be included in the *brandea*-type relics mentioned above. From 1547 onwards, Caravaca-type crosses were considered a protection against plague, and copper, silver and gold copies of the Caravaca reliquary were supposed to have such protective properties (Chudzińska 2008, p. 349; Kołyszko 2013, p. 45). Of the analysed set, the decorated Caravaca cross from burial 4 crypt B6 was the only one that was part of a rosary. Artefacts similar in form but differing in decoration have been found in churches in Toruń (Kwiatkowski 2005, p. 37), Gdańsk, Łobżenica, Złotoria, Wierzchucin Królewski (Kołyszko 2013, p. 41–61, Fig. 8, 18–19, 20, 21––22, 24–25, 27), Lublin (Niedźwiadek 2015, p. 71–97) and Gniew (Pawlikowski 2017, p. 69–70).

Fig. 84. Caravaca form cross, probably a glass bead rosary element, averse and reverse, at the bottom: magnified details, after conservation, crypt B6 burial 4, photo M. Nowak

Non-decorated crosses similar to those retrieved during the present survey were found also in the remains of Dominican monastery in Toruń (Kołyszko 2013, p. 41–61, Fig. 16–17, 27) and in St Nicolas church in Gniew (Grupa et al. 2015, p. 125–40, Nowak 2015). The presence of these two small Caravaca crosses inside the structure of a scapular from burial 1 crypt B2 indicates the very important role that these symbols played in daily life. They also give the whole confraternity scapular structure an apotropaic character, practically turning it into an "amulet-bag". The presence of two crosses (one in each of the petals) can be interpreted as an attempt to provide the person with full protection against visible danger (front) and poorly visible danger (from the back).

Fig. 85. Scapular, two scapular petals, at the bottom: close-up of the Caravaca cross at the upper, outer part of one of the petals, after conservation, burial 5 crypt B5, photo M. Nowak

The metal crosses recorded in the crypts of the Cracow church of St Francis of Assisi can be divided into two categories: usage crosses, which were worn independently, probably on the neck; and elements of other devotional items. The first group consists of only two items: a simple, one-sided cross from crypt K2 in the cloisters and a silver Caravaca cross from crypt B5 burial 9. The absence of additional relics, such as bands, cords or chains, may suggest the

use of such materials as flax or wool that decomposed due to post-deposition processes. The crosses from the other mentioned burials, as was already stated, often constituted an additional element of scapulars or rosaries (Chudzińska 2008, p. 349). Confirmation of this trend for scapulars that was observed on four Cracow items can be found, for instance, in Gniew: scapulars with catalogue numbers 347, 355, 402 (Grupa et al. 2015, p. 125–40, Niedźwiadek 2015, p. 98–102, Nowak 2015, p. 113–20) or Lublin (Niedźwiadek 2015, p. 71–97). The use of metal crosses at the ends of rosaries is a rarer find. Among the Cracow materials, only two rosaries ended with metal crosses.[21] This gives a completely different character and function to these forms, as confirmed at other sites of similar chronology, including, among others, Ostrów Tumski (Pankiewicz, Witkowski 2012, p. 49–68).

Medallions

The small items related to personal religious practice and belonging to the persons buried in the Cracow Franciscan church included quite a high number of devotional medallions. A total of seventeen such artefacts were found, including seven attached to a rosary (crypt B5\8, B5\12, B5\14, (Fig. 86), B5\15 (Fig. 87B), crypt B6\4, crypt B3 and K2 in the cloisters, among the damaged burials), four placed in scapulars (crypt B5\1, B5\2 and crypt B2 and K2 among damaged burials), and another seven placed separately next to burials (crypt B7\1, B9\11–2 specimens, B3\damaged burial – 2 specimens, K2\damaged burial). The set includes mainly bronze or other non-ferrous metal casts, with copper dominating. The material composition of the alloy heavily influences the state of preservation of an item subject to the influence of aggressive substances produced by the decomposition of a human body. Thus, the pendants cast in lower-quality alloys have lost their original legibility to various extents. Two of the discovered medallions were made with a painting technique on a copper sheet (crypt B9\11 and crypt B3\damaged burial), three others were drawings on paper, covered by glass either in a copper frame (two in crypts B5\1 and B\2) or in a cross medallion (one – crypt B5\15). One pendant was cast in tin (probably later coated in silver; crypt B5\12). The separate items are of very diverse shapes. Despite the fact that oval medallions were the majority (with 11 items), only one (crypt B6\4) was oriented horizontally, and the other ten vertically.

The analysed set also included pendants of other shapes. Two medallions were square (crypt B5\1, B5\2), and one was octagonal (crypt B5\8). The qualitative and quantitative selection of iconographic motifs of these devotional items is an interesting issue. Fifteen medallions are decorated on both sides, two on one side, totalling thirty-two individual images. Without doubt Mary was represented most often, usually accompanied by the Son (but with Mary as the dominant figure, more important to the specific scene). In eleven images she is clearly identified, while on three or four images her presence can be assumed (crypt B3 – damaged burials: 4 images, crypt B5\1, B5\2, B5\12, B5\14, B5\15, B6\4, crypt K2 in the cloisters – damaged burial). Christ was presented alone in only three cases. Such a proportion may be related to the deep belief in the idea of Mary as a proxy (*intercessio*) between sinful men and God. Christ is the source of life (*fons vitae*) but the Mother of God, who realises the Salvation, connects men with this source (Rożek 2010, p. 165). Hagiographic themes were identified at least four times on the analysed medallions, while five other images are possible. The high popularity of images

[21] See sub-section on rosaries.

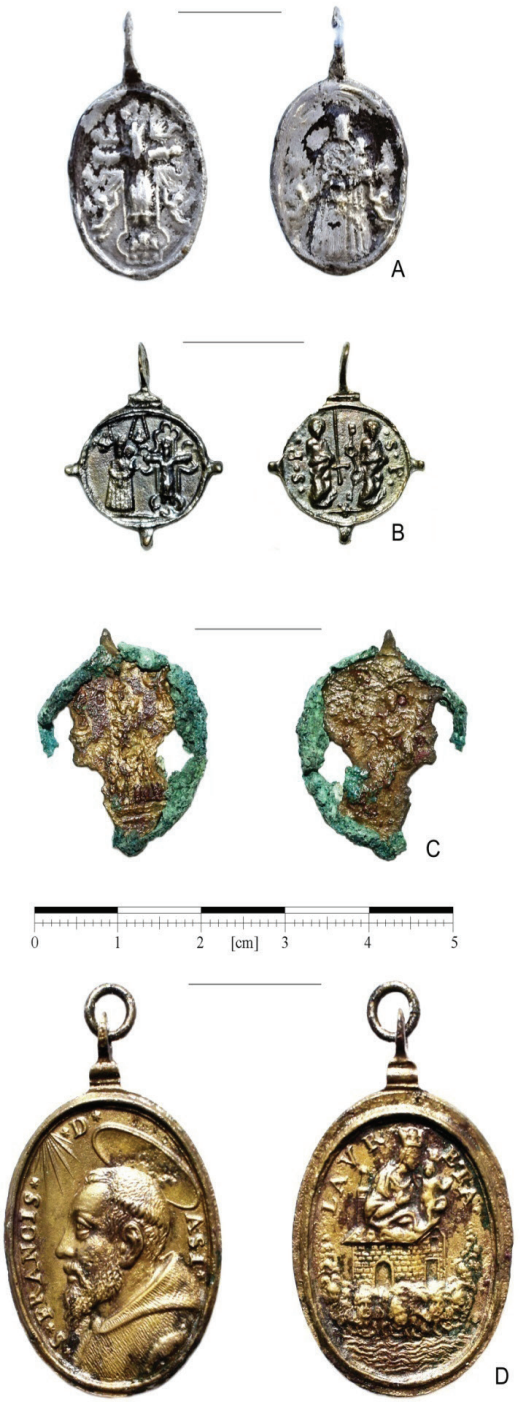

Fig. 86. Compilation of medallions: A) medallion constituting an element of a rosary, crypt B5 burial 12; B) medallion constituting an element of a rosary, crypt B6 burial 4; C) medallion constituting an element of a rosary, damaged burial crypt K2; D) medallion constituting an element of a rosary, crypt B5 burial 14; after conservation, obverse and reverse, photo M. Nowak

Fig. 87. Compilation of medallions: A) medallion constituting an element of a rosary, damaged burial crypt B3; B) cross with medallion constituting an element of a rosary, crypt B5 burial 15; C) medallion from the damaged burial from crypt B3; after conservation, obverse and reverse, photo M. Nowak

of Mary complies with the post-Trent tradition of spreading the cult of the Immaculate Conception of Mary, especially in relation to images commonly considered as miraculous. Thus the fact that four medallions bear images related to the Italian Loreto sanctuary, which has been linked with multiple miracles, is not surprising. Pilgrimages to this centre peaked in the seventeenth and eighteenth centuries, after a liturgical holy day of the Translation of the Holy House of Loreto was established in 1632 (Kołyszko 2013, p. 95). The house, currently placed in the fifteenth-century church is, according to tradition, a part of the house of Mary of Nazareth in which Jesus was born and raised. In 1294, after the Muslim capture of Palestine and the routing of the crusaders, the Angelli family, probably administrators of Epirus, organised the transfer of the elements of the house to Loreto, and its later reconstruction. According to a popular legend probably related to the surname of the initiators of this endeavour, *Santa Casa* was transferred to Italy by Englishmen. Inside it, on the altar, a figure of the so-called Madonna of Loreto was placed in 1315. The figure originates from the eleventh or twelfth century. It depicts Mary standing in a bright dress, with the Child Jesus with the orb and cross – the Earth – in his hand. Both crowned figures are covered with dalmatic. In Poland, the Madonna of Loreto was especially worshipped by the Sobieski family, most of all after King John II Sobieski captured the mysterious image of the Lady of Loreto[22] at Vienna. The cult also spread across the society – in the sixteenth and seventeenth centuries, thirty-three Loreto cult centres appeared in Poland (Marecki 1994). Joint motifs of the images of Loreto and Numano/ /Sirolo were confirmed on two devotional pendants from the discussed set: coffin 12, crypt B5 (Fig. 86A) and the child burial 4, crypt B6 (with a rosary and a Caravaca cross) (Fig. 86B). The third, almost certain image of the Madonna of Loreto was left in far worse shape (Fig. 86C) on a heart-shaped medallion, on a remaining fragment of a rosary from crypt K2, from the layer of damaged burials. Without doubt a higher artistic value is exhibited by a devotional medallion found with a rosary in coffin 14, crypt B5 (Fig. 86D). The medallion is of significant size (32×26 mm) with an eye, and was cast in bronze and finished with carving. An extensive decoration presents a scene showing the transfer of the *Santa Casa* to Italy.

Images of an eastern origin related to Byzantine art and usually following the fashion of the Jasna Góra icon that is especially worshiped in Poland were the second motif often exploited on medallions of the cult of Mary in the Baroque period. According to the legend, the Black Madonna of Częstochowa (Jasna Góra) was painted by Luke the Evangelist on the planks of a table at Mary's house in Jerusalem (Western tradition) or from the Cenacle (eastern tradition). In 1382 or 1384 it was granted by Duke Vladislaus II of Opole to the Pauline Fathers arriving (from Hungary) at a monastery being erected in the vicinity of Stara Częstochowa (Old Częstochowa). Iconographically it belongs to the type defined as Hodegetria. Among the images of the Lady of Jasna Góra, the iconographically and technologically most interesting is the item from crypt B3 (Fig. 87A). It was found among damaged burials, along with a rosary. An oval medallion with a clear rim (30.5×26.5 mm) was made as painting on a copper sheet. Mary with Child on the obverse is pictured in a pose analogous to the Częstochowa image. The second image of the Madonna of Częstochowa was found on a medallion placed in the centre of a cross attached to a rosary from coffin 15, crypt B5 (Fig. 87B).

[22] Scarfs, carried by the angels bear the following inscriptions: *In hac Imagine Mariae Victor ero Ioannes* and *In hac Imagine Mariae Vinces Ioannes*; due to coincidence with the king's name the event was considered a miracle (Widacka 2007).

In the seventeenth and eighteenth centuries, both in Poland and across all of Catholic Europe, medallions with compositionally consistent, antique-style profile busts of Mary and Jesus were popular. This type of image originates from the Italian Renaissance and relates to a classicistic trend in the Italian Baroque (Pankiewicz, Witkowski 2012, p. 55). Medallions from that period bearing such images were called "Abondino", since their form resembled products of the Italian medallion artisan workshop of Antonio Abondio and his son Alessandro that was active in the period 1570–1650 (Hupało 2018, p. 294). The figurative images were often supplemented by inscriptions – usually such as: *Salvator Mundi* and *Mater Salvatoris* or *Regina Caeli*. In the Franciscan church in Cracow, two medallions resembling this type were found (Fig. 88A, B). The first, made of non-ferrous metal alloy, was discovered among the damaged burials in crypt B3.

The obverse shows a female bust with veiled head looking to the left. There remains the relic of an inscription ARAVTI VSA that originally surrounded the figure. On the reverse, the bust of a young, long-haired man of classical profile and well-tended beard is shown. Around the head an incomplete inscription can be seen (SO/LECI(T?)ARIOR). The second specimen, also metal, and oval (30×26 mm), is in a much worse shape. The only legible side shows the bust of a man with short beard, looking to the left and surrounded with a halo with rays. A fragment of a classical inscription can be seen around the rim (possibly [RE]X(?) MVNDI). The whole was surrounded by a wreath of lilies (?) and a circle of pearls. The surface of the second side of the medallion was highly corroded (relics of a possible full figure image remain). Devotional items of this kind but differing in terms of detail have been found at, among other places, Ostrów Tumski in Wrocław, in Maniowy (Podhale), in Dubno (Volhynia), Wawel in Cracow, and in Sławków (Katalog 2007, p. 565; Kołyszko 2013, p. 84–86; Pankiewicz, Witkowski 2012, p. 54––55; Łyczak, Książyńska 2017, p. 154; Hupało 2018, p. 294–5).

The last two medallions linked to the cult of Mary, but also of Christological character, are related directly to the Franciscan rites in which the cult of Mary was of high importance. The cult was represented in the founding of confraternities focusing on the martyrdom of Christ and His Mother (association of worshippers of Jesus Suffering and Mary of Sorrows, continued by the Archconfraternity of the Lord's Passion or Confraternity of Seven Sorrows of Mary). Another one was the persistent cult of the late-gothic image of Mary of Sorrows, the so-called Sad Benefactor of Cracow, which was present among the brothers from the Cracow monastery and the faithful around it (KZSP 1971, 116). Two medallions supplementing scapulars from coffins 1 and 2, crypt B5 (Fig. 88C) are clear examples of the cult of the Passion. They both represent the same type and were very likely made by the same manufacturer. The monochromatic iconographic representation was made on paper, by convex print technique, and then placed on a copper sheet and covered with a piece of glass. The edges of the sheet were delicately bent outwards, fixing the glass and forming a roughly square medallion (32×30.5 mm and 28.5×28 mm). On a square space of the image, a circular medallion shape was drawn with a schematic image of the Pieta inside. Of the discussed set, the only specimen of a protective type medallion, even of a magical character, is the so called Medallion of St Benedict. According to tradition, Benedict of Nursia, the creator of the rule named after him, had the gift of foresight, miracles and healing with prayer. He was worshipped as a patron of a good and happy death and it was also believed that his intercession could protect against Satan's temptations and various disasters, or even reverse spells. Medallions with a cross and St Benedict's prayer for personal protection appeared probably in the fifteenth century in Germany. They were usually produced locally, without particular care for their aesthetic value, even though they were

Fig. 88. Compilation of medallions: A) medallion from a damaged burial, crypt B3; B) medallion from crypt B9 burial 11; C) medallion being an element of a scapular, crypt B5 burial 1; D) medallion being an element of a scapular, crypt B5 burial 2; E) medallion being an element of a rosary, crypt B5 burial 8; F) medallion from a damaged burial crypt K2; after conservation, obverse and reverse, photo M. Nowak

also issued by monastery workshops. The Monte Cassino monastery was one of important centres of production of St Benedict medallions. The pendants were of various shapes: ovals, circles, but also knight's crosses or polygons – the symbol of a shield, God's protection. The first reliable information about the medallion's iconographic programme comes from a leaflet issued in Innsbruck in 1664. This original version did not include the image of the saint. The medallion was already very popular, becoming the most popular devotional pendant in Europe in the seventeenth and eighteenth centuries. In 1742, Pope Benedict XIV issued a brief defining the form of the medallion. The Franciscan specimen was originally attached to a rosary (Fig. 88D). It was formed as an octagon (*ca* 17×17 mm). On the obverse there is a linear, graphical representation of the full figure of the saint in cuculla with very wide sleeves, with a crosier in the right hand and a chalice in the left. The figure is surrounded by the inscription CRUX SP BENEDICTI. The reverse is decorated with a knight's cross (which is typical for such

type of medallions) within an octagonal shield with the letters: CSPB (on the free fields on the outer side of the cross arms) – *Crux Sancti Patri Benedicti*; CSSML (vertically) – *Crux Sancta Sit Mihi Lux*; NDSMD (horizontally) – *Non Draco Sit Mihi Dux*. Around the shield with the cross, around the rim, are the letters: VRS – *Vade Retro, Satana*; NSMV – *Non Suade Mihi Vana*; SMQL – *Sunt Mala Quae Libas*; IVB – *Ipse Venena Bibas*. The whole was also placed within an octagonal pearl border. Full text: *May the holy cross be my light; May the dragon never be my guide; Begone Satan; Never tempt me with your vanities; What you offer me is evil; Drink the poison yourself*[23] is traditionally attributed to the saint himself. Because of the popularity mentioned above, various versions of the medallions of St Benedict are found at numerous archaeological sites, including Częstochowa, Maniowy, Lubin near Kościan, Gliwice, Pyzdry, Dubno, Puck, Tarnów Pałucki, Sandomierz, Płock, Chojnice, Trzemeszno, Gdańsk or Strzelno (Chudzińska 2008a, p. 288; Chudzińska 2008b, p. 354; Młodkowska-Przepiórkowska 2018, p. 218–20; Białobocki 1991/1992, p. 169–70; Furmanek, Michnik 2004, p. 412–13; Krzepkowski 2015, p. 247–52; Hupało 2018, p. 283–4; Truszkowski 2016, p. 150–55; Kołyszko 2013, p. 132–5).

The idea behind a medallion, defined as a small, personal, devotional, magical or apotropaic item, has a very long history, not only in the Christian world but already in the culture of Antiquity. Pliny used the word *amuletum* to describe small, protective items worn on the neck by representatives of all social classes. The early Christian Church adopted this quite innocent practice for its own purposes, binding it by means of iconography with the new ideology and giving it exclusively symbolical meaning. The term "medallion" comes from the Latin word *metallum*, meaning ore, or from the Latin word *medalia* – medal, coin. They were usually round, oval, polygonal or even cross-shaped (these last two symbolising an apotropaic shield). They were usually equipped with an eye for threading a cord or a strap, sometimes with three protrusions allowing the object to be stitched to a textile, such as clothing. Often they supplemented other types of devotional items, such as prayer ropes, chaplets, rosaries or scapulars. They were usually made of corrosion-resistant metals (non-ferrous alloys predominating in copper, bronze, brass or silver, and in more recent times with aluminium – often gold- or silver-coated) by casting or punching. Specimens of higher quality and artistic value were additionally carved. Medallions painted on a metal sheet or with a painted or printed picture on paper covered with a glass were usually a cheaper equivalent. Due to the presence of iconographic imagery, inscriptions and sometimes punched dates, and due to the long time of their use, they should be treated as valuable sources of numismatic character (Kołyszko 2013, p. 76–78).

Reliquary

One unique find is a small, oval personal reliquary in the form of a medallion with an eye, suggesting it was suspended on a rope or chain, that was found among the burial furnishing in crypt B9. The item was recorded below the coffin with burial 12, where human and coffin remains from several damaged burials were deposited. This makes it impossible to link it with a specific skeleton.

The reliquary was made of non-ferrous metal alloys with copper as the primary metal. It has the form of an oval container (Fig. 89) of 51.51 mm tall and 43.20 mm wide. It consists of two oval sheets set in a bracket, with one permanently soldered to the bracket and the

[23] English translation after: https://www.osb.org/the-medal-of-saint-benedict/ on 16th Aug. 2020.

other with a soldered pin (the counterpart of an opening in the bracket) and a protrusion (at the upper part of the sheet, additionally ending with a band-like eye), being an opened cover. There was a "bundle" containing five items inside the container. After removing the cover the first item to be revealed was a small, rectangular fragment of green silk velvet (Fig. 89B). Underneath the fabric there was a red elliptical wax seal (Fig. 89C, 90) of 22.11 mm tall and 19.63 mm wide. The seal was placed on a contact of the edge of a thick paper, that wrapped two items inside. The seal was both a "closing" of the "bundle" and a certification of the authenticity of the item inside, preventing its being broken without leaving a visible trace. Directly under the folded edges protected with a seal, an oval parchment fragment was placed (Fig. 89E). On its surface there was clear negative imprint of the item it had covered, suggesting a very tight contact between the two items. This item, being most likely a container for a relic or a relic itself, is of elliptical shape of 39.05 mm tall and 30.22 mm wide (Fig. 89F, 91). The basic element is a paper oval consisting of a few layers of glued and pressed paper. In the central part a stylised cross was cut, surrounded with polygonal, arch-shaped and round openings, thus giving it the character of an openwork plaque. On the bottom side, fragments of letters written in black ink are visible (Fig. 91).

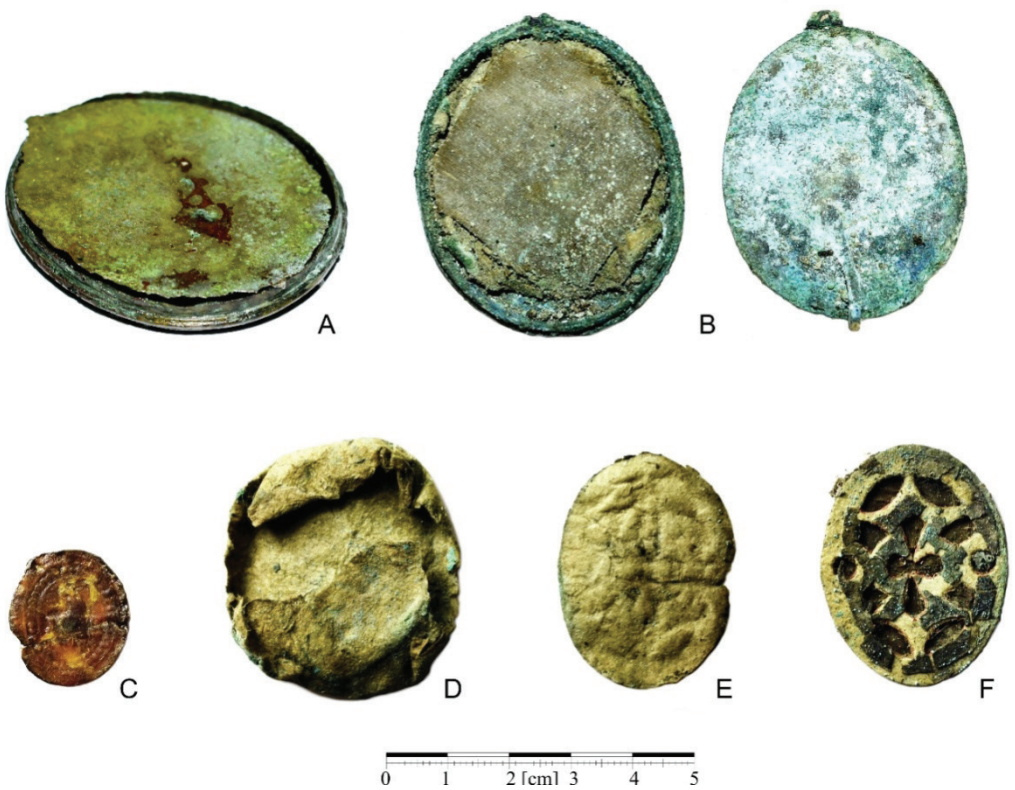

Fig. 89. Medallion: A) reliquary medallion, overview; B) reliquary medallion after opening of the cover; C) wax seal; D) paper bundle of the reliquary; E) parchment insert; F) reliquary, overview from the outer side, after conservation, photo M. Nowak

Due to the character of the item, it can be assumed that pages of a printed prayer book or specially prepared pages with religious text had been used. All internal edges of the cells, and

some points along the outer edge of the ellipse, are covered with orange lacquer. On the bottom side, underneath each of the cells, pieces of multi-weave silk fabric were placed. Currently, all have a similar, beige-ochre colour. This structure makes the whole element resemble a stained glass, while also allowing the assumption that each of the cells might harbour a relic.

Relics are an important formula of the cult of saints in the Catholic Church. The cult involves the worship of the remains of saints or of artefacts related to them. Its origins reach back to the second century. The original version of the cult included visits to the tombs of saints, and prayers at the tomb on the anniversary of their death. It stimulated pilgrimage tendencies. At the same time, in the second century, and then from the fourth century onwards, there was an intensive process of finding and transferring relics. By definition, a reliquary is a religious cult vessel used to harbour and present relics (Starnawska 2008, p. 225–34; Datko 2012, p. 412–13; Encyklopedia ekumeniczna 2017, p. 332).

Fig. 90. Wax seal: A) obverse; B) wax seal, microscopic photo of a detail, after conservation, photo M. Nowak

The literature also describes the notion of "reliquary jewels", which are defined as items used for harbouring relics of saints or related objects (K. Szczepkowska-Naliwajek 1996, p. 235–9; Letkiewicz 2006, p. 542). Several types should be distinguished here: reliquaries in the form of a tomb (coffins, sarcophagi), reliquaries related to architectural forms, anthropological ones and paxes (also including those in the shape of a monstrance and of an extensive artistic form) (Marecki, Rotter 2012, p. 15–17). The basic purpose of introducing reliquaries was to secure valuable, cult remains, and items or fragments thereof against the destruction that often occurred when they were presented in an openly accessible manner (Marecki, Rotter 2012, p. 15). Relic containers were made using precious materials, including golden or silver sheet, supplemented with gemstones or pearl, ivory and colourful enamels, creating a rich iconographic programme. Both the protective function and rich decorations of the reliquaries might be interpreted as emphasising the role of this cult in religious life and the value of the relics themselves (Letkiewicz 2006, p. 332; Datko 2012, p. 412–13, Marecki, Rotter 2012, p. 15). As early as the pre-Romanesque and Romanesque periods, personal reliquaries in the form of a pendant existed, evolving to the form of an object constituting an insignia of power,

Fig. 91. Reliquary: A) outer side overview; B) reliquary, microscopic photo of an outer side detail, C) reliquary, microscopic photo of bottom side of the fabric, after conservation, photo M. Nowak

such as bishop rings, pectorales[24] or encolpions (Letkiewicz 206, p. 332, Datko 2012, p. 413). The discussed reliquary can, due to its simple form, be included in a category of medallions or reliquary pendants, and the first ones were most popular in the fourteenth and fifteenth centuries. A similar artefact[25] was found during an excavation survey of St Martin's church in Prozorje (Martin-Breg), unfortunately as a separated find, as well as in Žumberk and Ližnajn (Belaj, Stingl 2017, p. 110–14). The Cracow reliquary was not a permanently closed container. Its owner was able to open it any time and touch the particles inside. At the same time this possibility was quite limited. The particles of the relics were probably placed in the open spaces of the openwork, resting on fragments of silk fabric, and the whole was covered by a fragment of parchment, constituting a kind of sealed bag. The owner could obviously remove the seal and look inside. According to written sources and the literature on the subject, however, the demand for particles, transfer of bodies or of reliquary ownership favoured forgery. In order to

[24] In crypt K2, located in the cloisters of the Franciscan monastery, a cross was found. Its form relates to Baroque pectorales and it is probably also a reliquary. The item was recorded as a fragment of scapular decoration, and a detailed description can be found in the chapter devoted to metal crosses.

[25] The similarity was determined from very sparse information and a colour photo of the item. There is no information about the contents of the container.

counteract the forgeries and preventing circulation of forged relics, certificates of authenticity were added to the reliquaries in the form of diplomas, fabric bands or parchment sheets. Furthermore, they were secured with seals. The Fourth Council of the Lateran mentioned above stated also that the authenticity of new relics could be confirmed by the Pope alone, and not by bishops, as had been the custom. There regulations were breached several times, however. At the same time, previously certifications of particles remained valid. Often this authenticity was confirmed by their last owner, and sometimes by a ruler who became the owner. Another important factor for acknowledging remains as relics was the confirmation of miracles supposedly having occurred around them or as a result of contact with them (Starnawska 2008, p. 173–92). This might be why the contents of the reliquary from crypt B9 were not breached and the seal still merged the edges of the "bundle" and did not bear any visible signs of breaking. An important argument in favour of placing particles in the small spaces of the openwork plate was the use of separate fragments of silk fabric. The inner sides of the elliptical sheets of the container bear small, carved marks in the form of an underlined letter X. The reliquary from crypt B9 was certainly an element of a burial furnishing of a person of high social and financial status. This suggests that the close presence of particles in daily life, even without the possibility of visual contact or touch of the relics, was important for the spiritual development and deepening of faith. At the same time, the apotropaic character, which originated from pagan beliefs, should be considered. Identifying this item as a talisman would not be an error. Without doubt, the particles deposited inside the medallion-shaped container were supposed to protect the owner and help in gaining the favour and intercession of a saint or many saints after the owner's death.

Rings with a head and plain rings

Only four hand-worn decorative items were recorded during the survey, in the burials: crypt B3\4, crypt B6\2, crypt B7\1, B9\11A/11B[26] (coffin 11). During the field survey, two basic categories based on this form were distinguished: rings with a head (Fig. 92, 93) and plain rings (Fig. 94, 95). The material was another criterion: non-organic (2 rings with a head and 1 plain ring) and organic (1 ring). Rings with a head and plain rings from the tombs constitute a body decoration and a luxury, being material remains confirming the high social status of the person or an official function. They are also an element of tradition, well established in burial rites. They also reveal the skill level of the contemporary artisans.

Besides a decorative function, most of the rings also had symbolical meaning, such as engagement rings, wedding rings, and bishop or royal rings (Letkiewicz 2006, p. 255–63; 2011, p. 320–36; Nowacki, Piwocka 2011, p. 23, 43, 266–7, Drążkowska 2014, p. 257–65). Wedding rings did not necessarily resemble those used in present times. But their symbolical representation, the expression of lasting feelings between two persons, and putting them on each other's fingers remain. Whether the ring was of a plain form or elaborate ornamented form does not matter in this case (Jones 1877, p. 275–322).

Rings with heads and plain rings are quite often found in city-type strata, at sites such as Targ Sienny (Straw Market) or Wyspa Spichrzów (Granary Island) in Gdańsk, as well as Nowy Targ (New Market) in Wrocław (Wachowski 2018, p. 975–80). These finds allow us to assume

[26] One coffin included two burials.

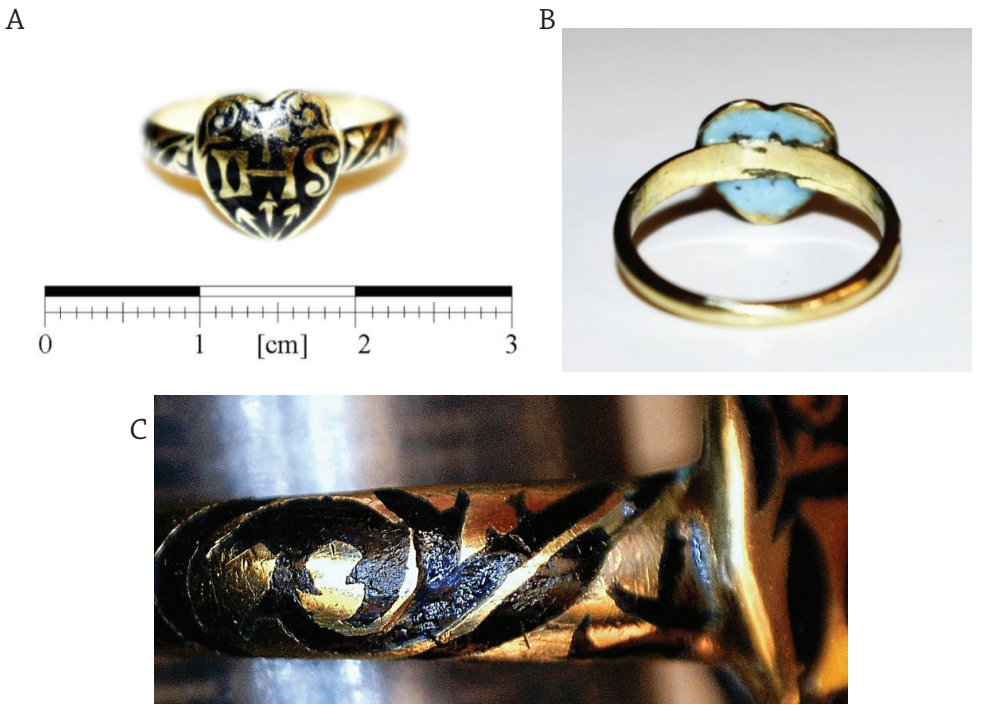

Fig. 92. Ring with the initials IHS: A) after conservation, burial 1 crypt B7, view from the outer side of the head; B) ring, on the inner side of the head the method of its setting with a blue glass can be seen; C) close-up of a rail ornament, photo M. Nowak

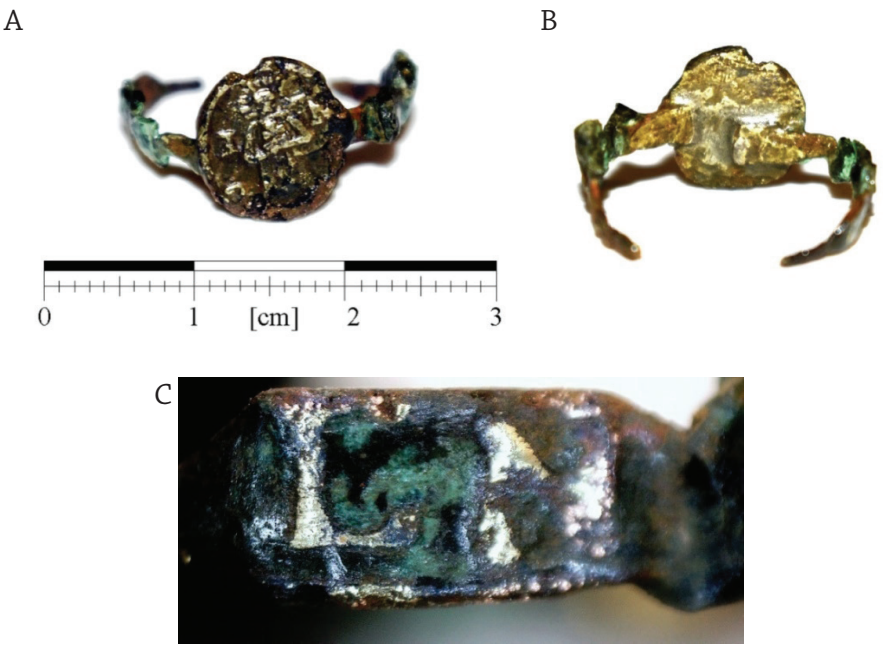

Fig. 93 Ring with figure of Christ: A) view from the head, after conservation, burial 4 crypt B3; B) ring from the bottom side of the head, showing method of fixing of rail to head: soldering with tin; C) close-up of a detail with the letters E and N on the rail, microscopic photo, photo M. Nowak

that rings were becoming more and more popular and they were often lost. Furthermore, quite a wide diversity of materials and styles is seen among the rings. Two analysed simple rings did not have an additional decoration. A brass decoration from coffin 10 of crypt B9 (Fig. 94) may have been a wedding ring. Comparison of its form and material points to an analogy to other sixteenth- to seventeenth-century rings from England (Awais-Dean 2017, p. 84–85). The entering into marriage by placing rings on the fingers in the Roman Catholic faith has been confirmed for the beginning of the seventeenth century in the *Roman Ritual* (1612), while in the Anglican Church this custom was accepted already in the sixteenth century. The scheme above is not followed by a turned wood ring, since it was placed on the smallest finger of the left hand when found. The material itself could exclude it from the group of wedding rings, since as early as in the thirteenth century it was suggested that they be produced in gold, which, as the most perfect of the metals, represented the value of love as the most perfect feeling (Awais-Dean 2017, p. 85). At the same time it should be noted that the unique character is confirmed by the lack of analogies from other sites.

Rings related directly to Christianity appear as early as the period of the apostles. Their heads or rails bear images of a dove, fish, letters or Christograms (Jones 1877, Mercier 2011, p. 21–42; Awais-Dean 2017, p. 7–109, Wachowski 2018, p. 975–80). Examples of such items include the one found in Bosington, and currently stored in the Ashmolean Museum in Oxford. It is a golden ring with an image of a man (9th–11th century). It bears a Latin inscription *NOMEN EHLLA FID IN XPO* (I am Ella, I believe in Christ) which directly points to the owner, who could afford to order such an item, but which is also the owner's credo (Jones 1877, p. 47, Smith 1908, p. 1–79).

Fig. 94. Brass plain ring, crypt B9 burial 11A, B, after conservation, photo M. Nowak

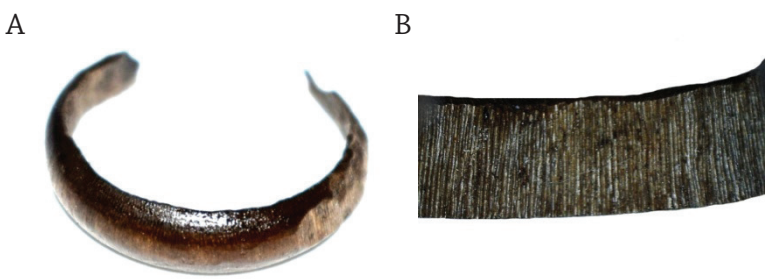

Fig. 95. Wooden ring: A) outer side, after conservation; B) Wooden ring, inner side, microscopic photo, photo M. Nowak

Rings, being a symbol of devotion, often bore images of saint patrons, such as St Francis, St Stanislaus, St John, St Veronica, John of Nepomuk and others. Especially the images of Mary worshipped by specific cults were popular – among others, the Black Madonna of Częstochowa, Mary with Child, Our Lady of Sorrows. Also, images of Christ were common (Letkiewicz 2011, p. 326–7). Rings with religious themes, inscriptions or figures of saints were popular purchases among the nobility and wealthy burghers, and thus are present in numerous inventory records: "*A golden ring, with one diamond and a second one missing, with the portrait of the Lady of Częstochowa in the middle*" was in the inventory of Anna Znamierowska of the Dobraczyński family (Letkiewicz 2011, p. 326), as well as "*a golden ring […], with the heart of our Lord Jesus on a sheet under a glass*". Michał Kazimierz Radziwiłł had "*a golden ring, with the name of Jesus carved inside…*" (Letkiewicz 2011, p. 327). Similar rings belonged also to the daughter of Michał Gaber – *"a tiny seal ring with the name of Jesus*" (Inwentarze mieszczańskie 1961, p. 488) and Zachariusz Kosmowski, a furrier – "*a golden ring with the name of Jesus*" (Inwentarze mieszczańskie 1961, p. 489). Nobility inventories include also funeral rings, that were already being used in the Middle Ages. This purpose is confirmed by the following decorative motifs: skulls, skeletons, or "spade and hoe", symbolising the end of human life and tools for separating the dead from the living (Letkiewicz 2011, p. 332–3). Funeral rings were an item commemorating the person they belonged to, so according to the testator's will they were distributed among the family and friends before the funeral ceremony. They were a part of the bereavement dress, and sometimes presented quite a large value. In England, wealthy persons predicting imminent death and willing to grant more people made a specific provision in their testaments. In such a case a larger number of identical rings was made. In order to further emphasise the commemorative character of these items, there was the first and last name and the date of death of the commemorated person carved on the inner side (Letkiewicz 2011, p. 333). From the mid-seventeenth century onwards, funeral rings became more popular in many countries (Newman 1996, p. 208).

Items found in burial 4 of crypt B3 (Fig. 93) and burial 1 of crypt B7 (Fig. 92) can be qualified as rings with an iconographic head, or so-called Jesuit rings (Stone 1974, p. 123, Kerr 2012, p. 28–29), with images that allow them to be described as "rings of faith" (Bayard 1924, p. 174). The items have similar structures, and the heads were soldered to the rail. The heads were probably cast, and possible imperfections of the semi-product might have been corrected by carving. In case of the golden ring from burial 1 (crypt B7) a rail, or rather a seamless ring, was decorated with a plant ornamentation, by carving a groove of trapezoid section. The rail of ring from burial 4 (crypt B3) does not constitute a full circle. Differentiations in the making may result mainly from the material used and the cost of preparation of a given ring. The technique of making "Jesuit" rings of copper (including copper alloys with zinc and with tin), of silver-based alloys and of tin-lead alloys is based mainly on making the heads in a technique of casting or punching, giving them round, rectangular, polygonal or heart shapes (Mercier 2011, p. 21–42, Wachowski 2018, p. 975–80). The rails were most likely made by rolling or wire drawing, with bending and coining. Such a method of ring-making was used in the seventeen and the eighteenth centuries (Mercier 2011, p. 21–42). This is additional evidence that coffin 4 was deposited in crypt B3 no later than in 1775. The golden ring was made by a specialised goldsmith-jeweller workshop, most likely after an individual order, or was imported from Italy. The form was completed by adding a contrasting glazing. Figure images, religious symbols, letters and inscriptions are indispensable elements of decoration on rings with a credo (Jones 1877; Mercier 2011, p. 21–42; Awais-Dean 2017, p. 7–109; Wachowski 2018, p. 975–80). Some schol-

ars suggest that by the second half of the eighteenth century in New France the "Jesuit" rings had lost their religious value, transforming into a commodity to be traded with native population (Evans 2003, p. 33; Kerr 2012, p. 28–30).

One item draws special attention. It is a golden ring from a female burial from crypt B7. It is very well preserved. It was found under the textile sheath of the coffin cover. The place of its deposition suggests that it probably could not be fitted on a finger, but it made it into the tomb anyway. Also, there is a wooden ring whose outstanding make and interesting choice of material makes it unique within the analysed set. It was impossible to find mentions in the literature of similar items from other sites. It is difficult to evaluate the popularity of such wooden jewellery. The present state of knowledge does not allow us to answer the question of whether this item was worn during daily life or was prepared especially for the burial.

Considering the fact that among 95 burials studied in the Francis of Assisi church in Cracow only four were furnished with plain rings and rings with heads, it can be assumed that in modern times items of this type were relatively rare as burial furnishings. One should, however, remember, that some coffins might have been penetrated or even robbed many years ago. Some of the coffins bore traces of such activity.

A picture

An interesting find comes from the coffin of a Franciscan monk, marked as burial 14 in crypt 9. It is a paper picture with a religious motif. Artefacts of such delicate material as paper, being prone to decomposition processes, remain very rarely in the archaeological material, and each such case thus requires individual treatment (Grupa et al. 2014, p. 86–97). Unfortunately the artefact is in very poor condition – immediately after extraction it completely broke apart and all information related to the item is based on observations made at the moment of the discovery. The picture belonged to a man buried in Franciscan monk's clothes in 1759. It was deposited at the left wrist, above the hands, which had been put together, above the pelvis. Decomposition processes occurring in the coffin had caused it to pucker. Poorly visible decoration was placed on a rectangular field, surrounded by a non-decorated frame at the edges. The image of a figure remained only as relics – in the upper part there were cross beams, below a head with a halo of rays, and in the bottom part a delicately widening cross base. It can thus be assumed with high probability that the picture portrayed the scene of Christ's martyrdom on the cross. The state of preservation of the artefact did not allow the technique by which the image was made to be identified. The only conclusion was the use of concave print (copperplate? etching?).

The origins of religious painting on paper should be linked with the Middle Ages. At the end of the fourteenth century, in pilgrimage centres, sanctuaries and larger monasteries images of devotional character in the form of separate cards with prayer book miniatures started to appear. The oldest ones were hand-painted on parchment or paper. After some time woodcut, copperplate or lithographic copies also began to appear. In the beginning, images of Jesus, Mary or Bible scenes were the main themes. In the seventeenth century the repertoire extended onto allegorical, symbolical and didactical scenes, as well as images of saints. Often, prayers, dedications or descriptions of religious events (such as jubilees, coronations, icon peregrinations, ingresses) were added to images. In the eighteenth century it became popular to add small fragments of relics or plants (dried flowers) from holy places to the painting

(Przywara 2014, p. 325–6). Such items, which were easily accessible and easily carried on one's person because of their small size, had various functions – they were educative ("the Bible of the poor"), a carrier of faith (private religious practice), a salvation aid (some images had indulgence privileges) and sometimes even served as talismans (images with the cholera Caravaca cross) (Chudzińska 2008a, p. 461–3; Chudzińska 2008b, p. 449; Grupa et al. 2014, p. 87–89).

Wreath and bouquets

The analysed set included five wreaths of natural plants. Four tiny plant rings were part of a child burial furnishing (crypt B9\6, B6\3, B9\2, B2\4) and were placed directly on the skull or in its vicinity, on the pillow (B6\3). This element appeared in the burials of children with highly damaged skeletons, but the size allowed the age to be determined as *Infans I*. Only one wreath was placed on the body, at the height of the chest of a woman of *maturus* age (crypt B9\12). The circumference of the child wreaths was *ca* 31 cm to 35 cm. Due to their poor state of preservation, no precise measurements were possible. The wreath from the adult woman burial was a bit larger and had a circumference of 38 cm. The child wreaths were formed on a circular ring made of a flexible slat (of rectangular section, 1.8 wide, about 2 mm thick), probably of birch wood, with connected ends (Fig. 96). Separate branches were tied to it, quite tightly distributed along the whole circumference. Each of the plants was connected to the ring by tying several times with a flax thread (crypt B2\4, B6\3, B9\2), and in one case with a silk thread (crypt B9\6).

Fig. 96. Rosemary wreath, crypt B9 burial 6, photo M. Łyczak

The wreath for the woman had a similar structure, but the plants were gathered into tiny bunches and these were fixed to the ring with a silk thread (width 5 mm, thickness 1.8 mm). In

some places around the ring, fragments of smooth silk ribbon (width 8 mm) have remained. Some wreaths included rosemary with light-blue flowers and numerous narrow and very durable leaves. Wreaths of fresh plants, herbs and flowers were made in spring and summer months, when the plants were abundant. Thus, besides rosemary, evergreen branches of myrtle and rue also often appear, and sometimes yew. The herbs were probably composed together with wild flowers. Wreaths made of fresh plants only – despite their popularity in the past – are very rare archaeological finds, since they decay and do not leave any clear trace in the coffins. A wreath, similar to the Cracow one but made of common rue and artemisia appeared in the crypt of the church of the Name of the Holy Virgin Mary in Szczuczyn and decorated the head of Stanisław Konopka (Grupa, Nowak 2017, p. 159–72). The symbolism of wreaths in the tomb was multidimensional. They were surely an aesthetic and quite costly addition that strengthened the impression of wealth. If made of fresh, natural plants, their scent and oils might have repulsed insects, act antiseptically and suppressed the unpleasant odour of decomposing bodies (Drążkowska 2016, p. 368). That only selected burials were furnished with wreaths suggests that, beside the decorative function, a more important, symbolical one was present that determined their use. *In the notions of the Polish nation the wreath has always been the symbol of immaculate virginity* (Gloger 1972, p. 430): it meant chastity, innocence and virtue (Dekowski 1975, p. 26). Thus wreaths were allowed to decorate the heads of young girls only. Married women lost this privilege. According to St John's Book of Revelation: *Be thou faithful unto death, and I will give thee a crown of Life*,[27] so a wreath might have also been a gift for faithfulness and devotion to God (Kizik 1998, p. 88). According to Jan Chryzostom: *A young married couple is crowned with a wreath, a symbol of victory, for the undefeated [in virginity] lay down to bed and have not been prone to pleasure* (Forstner OSB 1990, p. 439). The wreath is well established in the Polish tradition and culture as an attribute decorating the bride's head during a wedding. It was used during harvest festivities and on St John's Eve and was full of magic (Gloger 1972, p. 430).

Furthermore, for those who trusted God with their life, it was the symbol of triumph over death, the hope and promise of eternal life, as well as the promise of resurrection. It also symbolises victory over darkness and sin (Biedermann 2001, p. 401). The plants woven into wreaths also had deep meanings, supplementing the message of the crown. For example, myrtle was popularly used for making wreaths symbolising love and courage. Young brides often wore this plant to emphasise their chastity and virtue. Similarly, rosemary branches symbolised truthfulness in love (Kopaliński 1987, p. 998), while a small flower of forget-me-not symbolised remembrance, love and farewell (Drążkowska 2007f, p. 493; 2016, p. 368). Cupressus, on the other hand, is a symbol of sadness and mourning, while yew is a symbol of immortality (Biedermann 2001, p. 55). Wreaths made of, or with, golden ribbons, wires or sheets had symbolical meanings resulting from their golden glow, which represented indestructibility, eternity and immortality, as well as glory and the essence of life.

Wreaths as decorations for burials of small children also appear in a few images. For example, little Elizabet, daughter of Jakub Pietersz, is dressed in a white shirt and has a wreath on her head in a painting from 1621 (Bedaux, Ekkart 2001, p. 131, Fig. 19). A wreath is a head decoration for a boy, Edzart von Grovestinsa, as painted by an unknown Danish painter in 1644 (Bukolska 1985, p. 250–51). This detail was also present in the image of a child of Frederic III (king

[27] Revelation 2:10, translation after 21st Century King James Version (KJ21).

of Denmark and Norway). Also, the sisters Anna Eleonora and Konstancja Jadwiga Mielęcki are pictured with wreaths on the heads (Dziubkowa 2002, p. 301–24).

Appearing of wreaths in burials has also been confirmed by numerous archaeological surveys: at St Laurence church in Videniškiai, in Lithuania (Niedźwiadek, Drążkowska 2015 et al. 121); in St George's Basilica in Prague Castle (Beranová 1989, p. 269–80); in archcathedrals of the Ascension of Holy Virgin Mary in Przemyśl (Drążkowska 2017, p. 368); and St Johns the Evangelist and Baptist in Lublin (Niedźwiadek, Drążkowska et al. 2015, p. 90); as well as in the church of the Name of the Holy Virgin Mary in Szczuczyn (Grupa et al. 2014); St Nicolas church in Gniew (Niedźwiadek et al. 2015; Grupa et al. 2015, p. 118; Grupa, Nowak 2017, p. 159–72); St John's church and St Trinity church in Gdańsk (Drążkowska 2007); Holy Virgin Mary church in Kostrzyn nad Odrą (Drążkowska 2004, p. 32; 2005f, p. 17; 2017, p. 187); the church of the Assumption of the Holy Virgin Mary in Toruń (Drążkowska 2006c), in the church of Assumption of Mary the Victorious in Lublin (Niedźwiadek et al. 2015, p. 84); and St Peter and Paul church in Tworków. They were found also in tombs at Salvator Cemetery in Wrocław, St Mary Magdalene in Wrocław (Wachowski 2015, p. 229–41) and the cemetery at St Jacob's Church in Toruń (Grzyb 2011, p. 160).

Besides wreaths, coffins in Cracow crypts also included small bouquets and bunches of natural plants. Some were placed on the bodies (crypt B8\2, B3\3, B8\3, B9\3, B9\2, B9\12; B5\18), at chest height or on the abdominal part, looking like they had been put in the person's hands. Several bouquets were found around the head, on the pillow (crypt B2\10), and some were placed around a child corpse (crypt B6\3). In one case (crypt B8\7) a bouquet was found at the person's feet and it is hard to state if this placement was intentional in this original location or possibly moved while the coffin was being exported to the crypt through the narrow opening. One small bouquet was tied to a wooden cross kept in the person's hands (crypt B9\4). As with the wreaths, the analysed set usually included branches of rosemary placed in bunches both on the corpses and around the heads, on the pillows. It is present also in bouquets held in the hands. Also, St John's wort, mint and groundsel were found (bouquets around the head, crypt B2\9).

Flowers included in the bouquets given to the dead had symbolical meaning, just as in the case of wreaths. Some of them expressed sadness at a premature death or emphasised the chastity and virtue of the person. White lilies, for example, had such a meaning. They expressed chastity and the soul returning to God, as well as virginity and passing away. A rose was a symbol of truthfulness, passing away and wedding. Plants wither quickly, thus symbolising premature passing away and death.

Pillows and mattresses

In forty-five burials, traces of pillows of various state of preservation were recorded. Some of them remained complete or with minor damage. Most, however, remain only as small fragments. In thirty-two cases the presence of a pillow was only suggested by plants placed in a typical way around the head.[28] Most of the discovered pillowcases were made of a single, rectangular piece of cloth, folded in the middle and stitched along three edges (crypt B2\3,

[28] Crypt B3\1, B3\2, B3\4, B3\5, B3\6, B3\7, B4\1, B5\1, B5\2, B5\3, B5\4, B5\7, B5\8, B5\9, B5\12, B5\15, B5\17, B5\18, B5\20, B5\21, B5\22, B5\25, B5\26, B6\1, B6\2, B8\5, B8\7, B9\1, B9\3, B9\4, B9\5, K2\12.

B2\4, B2\6, B2\7, B2\8, B2\9, B2\10, B2\11, B5\10, B5\11, B8\2, crypt B9\1, B9\6, B9\7). The majority of such pillows was rectangular (Fig. 97, 98). Only two pillows made in such a way were square (crypt B2\6, B6\6). Several pillowcases were made of two pieces of cloth, merged around four edges (crypt B5\6, B5\10, B5\14, B5\23, B6\3, B9\8, B9\11). Three pillowcases were stitched along one edge after folding. In this way a tunnel-like space was created and this was filled with plants. In order to prevent their falling out, the two remaining edges were folded inwards (crypt B2\5, B5\24, B6\6). This was a very simple and quick way to prepare a pillow. Only pillowcases prepared especially for a funeral were made in this way. The size of pillows depended on the size of the coffin.

Most of the preserved pillowcases were made of silk: thirteen of smooth satin (crypt B2\3, B2\4, B2\6, B2\7, B2\8, B5\24, B6\3, B9\1, B9\6, B9\7, B9\8, B9\11, B9\13), four of rep (crypt B2\9, B5\11, B5\14, B5\23), and three of taffeta (crypt B2\11, B5\6, B5\10). Only three woollen pillows were found (crypt B3\3, B8\7, B9\14) and one of flax linen (crypt B3\5); they remained only as small fragments. Certainly they must have been more numerous but have not been preserved. Most of the pillowcases were stitched with a simple stitch (crypt B2\3, B2\4, B2\5, B2\7, B2\8, B2\9, B3\6, B5\10, B5\14, B5\23, B6\3, B6\6, B9\6). Very loose basting stitch was used only for two specimens (crypt B2\10, B9\11). On the remaining ones a backstitch was recognised (crypt B2\6, B9\7, B9\8, B9\13, B5\6).

All pillowcases are discoloured. Currently, most of them have an ochre tint (crypt B2\3, B2\4, B2\5, B2\6, B2\7, B2\8, B2\10, B2\11, B5\10, B5\24, B6\6, B8\2, B9\6), seven are brown (crypt B2\9, B5\6, B5\11, B8\7, B9\7, B9\11, B9\13), while two are amaranth or red (crypt B9\1, B5\23). One pillowcase is discoloured green (crypt B5\14). Most of the ochre pillows were placed in child burials. Only four were found in adult burials (crypt B2\10, B2\11, B5\10, B5\24).

All pillowcases for children were made of the same textile as was used for their clothing (crypt B9\7). Such sets were unified stylistically and are evidence that they were made especially for the funeral. It was common to prepare funeral clothes and pillowcases (as well as coffin coverings) with the same fabric, as was observed in some cases here and can be observed at other sites. But similarly to the discussed set, it most frequently appeared in small child burials located, among other places, in St Peter and Paul church in Tworków, the church of the Holy Virgin Mary in Kostrzyn, St Nicolas church in Toruń (Drążkowska 2007g, p. 409–11), the church of the Name of the Holy Virgin Mary in Szczuczyn (Grupa et al. 2014, p. 84) and the archcathedral of St John the Baptist and the Assumption of Mary in Przemyśl.[29] Not always, however, did the preparation of clothes and pillows with the same fabric necessarily prove their narrow purpose. We know of some examples of adult burials where the same material was used and where the clothing and pillow were of repeat use character and were used by the person during their daily life. For instance, a pillow and household robe made of the same fabric was found in the coffin with the remains of Jan Dobrogost Krasiński, buried in the church of St Peter of Alcantara and St Anthony of Padua[30] in Węgrów. Similar furnishing was found in the tomb of Marcin Leopold Szczuka in the crypt of the church of the Name of the Holy Virgin Mary in Szczuczyn (Dudziński et al. 2015, p. 84).

Only one pillow of the analysed set was decorated. In its corners small two-centimetre-wide bows of silk ribbon were stitched (crypt B2\4). Almost all pillowcases, both child and

[29] Prof. A. Drążkowska extracted the clothes, conserved them and performed costumological analyses.

[30] Prof. A. Drążkowska extracted the clothes, conserved them and performed costumological analyses.

adult, were filled with plants. They included, among others, oregano, malva neglecta, rosemary, tanacetum, savory, campanula, calendula officinalis, hypericum, thymus, hyssop, lavender flowers, branches of moss, and ferns. These plants were used in the pillows not by accident. They were chosen deliberately, because they not only gave the pillows the convex shape, but also repelled insects and decreased the unpleasant odour of decaying bodies, among other uses. Pillows were packed with herb sprouts, inflorescence, fruit, seeds and leaves. Some plants were placed in large bunches or in small bouquets. Only one of the discovered pillowcases was filled with cotton fibres – a cotton wadding (crypt B9\3). Pillows were filled also with moss, and sometimes with sawdust, hay and needles (Drążkowska 2014, p. 332).

Pillows were quite an important element of the coffin furnishing. It seems they were a must, especially for wealthy families. They supported the head, preventing the jaw from dropping and allowing the dead to maintain their dignity during the last farewell. They also filled the space within the coffin, increasing the impression of splendour and wealth. The plants filling them repelled the insects that feed on decaying bodies. They also had symbolical meaning, being an attribute of a sleeping, tired person resting after the toils of the day or a whole life. They made the horrifying presence of death more bearable, since a person with such furnishing looked like in a deep sleep. Evoking such comparisons was intended to decrease the pain of loss of a close one and to tame the fear of death in general (Drążkowska 2007h, p. 414, 2014, p. 326).

It was probably a frequent practice that the same pillow that supported the deceased's head on the celebratory deathbed before the funeral was later put into the coffin. Some such pillows were stuffed with feathers. But such stuffing in the crypts is very rare. Single items were found in St John's church in Gdańsk (Drążkowska 2007g, p. 411), in the church of the Name of the Holy Virgin Mary in Szczuczyn (Grupa et al. 2014, p. 119) and in the church of St Peter of Alcantara and St Anthony of Padua in Węgrów. The presence of pillows in coffins has been confirmed during numerous archaeological studies at various sites. They appear in child tombs (Drążkowska 2007g, p. 409–16) and tombs of adults, wealthy noblemen and burghers (Drążkowska 2007g, p. 409–16; 2014, p. 322; Dudziński et al. 2015, p. 84), monks (Dudziński et al. 2017, p. 123–38), bishops (Drążkowska 2014, p. 319–27), kings and members of royal families (Rożek 1997, photo 41, 49). A pillow supported the head of King Sigismund III Vasa, his wife, queen Constance,[31] Stephen Báthory, Marie Casimire, John III Sobieski and Duke Józef Poniatowski (Rożek 1997, photo 41, 49, 51, 54). King Augustus II the Strong had two pillows in his coffin.[32]

Besides the pillows, the analysed set also included small fragments of textile mattresses on the bottoms of the coffins. In most cases the textiles have not been preserved and their presence is suggested only by distinctive arrangements of plants on the bottoms of the coffins. They were placed directly under the human remains, on the planks, and had a compact structure. In some cases they were placed on a mineral filler, being a mixture of loess and lime. Basing on small fragments of remaining textile shreds it is impossible to reconstruct the way they were cut. Some idea about their make is suggested only by a mattress from a child coffin (crypt B8\1) containing a tiny, seven-month-old premature baby wrapped in swaddling clothes (Fig. 97). The mattress was made of damask on a linen with a band pattern, with one band with

[31] Prof. A. Drążkowska participated in exploration and study of the royal couple burial (2018).

[32] Prof. A. Drążkowska participated in exploration and study of the royal couple burial (2019).

a chequered decoration made using the *liseré* technique. The case for the mattress was prepared out of an elongated piece of cloth, folded in half and stitched along three edges (crypt B8\1).

Fig. 97. Seven-month-old premature baby skeleton wrapped in swaddling clothes and placed on a silk mattress, crypt B8 burial 1, photo M. Łyczak

Most of the mattresses in the analysed set were filled with plants (herbs).[33] The identified species include yarrow, fir (crypt B3\6) rosemary (crypt B2\4, B2\8), true lavender, field eryngo (crypt 3B\7), paucedanum, ragwort and tansy (crypt B2\1). In two coffins the mattresses were filled with plant bunches placed like bouquets (crypt B5\9, B9\10). Some mattresses were filled with wood shavings (crypt B2\2, B3\3, B3\4, B3\7, B5\1). Sometimes they were so abundant that at the moment of discovery they created the impression of filling the whole coffin and even pouring out. During the survey of some of the burials it sometimes seemed that no casing had been made and stuffed with a diverse filler, but that the plants placed on the bottom had just been covered with a fabric, constituting a sheet with its edges folded down to embrace the coffin padding (crypt B9\12, B9\7). In one case it was a flax linen sheet (crypt B9\12), in

[33] (B2\1, B2\4, B2\12, B3\2, B4\1, B5\3, B5\9, B5\11, B6\6,B8\1, K2\3, K2\10).

another (crypt B9\7) it was a sheet made of the same silk fabric used to make the pillowcase and the dress for the dead woman. It is possible that most of the mattresses were made of flax or wool fabrics that do not preserve. Their traces remain only in a few burials (B3\5, B5\12, B5\25, B6\3, B9\9, B9\12). Mattresses of non-durable fabrics were often used in coffins, but due to their low durability they are a relatively rare find. They appeared, among other places, in the crypts of the church of the Name of the Holy Virgin Mary in Szczuczyn (Grupa et al. 2014, p. 119). But apart from technical analysis of the fabric, there is no information about their structure and appearance.

THE STUDY OF DRESS AND TEXTILES

Clothing of clerics and laymen

Anna Drążkowska

In the Cracow crypts a large set of clothes from the seventeenth and eighteenth centuries, prepared for laymen and clerics was found (Drążkowska 2020b, p. 315 –328). Among 130 specimens there were clothes and accessories in various state of preservation. Some silk clothes were almost complete, while others, made of flax linen or wool, remained only as small fragments. The seventy-two specimens for laymen included shirts, national Polish costumes, women's and children's dresses, an apron, trousers and archconfraternity habits. Information on the presence of specific types of clothing in specific crypts and burials is compiled in Tables 4 and 5. Male national costume deserves special attention. It created a rich and diversified collection, with specimens of unique cut and fastening structure. No similar collection has ever previously been found at any archaeological site. There is no similar collection in any Polish museum. This unique set includes as many as twenty specimens: thirteen żupans,[34] two czechmans,[35] two pairs of trousers,[36] one ferezja[37] and one kontusz.[38] Additionally, the set also included fragments of clothes described in Table 4 as an "undefined national costume" (crypt B8\damaged burial). It has a unique appearance and closer identification requires detailed analyses. It will be presented in another paper that is currently in preparation. Almost all clothes were made of silk fabric. Only the kontusz was cut with cloth. Five of the żupans are made of satin (crypt B2\10, B5\10; Fig. 98A, B5\16, B5\26, B8\6), and three of damask (crypt B2\12, B7\2, B7\4). Another three were made of various types of rep (crypt B2\11), moire rep (crypt B5\14 (Fig. 98B) and rep with golden thread (crypt B5\5). The ferezja was cut with damask, the trousers with woollen fabric, and the fragments of the national costume with two types of fabric: sides of velvet, front with damask. The żupans vary in length, and most were fastened with buttons made of cord or decoratively woven threads.

[34] Crypt B2\10, B2\11, B2\12, B3\damaged burial, B5\5, B5\10, B5\14, B5\16, B5\26, B7\2, B7\4, B8\6, B9\11.

[35] Crypt B5\19, B5\25.

[36] Crypt B5\5, B5\10.

[37] Crypt B8\4.

[38] Crypt B8\6.

Table 4. Clothing and layman accessories, divided by crypts and burials

BURIAL	LAYMAN CLOTHES AND ACCESSORIES																	
	Shirt/funeral shirt	Swaddling clothes	Żupan	Czechman	Ferezja	Undefined national costume	Trousers	Robe	Child's dress	Kontusz	Archfraternity habit	Dress	Skirt/apron	Headwear	Stockings	Footwear	Scarf	Belt	Gloves
THE CHURCH																			
CRYPT B1																			
1																			
2																			
3																			
4																			
5																			
6																			
CRYPT B2																			
1								1						1					
2								1						1					
3									1					1					
4									1										
5									1										
6									1										
7									1										
8									1					1					
9												1	2	2					
10			1											1					
11			1																
12			1																
CRYPT B3																			
1											1								
2																			
3											1			1				1	
4											1			1				1	
5											1			1					
6																			
7																			
Damaged burial			1																
CRYPT B4																			
1																			
CRYPT B5																			

Table 4. Clothing and layman accessories, divided by crypts and burials (continue)

LAYMAN CLOTHES AND ACCESSORIES																			
BURIAL	Shirt/funeral shirt	Swaddling clothes	Żupan	Czechman	Ferezja	Undefined national costume	Trousers	Robe	Child's dress	Kontusz	Archfraternity habit	Dress	Skirt/apron	Headwear	Stockings	Footwear	Scarf	Belt	Gloves
1																			
2								1											
3								1						1					1
4								1						1		1			
5			1				1								1	1			
6								1						1	1		1		
7	1											1	1	1					
8								1						1					
9												1		1					
10			1				1								1				
11												1		1					
12								1											
13								1											
14			1											1					
15																			
16			1																
17																			
18																			
19				1										1	1				
20								1											
21																			
22																			
23	1																		
24									1										
25				1															
26			1																
CRYPT 6																			
1								1						1					
2																			
3									1										
4									1										
5																			
6									1										
CRYPT B7																			

Table 4. Clothing and layman accessories, divided by crypts and burials (continue)

LAYMAN CLOTHES AND ACCESSORIES																			
BURIAL	Shirt/funeral shirt	Swaddling clothes	Żupan	Czechman	Ferezja	Undefined national costume	Trousers	Robe	Child's dress	Kontusz	Archfraternity habit	Dress	Skirt/apron	Headwear	Stockings	Footwear	Scarf	Belt	Gloves
1	1											1	1						
2	1		1											1					
3								1											
4			1															1	
Damaged burial						1						1							
CRYPT B8																			
1		1																	
2									1										
3																			
4	1				1														
5																			
6			1							1						1		1	
7																			
8																1			
CRYPT B9																			
2																			
3	1														1				
5																			
6	1								1										
7												1	1	1	1				
8	1							1						1					
9																			
10														1	1				
11								1											
11A			1															1	
12																			
13	1											1	1	1	1				
15																			
THE CLOISTERS																			
CRYPT K1																			
1																			
CRYPT K2																			
1																			

Table 4. Clothing and layman accessories, divided by crypts and burials (continue)

LAYMAN CLOTHES AND ACCESSORIES																			
BURIAL	Shirt/funeral shirt	Swaddling clothes	Żupan	Czechman	Ferezja	Undefined national costume	Trousers	Robe	Child's dress	Kontusz	Archfraternity habit	Dress	Skirt/apron	Headwear	Stockings	Footwear	Scarf	Belt	Gloves
2																			
3																			
4																			
5														1					
6																			
7																			
8																			
9														1					
10																			
TOTAL	10	1	13	2	1	1	2	14	12	1	4	8	5	27	7	3	1	5	1

On one żupan, gold-coated metal buttons remain (crypt B5\1). In most cases the cuffs were fastened with brass hook and eye. All mentioned clothes prepared for repeat use were probably used by the wearer during their lifetime. They usually do not bear any traces of wear caused by intensive use. Three żupans were tied with belts: two were made with a silk-weave double-interlinked sprang technique (crypt B7\4, B8\6), and one with a leather belt (crypt B9\11). Elements of the Polish national costume have been found in the crypts of several churches: the Assumption of Mary in Toruń (Grupa 2005, p. 150–63; Drążkowska 2008, p. 81–83), St Nicolas in Toruń (Drążkowska 2008, p. 57), Our Lady of Sorrows in Jarosław (Biedrońska-Słotowa 2005, p. 146), St Peter and Paul in Cracow, Świętokrzyska Chapel at Wawel Castle (Biedrońska-Słotowa 2005), St Laurence and St Stanislav in Żółkiew (Gutkowska-Rychlewska, 1968, p. 519; Biedrońska-Słotowa 2005, p. 145), the Lublin archcathedral of St John the Evangelist and St John the Baptist (Drążkowska 2008, p. 65–66; Drążkowska, Grupa 2012, p. 316; Drążkowska et al. 2015, p. 130–34), the church of the Name of the Holy Virgin Mary in Szczuczyn (Grupa et al. 2013, p. 99–118), St Joseph church in Pułtusk (Drążkowska 2007d, p. 21–36), the archcathedral of St John the Baptist and the Assumption of Mary in Przemyśl and the archcathedral of St John the Baptist in Warsaw (Drążkowska 2014a), as well as in Ukraine, in the church of the Immaculate Conception of Mary in Dubno (Drążkowska 2008, p. 217; 2006a, p. 239) and in Lithuania, in the church in Kėdainiai (Niedźwiadek, Drążkowska et al. 2015, p. 156).

The analysed set contained multi-use undershirts, worn under the outer clothes and made of flax linen. It is likely they were used in daily life. Seven such items remain as small fragments (crypt B5\7, B7\1, B8\4, B9\3, B9\6, B9\8, B9\13). They were mid-calf length, and cut simply,

with a small, semicircular cleavage under the neck. The presence of two other specimens is confirmed only by silk ribbons tied around the wrists (crypt B7\1, B8\4). One should remember, however, that all the dead buried in the Cracow crypts surely had underwear, but that it decayed along with the body, leaving no traces. Only two so-called funeral or death shirts remain. One, made of silk taffeta, was found on a male from crypt B5, coffin 23. Another was made of flax linen for a small child (crypt B8\3).

Fig. 98. Silk żupans from crypt B5: A) burial 10; B) burial 14, photo M. Łyczak

Clothes for children had a single-use character and were made especially for the funeral (crypt B2\3, B2\4, B2\5, B2\6, B2\7, B2\8, B5\24, B6\3, B6\4, B6\6, B8\2, B9\6. Most were cut in a very similar way: long, straight sleeves and shallow neckline. They reached down to the ankles or below the line of the feet. Children's satin costumes from crypt B2 under the Blessed Salomea chapel (crypt B2\3, B2\4, B2\5, B2\6, B2\7, B2\8) look like they were made by the same person within a short time frame. Next, five dresses are made of silk taffeta (crypt B5\24, B6\3, B6\4, B6\, B8\2) and one of decorative fabric with a flowery pattern (crypt B9\6). Several similarly cut dresses come from other sites, such as the church of the Holy Virgin Mary in Tworków (Drążkowska 2007, p. 125–33), St John's church in Gdańsk (Drążkowska 2012a, p. 171–80), St Nicolas' church in Gniew (Drążkowska et al. 2015, p. 141; Grupa et al. 2015, p. 99–103), the Holy Virgin Mary church in Kostrzyn and Odrą (Drążkowska 2004, p. 33; 2004a, p. 167–9; 2007, p. 208; 2007b, 135; 2017, p. 186), St Nicolas' church in Pieranie (Drążkowska 2004b, p. 71–75) the church of the Assumption of Mary in Toruń (Drążkowska 2005, p. 253––63; Grupa 2005, p. 144–50), the church of the Name of the Holy Virgin Mary in Szczuczyn (Grupa et al. 2014, p. 60), the archcathedral of St John the Baptist and the Assumption of

Mary in Przemyśl (Drążkowska 2013) and the archcathedral of St John the Evangelist and St John the Baptist in Lublin (Drążkowska 2008, p. 149–55; Drążkowska, Grupa 2012, p. 324; p. 137; Drążkowska et al. 2015, p. 137).

In the Cracow crypts, one small child was wrapped from head to toe in woollen swaddling cloth bands of about four centimetres wide, (crypt B8\1). They were supposed to protect the delicate living body, but in reality they would have caused discomfort by being too tight, causing digestive and respiratory problems and leading to skin chafing (Drążkowska 2019, p. 179–81). In Poland they were called the "first diapers" (Fabiani 1996, p. 58). Swaddling clothes are rare among archaeological finds. They were found in the Holy Virgin Mary church in Kostrzyn (Drążkowska 2004, p. 33; 2004a, p. 167–9; 2007, p. 208; 2017, p. 186), in the archcathedral of St John the Baptist in Warsaw (Drążkowska 2017, p. 186) and in St Trinity church in Strzelno, tomb 42 (Drążkowska 2007b, p. 135–41).

In the Cracow crypts, eight women's dresses were also found: seven had been used during the wearer's lifetime, and one, with a cut at the front, and of a loose, wide cut, was made especially for the tomb (crypt B9\7). Two were made of rep (crypt B2\9, B5\7), two of satin (crypt B5\9, B9\13), two of smooth taffeta (crypt B5\11, B9\7), one with patterned taffeta with liseré effect and one with taffeta with effects made of pile (crypt B7\damaged burial). Three dresses are made of two elements, consisting of an outer dress and a skirt (crypt B2/9, B5\11, B7\1). The outer part is cut at the front, along the whole length and with flaps open to the sides. The bodice is cut together with the whole, fitted and fastened with hooks and eyes (B2\9, B7\1). A wide skirt with multiple folds is added to the dress. Another two dresses, also made of two elements, have short, separate bodices reaching the waist, and a wide skirt, similar to the former model (crypt B5\7, B9\13). Only one dress (crypt B7\1) was made of a fabric (taffeta) that differed from the outer dress (patterned taffeta with liseré effect). One of the analysed set of dresses is a one-piece costume, with the dress and the bodice cut from a single cloth (crypt B5\9, B9\13). The dress from crypt B2, coffin 9 was supplemented with a small apron with two large pockets.

Table 5. Clothes and accessories of clerics, divided into crypts and burials

CLOTHES OF CLERGYMEN										
Burial	Shirt	Chasuble	Cassock	Gloves	Stole	Stockings	Footwear	Headwear	Cinngulum	Habit
THE CHURCH										
CRYPT B9										
1		×	×	×	×	×	×	×		
4	×					×				×
14								×	×	×
TOTAL	1	1	1	1	1	2	1	2	1	2

The category of "robe" is distinguished within the analysed set, and in Table 4.[39] This term was usually used in relation to clothes that remained as small fragments and whose state pre-

[39] Crypt B2\1, B2\2, B5\2, B5\3, B5\4, B5\6, B5\8, B5\12, B5\13, B5\20, B6\1, B7\3, B9\11, K2\8.

vented more detailed identification of the cut. It was only stated that it had long sleeves and an oval neckline, and reached to the middle of the calf or below. Most of the robes were made of woollen fabrics, two of silk taffeta (crypt B9\11, K2\8), one of satin (crypt B2\2) and one of velvet (crypt B5\13). In crypt B3, in the chapel of the Passion of Jesus, burials of the members of the Archconfraternity of Good Death were placed. Their remains were covered by clothes resembling the cut of woollen habits (crypt B3\1, B3\3, B3\4, B3\5). This was a trailing, long type of clothing that covered the ankles and had very wide sleeves. It was tied with a leather belt (crypt B3\3). The skulls were covered with hoods or another kind of headwear that also covered the faces.

In crypt B9, the tomb of priest Wincenty Wyszkowski was found (crypt B9\1). His remains were covered by: a woollen cassock reaching the middle of the calf; a heavily damaged violet, silk chasuble with multiple traces of frequent patching and darning; woollen biretta, gloves and stockings; and a stole prepared especially for the tomb, with a scarf made of a wide, two-coloured ribbon with a plant pattern running along the edges (Fig. 99B). The feet were protected by leather shoes. In the same crypt, two monk burials were located (Fig. 99A). The monks were dressed in woollen habits (crypt B9\4, B9\14).

Fig. 99. Burials in crypt B9: A) the monk in a habit, burial 14; B) the priest, burial 1, photo M. Łyczak

In the Cracow crypts quite a large number of clothing accessories was observed, supplementing the clothes of both laity and clergymen: twenty-seven items of headwear, six belts, two pairs of gloves, nine pairs of stockings and four items of footwear.

Headwear is the largest set, and includes: men's household hats (B2/2, B5/14, B5/19, B7/2, K2/5, K2/9); women's caps (B5/7, B5/9 – 2 items, B5/11, B6/1, B9/13); children's caps (B2/3, B2/8); women's turbans (crypt B2/1, B9/10); birettas (B5/4, B9/1); a small, oval monk's hat (B9/14); and three Archconfraternity member hats. Additionally, men's single-use hats were found (crypt B2/10, B9/80). In some cases, the presence of linen caps was confirmed only by silk ribbons tied around women's skulls (B2/9, B5/3, B5/6, B5/8, B9/7). The analysed set included one cap made entirely of bobbin lace.

Stockings are another accessory: five pairs were knitted of wool (crypt B5/6, B9/3, B9/7, B9/13), while others were made of silk taffeta (crypt B5/19) or linen (crypt B5/5, B9/4) and woollen fabric with oblique weave (crypt B9/10). The remaining textile footwear supplemented women's clothes (crypt B9/7, B9/13, B5/6) and men's clothes. One pair was worn together with a żupan (crypt B5/5), and another with a czechman (crypt B5/19). Stocking also covered the feet of clergymen: a priest (crypt B9/1) and a monk (crypt B9/4).

Within the analysed set only four pairs of footwear remain. Two were made as double-cut shoes, with a quarter embracing the heel and running forwards to form bands covering the instep. One pair was kept on the feet by shoe lashes (crypt B9/1), another one had a buckle (crypt B5/4). A man in a żupan had shoes with a low shank, reaching the ankle (crypt B5/5). Another man in a żupan had shoes with a warm lining, probably for household use, with a free heel (B8/6).

Only five belts were found: three made of leather and two silk net belts made with sprang technique. The two leather belts were used for tying the confraternity habits (B3/3, B3/4), and the others for żupans (B7/4, B8/6, B9/11).

The clothing was also supplemented with five-fingered gloves. One leather pair with a short cuff was found in crypt B5, coffin 3 on the hands of a woman dressed in a loose, woollen robe. Knitted gloves made of thin, woollen crewel were added to a liturgical costume (crypt B9/1).

Clothing accessories are found quite frequently during archaeological surveys of crypts. They appeared, among others, in the burials of the crypts of the churches of the Assumption of Mary in Toruń (Grupa 2005, p. 117, 180, 183; Drążkowska 2005c, p. 54–63; 2008, p. 169–225; 2009, p. 223–32; 2011, p. 254; 2012, p. 212), St John in Gdańsk (Drążkowska 2009, p. 223–32; 2012a, p. 171–80), the Discovery of the Holy Cross and St Andrew the Apostle in Końskowola (Drążkowska 2010, p. 160), St Nicolas in Gniew (Drążkowska 2012, p. 211; Drążkowska et al. 2015, p. 141; Grupa et al. 2015, p. 99–103), the Holy Virgin Mary church in Kostrzyn and Odrą (Drążkowska 2004, p. 33; 2004a, p. 167–9; 2007, p. 208; 2007b, 135; 2012, p. 211; 2017, p. 186), St Nicolas' in Łabiszyn (Drążkowska 2010a, p. 312; 2012, p. 269) the church of the Name of the Holy Virgin Mary in Szczuczyn (Przymorska-Sztuczka, Majorek 2013 p. 31–41; Grupa et al. 2014, p. 60, Dudziński et al. 2015, p. 23–44) and in Ukraine in the church of the Immaculate Conception of Mary in Dubno (Drążkowska 2008, p. 217; 2006a, p. 239; 2007e, p. 135; 2012, p. 185; Drążkowska et al. 2015, p. 154), the archcathedral of St John the Baptist and the Assumption of Mary in Przemyśl (Drążkowska 2013, 2014) and the archcathedral of St John the Evangelist and St John the Baptist in Lublin (Drążkowska 2008, p. 149–155; Drążkowska, Grupa 2012, p. 324; p. 137; Niedźwiadek, Drążkowska et al. 2015, p. 137).

The clothes from the Cracow crypts are an important find, since they constitute a perfect source for studies of the history of clothing and a basis for further, detailed research. The exceptional value of the set results from the fact that it includes specimens of a previously unknown cut, not represented in Polish museum collections.

Beautiful sadness. Textiles from the crypts

Maria Cybulska

For researchers studying historical textiles, archaeological findings are of particular interest. They contain not only the prestigious, most beautiful fabrics of their time, known from museum exhibitions and catalogues or depicted by painters in paintings, but also those worn by their owners every day (Cybulska 2020, p. 375 –408). Because these were put into heavier use, they were damaged and rarely survived in collections, which is why our image of textiles of different eras is incomplete. Although of course different periods and social spheres had their own funeral culture, the textiles from the crypts generally create a more faithful and more realistic picture of the customs, tastes and even financial possibilities of their owners. Often they include truly unique objects. This is also the case with the collection of textiles discovered during archaeological works in the crypts of the Franciscan Basilica in Cracow. Among the many typical textiles of the seventeenth century, we find very interesting objects for which it is difficult to find analogues in museum collections.

Textiles found in the crypts include 101 objects, mainly woven silks and trimmings: woven tapes, ribbons and lace. Most of the objects are made of protein fibres: silk and wool. Due to the archaeological environment, which is inhospitable to vegetable fibres, only one fragment of woven linen was found in the analysed collection, but in a state of degradation that did not allow analysis. In a second case, tiny fragments of linen threads remained between silk threads. All objects have been thoroughly analysed and catalogued, while the catalogue containing notes of the sixty-three most interesting objects can be found in the study on Franciscan crypts published in Polish (Cybulska 2020).

Weaving techniques

First, I shall present a brief introduction to textile techniques, briefly discussing the basic types in the analysed set.

Woven fabric is formed on a loom by interweaving two perpendicular thread systems – the weft and the warp. The warp is attached to the loom before weaving, and its individual ends are threaded through a harness that can be raised or lowered. The space created between the upper and lower part of the warp is called a “shed”, and weft threads are introduced into it.

Lowering the raised warp ends means closing the shed and lifting another batch of warp ends up, to open a new shed. Woven fabric can be constructed from one warp and one weft. Patterns on this type of cloth are obtained by combining different weaves. To get more complicated, colourful decorative effects, additional warps and wefts are introduced to create complex structures. Basic weaves include a plain weave, also called a "tabby", twill and satin. They can be used as the basis for creating modified and complex weaves.

Basic structures
Plain fabrics
Taffeta

Of the silk fabrics from the Franciscan crypts, fifteen are taffeta (Fig. 100A). Taffeta appeared as a stand-alone fabric, and it could also be decorated by introducing additional patterning or brocading wefts or by finishing processes, such as calendering. Decorative effects for taffeta can also be achieved by introducing simple weft-and-warp effects, such as a multi-coloured warp or weft, or differentiation of threads through a thickness of thread or raw material. In addition to one fabric from which a pillow was sewn, most taffeta silks come from women's and children's dresses, and four from men's costumes, in which it was usually used as a lining, but also for headgear. Also, two ribbons are made of smooth taffeta. The collection also includes two taffeta ribbons with simple warp effects: one with a pattern of two colourful stripes of warp ends that differ in colour, and another with an openwork effect obtained by varying the warp in terms of the thickness and density of the ends. The most interesting in this group is the shawl. At first glance it is a fabric with the effect of openwork stripes, and was initially classified as such. However, the signs of interlacing on warp threads required a thorough analysis of the entire surface, which revealed tiny fragments of flax threads in two places. So it was a striped silk taffeta scarf with linen thread periodically used as a weft.

Derivatives of plain weave

On the basis of a plain weave, other weaves are created by multiplying the ends of the warp and/or weft picks, called "extended tabbies". These include a warp rib called "Gros de Tours", a weft rib called "Louisine", and a matte rib called "Natté" (Fig. 100B).

Gros de Tours without any additional effects can be found in one dress, four headgears and four żupans. Only one of them, used as the outer fabric, was additionally calendered (moiré). Also, one ribbon is made in Gros de Tours.

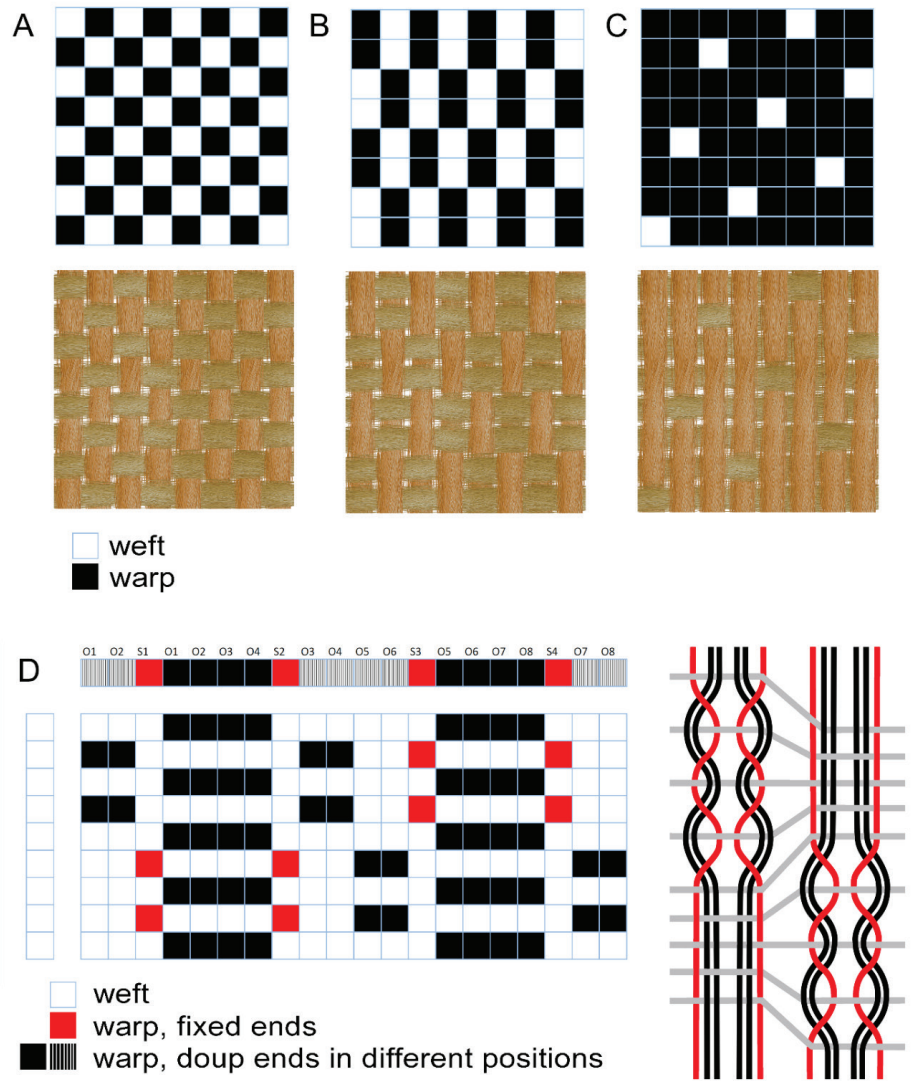

Fig. 100. Weaves: A) plain weave; B) Gros de Tours, C) sateen, 8 warp ends 7/1 (3); D) patterned gauze, graphics M. Cybulska

Sateen

Sateen is a reflective fabric woven with satin weave, whose shiny surface is formed by warp. Under them, weft threads remain invisible on the obverse (Fig. 100C). Sateens often have additional effects, e.g. liseré, or motifs using supplementary wefts. In Poland it was a popular silk for żupans, which is confirmed by the burial clothes. This is the most numerous group of plain silks. Of the seventeen sateens, only one comes from a woman's dress and one from a children's dress, three from headgear, and as many as twelve from men's clothing, in which they served mainly as the outer cloth of żupans.

Patterned silks
Damask

Damask is a patterned fabric, with one warp and one weft, in which the pattern differs from the background by the weave difference, resulting in a contrast between matte and glossy parts of the pattern. Classic damask is double-sided and is created by combining a weft and a warp variety of the same weave – most often satin; less often twill. In damask, you can also combine warp and weft weaves of different types, e.g. satin and twill, if they have the same size weave or one size is a multiple of the other. It is assumed that the name "damask" is not used in relation to similarly constructed fabrics with a linen weave background. In the literature, the term

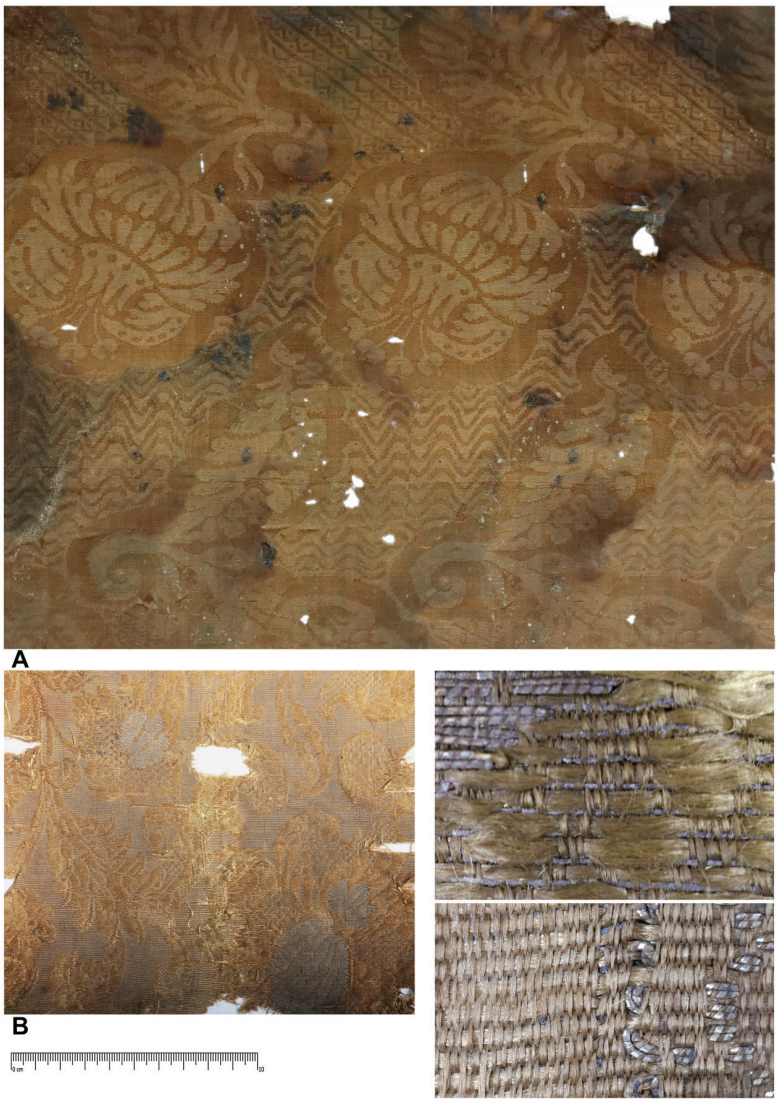

Fig. 101. Patterned silks, coffin upholsteries I: A) damask, crypt B5 burial 2; B) Gros de Tours with liseré, patterned and brocaded, crypt B2 cloister burial 2). Photographs on the right show details of the structure on the obverse and reverse sides of the cloth, photo M. Cybulska

"damask on tabby" is used to refer to such fabrics (CIETA 2006, p. 35). Damasks are by far the best-represented group of fabrics in the analysed collection, but most, as many as fifteen, are patches in repeatedly repaired chasuble, which will be discussed later. In fact, we are dealing with the main fabric of the chasuble from crypt 9, with one coffin covering and only three secular outfits (żupans in which it was used as the outer cloth). Damask was a much more prestigious silk than smooth sateen, Gros de Tours or taffeta, because it is a patterned silk with a large number of warp ends that requires the use of a large number of harnesses, and is therefore more expensive to manufacture.

Liseré

Liseré is a technique of patterning fabric with the main weft, with long floats of threads, untied or, in the case of very long sections, bound in a different way than in other parts of the

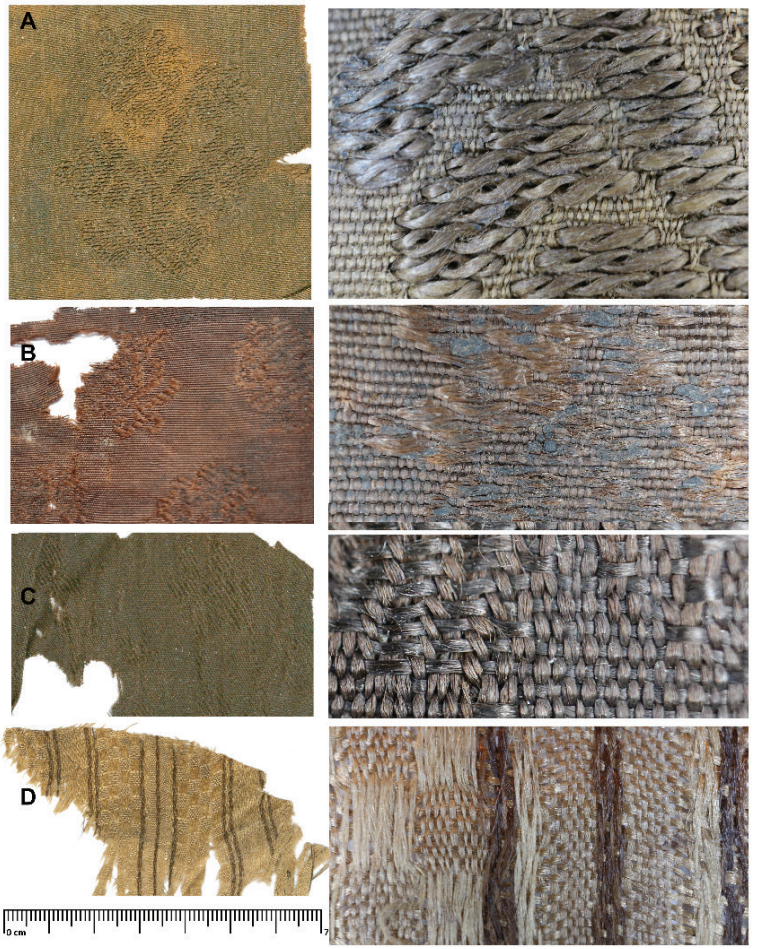

Fig. 102. Patterned silks II: A) Gros de Tours brocaded with metal thread, clothing, crypt B5 burial 17; B) Gros de Tours liseré, calendered, clothing, crypt B5 burial 17; C) taffeta liseré, part of a dress, crypt B7 burials 1; D) stripped silk, mattress, crypt B9 burial 1. Photos on the right show the details of the structure, photo M. Cybulska

fabric (Fig. 102B, C). It was used in European weaving at least from the end of the seventeenth century. Among the silks in the collection, four have patterns made using this technique. The mattress cloth (Fig. 102D) is a damask on tabby. One of the strips has a checkerboard decoration made with a liseré.

One of the more prestigious silks is a Gros de Tours using this technique; its entire surface is additionally patterned with a gold lamella (flat gold thread) (Fig. 101B). The floral motifs are made of one of two threads of weft tied together in Gros de Tours. Although it is difficult to assess the difference in the colours of the two threads, the fact that some of the motifs are made with the first thread liseré, and others are made with the second thread, it can be concluded that they were of different colours.

Liseré is the main method for creating a pattern, and the only method of decoration used on the four silks. The first silk (Fig. 102B) is Gros de Tours with a pattern of floral bushes made in liseré by every second weft thread. Another (Fig. 102C) is a taffeta with a floral pattern made in liseré by each weft thread. As a result, the pattern is also visible on the reverse of the cloth in the form of long unbound sections of warp ends. A similar method is used in silks with a small cube pattern. An example of using a liseré in a silk with a more complex technique is a damask patterned with lamella, in which only small motifs were made in the liseré. (Fig. 103C).

Compound structures
Supplementary wefts
Patterning and brocading

The main decorative effects that use additional wefts are patterns made brocading and patterning. Patterning is a technique of making a pattern with a supplementary weft (the "patterning weft") introduced periodically or along the entire length of the fabric, and passing across its entire width. Patterning is used in fabrics with either one warp or with an additional binding warp. The patterning weft is on the obverse of the cloth in the patterned parts of ornamentation, and on the reverse in other places. In structures with one warp, the patterning weft on the reverse can run loose – not bound – or it can be bound with the main warp. In complex structures with an additional binding warp, the patterning weft is regularly bound with a binding warp on the obverse and reverse of the cloth. Patterning wefts can create either pattern motifs or a patterned background.

This technique was used in four silks. In three of them the patterning weft is a flat metal thread – a lamella. In the silks of Figures 103C and 101B, it creates a background, while the motifs are created by other techniques. In the aforementioned Gros de Tours as a żupan outer cloth, a gold lamella is introduced over the entire length and width of the cloth. In all these cases, gold does not so much cover the surface of the fabric as it gives it a golden, metallic glow. Another situation occurs when we use the patterning weft in structures with an additional binding warp and the patterning weft itself is a thicker, metal wrapped thread that better covers the surface of cloth, as is the case with the Turkish lampas (Fig. 103A).

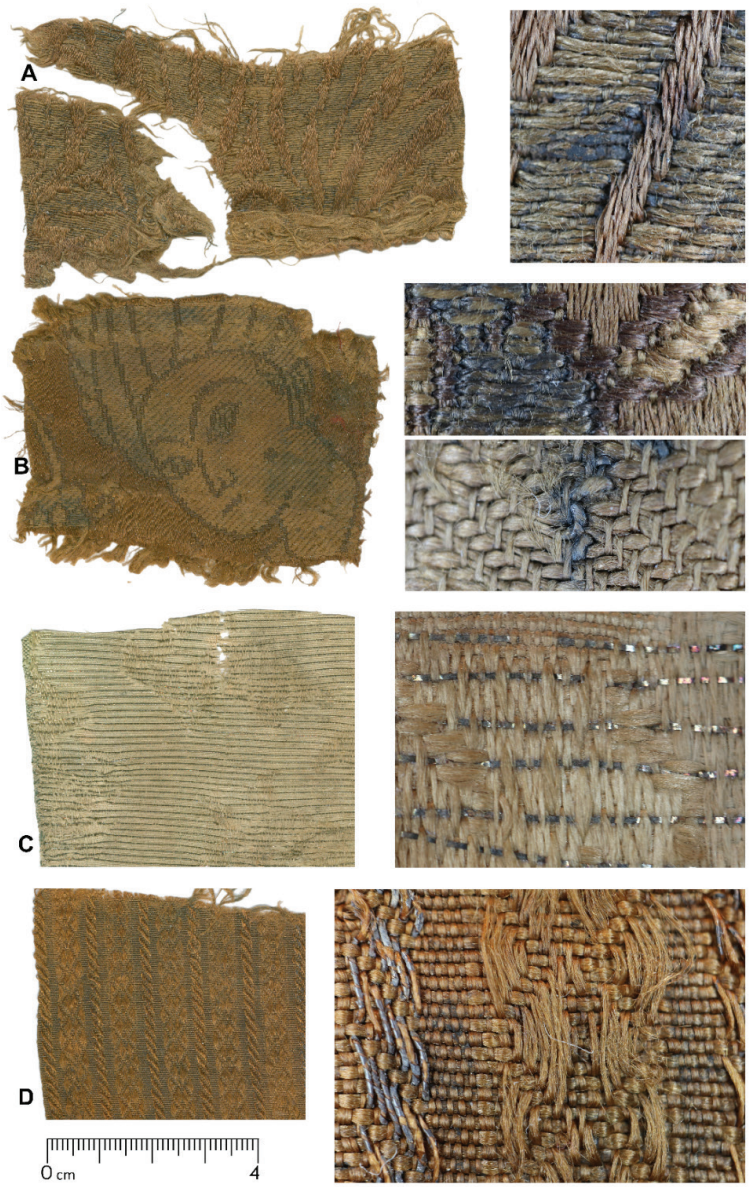

Fig. 103. Patterned silks III: A) Turkish lampas (kemha), crypt B9 burial 11; B) Persian lampas crypt B9 burial 11; C) damask on tabby with liseré effect, patterned with golden thread, coffin upholstery, crypt B8 burials 1; D) taffeta with flushing warp, stocking, crypt B9 burials 11. Photos on the right show details of the structure, photo M. Cybulska

Brocading is the creation of a pattern using a supplementary weft, which runs only within the area of the created motif. The threads on the obverse are bound by the main warp, or by the binding warp if one is used. Brocading wefts very often create a pattern using long, unbound floats. On the reverse, the thread of the brocading weft turns back and either goes back to the obverse, or on the reverse it is pulled to the beginning of the motif and only then goes back to the obverse. This technique was used in three silks. In Gros de Tour with a liseré effect, patterned with lamella (Fig. 101B), selected floral motifs were brocaded with metal thread. In

silk in Fig. 102A on a Gros de Tours background, the only decorative motif in the form of flower bushes was made with a brocaded weft in the form of a wrapped metal thread. In this case, the metal strip has almost completely fallen apart, and the brocading thread now presents only a relatively thick double-plied core that is free from compressive wrapping. The brocading was also used in the Persian lampas (Fig. 103B) to make a turban. In this case, too, the only small, remaining traces of the metal wrapping are the remains of a metal strip. On the reverse of the cloth we see a metal thread turning back (Fig. 103B on the right).

Structures with supplementary warps

In compound structures, in addition to the main warp, there may be other warps with special functions. They are called "supplementary warps". These include: a binding warp, a flushing warp, and a pile warp. Because the warp is attached to the loom before weaving, there are fewer varieties of warp effect than there are of weft effect.

Flushing warp

Warp effects can be obtained with each, or every other, warp end and take the form of long floats. They can also be formed by introducing a supplementary warp, which in selected parts of the pattern creates long unbound floats, in other parts runs loose on the reverse, or is interwoven with the weft together with the main warp. A flushing warp is most often of silk. Also found, especially in silks with striped patterns and only in selected fabric widths, is a flushing warp made of metal threads that creates effects in the form of long floats of golden threads that are bound, not in a particular weave, but such that they create various, usually geometric motifs. At the end of the seventeenth century, the flushing warp was used in striped silks. It is also found in lampas, in which it co-creates a usually smooth, slightly raised pattern background.[40] Among the textiles discussed, the hair warp is used in five woven tapes and only one fabric from clothing (Fig. 103D). This last is a striped silk with two types of decorative stripes on a taffeta background. Flushing warp occurs only within stripes and is of two types: one silk, and the other in the form of a metal thread.

Gauze

In the gauze weaves, the warp ends do not run in parallel, but cross each other. The warp ends are divided into two types: fixed ends and doup ends. Fixed ends are not threaded through the harness and are always below the weft, and the doup ends are moved over the weft alternately from the right and from the left of the adjacent fixed end. Two adjacent warp ends always cross between successive weft picks. The doup ends are threaded through ordinary harnesses and

[40] The flushing warp is also called the "patterning warp". This term, although rare, appears in the literature. However, its use is not recommended because, especially when translating into foreign languages, it can cause confusion. "Patterning warp" is sometimes used in the English as the name of the main warp, although not recommended by CIETA (CIETA 2006, p. 27).

additionally through a set consisting of an ordinary harness and a half-harness with loops for transferring the doup ends relative to the adjacent fixed end. (Becker 2009, p. 52). Patterned gauze can be created in different ways. One is by introducing supplementary brocading and patterning wefts. This type of gauze was also manufactured as a plain gauze and then embroidered. Another method used for the gauze presented in Fig. 104A is to combine the structure of a gauze weave with that of an ordinary weave. The background is realised by a gauze weave while, in the area of the pattern, the doup warp ends are moved using only a simple harness, forming together with the fixed warp ends a simple plain or other weave, depending on how many ordinary harnesses the ends are threaded through. The fabric itself is ornamentally reminiscent of Italian bobbin lace from the seventeenth century and probably comes from Italy, where popular, light gauzes were produced. However, these types of gauze silk are very rare, because the loose structure facilitates the deterioration of threads, even in less hostile conditions than in burials.

Fig. 104. Crypt B5 burial 6: A) shawl, patterned gauze, fragment and detail; B) shawl with silk and linen stripes. Photo on right shows remains of linen threads, photo M. Cybulska

Velvets

Velvet is a cloth with a pile – plain or patterned – in which the pile is produced by an additional pile warp. During weaving, every three to four picks of the weft, rods are introduced into the shed perpendicular to the warp, over which the pile warp is secured. After closing the shed, the warp threads form a kind of loop around the rods. Then the rods are pulled out. Depending on the type of rod (grooved or smooth) loops retain their form or are cut. In selected parts of the pattern (or on the entire surface of the cloth), a pile or uncut pile is created. Pile can be created on the entire surface of the cloth, or only in areas of certain motifs of pattern. Another characteristic of velvet is the ground weave, which means the weave of the main warp and the ground weft. As the ground weave, basic weaves and their extended versions were used, most often with two successive threads of the weft bound together; they are always picks between which the pile is fixed. The weave of the background sometimes lets us determine the origin of velvet. For example, according to many authors, in Sassanid velvet the ground was created in a satin weave only (Sonday 1987, p. 83). In order to produce velvet of varying pile height, a proportion of the pile warp ends are placed on one rod, and a proportion on two rods stacked on top of each other. If both rods are grooved, a velvet of varying cut pile height is created, called "pile-on-pile" or "alto baso". If one rod is smooth (lower) and the other (upper) grooved, uncut (lower) and cut (higher) piles create a pattern of so called ciselé velvet.

Patterned velvet could be woven using a pile warp in several colours. In Italian and Turkish velvets, the patterns were designed in such a way that at a given width of the fabric there could only be two pile warps in different colours. Persian velvets were always woven with a pile of one height. They stand out for their rich colours. While European multi-coloured velvets used two pile warps on a given fabric width, in Persian velvets there can be up to five at the same time. Two of them were permanently attached to the loom, while the others were discontinuous, inserted in small parts of the pattern and cut, or possibly pulled to the next motif if it was close enough. This passion for colours as well as the popularity of patterned dyeing methods meant that in Persia, as well as in India and the whole of Central Asia, ikat velvets were woven (French: *velours chiné*), i.e. those in which one pile warp patterned before weaving was used. Presented in museum collections and in Western literature, this type of velvet comes mostly from the early nineteenth century; however, woven fabrics of patterned warp were produced in Persia as early as the Sassanid era, although due to the expensive and laborious way of preparing the pile warp they were not as popular as traditional ones and most of them date back to the post-Sassanid period (Andrews, Reath and Sachs [1937] p. 46; Tezcan 2007, p. 29). In Europe, the first chiné fabrics were already produced at the end of the seventeenth century, but they grew in popularity in the latter half of the eighteenth century, when chiné velvet was also woven (Wrońska-Friend 1990, p. 104; Cybulska et al. 2016, p. 218–220)

These considerations about ikat velvets are related to the patterned velvet from burial 2.


NOBIS

ANTHROPOLOGY

Anatomical and anthropological analysis of human remains

Henryk Głąb

This study employed standard methods for describing historical human skeletal material. As could be expected, individuals buried in the crypts of the Basilica included people of high social status, financial donors, and people distinguished in service to the monastery, as well as priests (Głąb 2020, p. 17 –36). The spread of ages and balance of sexes within the group are not a true reflection of the life of Cracow's population at the time. Men constitute the vast majority of individuals buried in the crypts; women are far less numerous, and the number of child crypts is negligible. This phenomenon is well known and commonly described in studies on burials in crypts and church cemeteries. In the latter, the numbers of individuals by age and sex generally correspond to the actual structure of the historical population. Child burials, especially those of unbaptised newborn babies, have always proven problematic (Duma 2010).

Material and methods

The present anatomical and anthropological analysis concerns human remains buried in the coffins inside the crypts of the Church of Franciscan Fathers in Cracow. A total of forty-two skeletons of various degree of completeness were analysed, including: twenty-nine male, seven female and five child skeletons. Since in a single case (crypt 6, coffin 5) only two left ribs of an undoubtedly adult individual remained, it was impossible to determine the sex of the individual. Consequently, the group contained 88% adults with only 12% children deceased before the age of three. Of all adult individuals, there were 78.4% men, 20%, women and 1.6% persons of indeterminate sex. Child burials, i.e. a very well-preserved seven-month foetus (crypt 8, coffin 1) and a newborn (crypt 8, coffin 2) are particularly interesting. In all cases attempts were made to determine the sex of the person and estimate their age at death using standard methods applied in the analysis of skeletal remains (Qahtani et al. 2010, p. 481–90; Buikstra, Ubelaker 1994, p. 16–74; Lovejoy 1985, p. 57–66; Meindl, Lovejoy 1985, p. 57–66; Piontek 1999, p. 321–44; Molleson, Cruse 1998, p. 719–28; Phenice 1969, p. 297–301; Steele, Bramblett 2007, p. 153–72). Such attempts were unsuccessful in the case of child burials, due to the very early age at death (Schutkowski 1999, p. 199–205; Loth, Henneberg 2001, p. 179–86).

Selected indices based on a method developed by Rudolf Martin (Martin, Knaussman 1988, p. 133–92; Piontek 1999, p. 78–116; Malinowski, Bożiłow 1997, p. 181–345) were calculated for each of the skulls examined in this study: CI – the cephalic index (width-to-length

ratio), HLI – the height-to-length index, HWI – the height-to-width index, FPI – the fronto-parietal index, TFI – the morphological facial index (the total facial index), UFI – the upper facial index, OI – the orbital index, and NI – the nasal index.

Stature was estimated for adult individuals on the basis of long bone measurements using standard methods applied in analyses of skeletal remains (Trotter, Gleser 1952, p. 463–514; Trotter, Gleser 1958, p. 79–123; Vercellotti et al. 2009, p. 135–42; Manouvrier 1893, p. 63––82; Bach 1965, p. 12–21; Breitiger 1937, p. 249–74; Vančata 2000, p. 11–34). Child's age at death was determined by long bone measurements and state of dentition (Schaefer et al. 2008, p. 139–306; Scheuer, Black 2004, p. 354–92).

Due to the group's distribution of age and sex, special attention was paid to the frequency of occurrence of pathological alterations (Aufderheide, Rodriguez-Martin 1998, p. 58–59; Ortner 2003, p. 458–60).

Results

The skeletons analysed in this study were generally well-preserved, which enabled an adequate anatomical and anthropological analysis, calculation of cranial indices and estimation of intravital stature. Based on the data in Table 6 and 7, it may be concluded that the group was quite diverse in terms of cranial indices; we may suppose that its representatives were probably of various ethnic and genetic backgrounds. The width-to-length cranial index (CI) displays significant differences, and its values reveal considerable variation (74.7), from a long cranium (74.7) to an extremely short cranium (88.9). However, in most cases, the skulls are of medium to short length, which is typical of the southern Polish population of the investigated period (Table 10). The height-to-length cranial index (HLI) ranges from 68.6 to 79.4, with only a single skull described as low, the vast majority of skulls being of medium height (76.7%), and only a few tall skulls (62.0%). The height-to-width cranial index (HWI) demonstrates the largest differences in the group: its values range from 78.0 to 103.1. The values of the fronto-parietal index (FPI) vary from 60.7 to 73.6. Skulls with medium and wide foreheads prevail. The morphological facial index (TFI) is very diverse in the group. Its values range from 73.2 to 99.2. Consequently, the group contains both individuals with extremely narrow and extremely wide faces. This confirms the assumption that the individuals buried in the crypts present considerable ethno-genetic diversity (Talko-Hryncewicz 1926, p. 7–70). The values of the upper facial index (UFI) in the group are slightly less variable than those for the entire face. There are individuals in the group who have extremely wide faces, as well as those with extremely narrow faces. A clear majority of individuals have faces of medium width.

The orbital cranial index (OI) in the group has a wide range, specifically from 72.1 to 95.3. Apparently, the group contains individuals with low as well as high orbits, although the ones with low orbits are definitely fewer in number. Low orbits are a rare trait in historic populations of Central Europe.

High diversity of facial configuration is combined with the variability of the nasal index (NI). The latter index is contained within a broad range of 40.3 to 68.1. Almost a third of the deceased (31.3%) had narrow noses, and only one had an extremely wide nose. The remaining individuals were contained in the category of narrow and wide noses.

Judging by the data presented above, the group of deceased buried in the crypts of the Franciscan Basilica did not significantly differ from people living in Cracow and its neigh-

bourhood in roughly the same historical period. Mean values of the analysed cranial indices measured at different sites are very similar.

At this point we may attempt to estimate stature. This particular parameter is a good measure of the biological condition of both historical and modern populations. In terms of body height, individuals buried in the crypts of the Franciscan Basilica can be categorised as contained within the limits of variability for early late-medieval populations as well as the populations of the early modern period in southern and central Poland. Note the high value of the sexual dimorphism index (SDI=7.5%), indicating the relatively good condition of the investigated group. Nevertheless, attempts at interpreting the index may raise some doubts due to the fact that women are not sufficiently represented among the people buried in the crypts.

A very low prevalence of non-specific stress indicators in the form of *cribra orbitalia* and enamel hypoplasia was reported in the craniological material, which may suggest good quality of life and living conditions over the growth period, particularly in early childhood. This may also be an effect of the relatively high socio-economic status of individuals buried in the crypts of the Franciscan church.

The low frequency of occurrence of carious lesions (31%) and relatively large number of individuals with intravital absence of M3 (17%) are of particular interest. Generally, in the group we observe a low frequency of the intravital absence of teeth, although such absence most often concerns for M1 (27%), which is a common phenomenon even among contemporary populations. Dental calculus is present in several individuals (14%).

Markers of occupational stress (MOS), skeletal stress markers (SSM) and musculoskeletal stress markers (MSS) were very rare in the group and should be interpreted as old-age alterations associated with arthritis (Capasso L. et al. 1999). This is a sign that the deceased did not perform any hard or arduous physical work, which means that they were probably burghers (merchants, administrators, officials or representatives of the clergy).

The most interesting examples include: suspected syphilis (crypt B3, burial 2), lesions in the bony palate with pink pigmentation of the entire skeleton and partial mummification (crypt B9, coffin 1), clavicular and costal fracture (crypt B3, burial 1), and degenerative changes in the elbow (crypt B5, burial 5) (Aufderheide, Rodriguez-Martin 1998). In the case of syphilis, the diagnosis is likely, albeit not definite due to the absence of the skull and the mandible in the remains of the individual. Changes in the bony palate together with a detailed analysis of the prosthesis and the definitive explanation of the cause of the colour of the skeleton will be the subject of a separate publication. Culture tests and scanning microscopy failed to explain the pigmentation of the skeleton. It is therefore necessary to perform genetic tests to determine which bacterial genus or species caused the pigmentation.

Table 6. List of values of cranial indices for individuals buried in crypts B7, B8 and B9

NO.	TOMB	SEX	AGE	CI	HLI	HWI	FPI	TFI	UFI	OI	NI
1.	Crypt B7, burial 1	F	maturus	83.7	72.1	86.1	70.8	85.3	53.5	84.2/84.2	49.0
2.	Crypt B7, burial 2	M	mat-sen	79.5	72.4	91.2	69.4	86.6	51.3	73.2/73.2	54.7
3.	Crypt B7, burial 3	M	maturus	-	-	95.5	70.7	-	48.7	77.8/77.8	55.8
4.	Crypt B7, burial 4	M	maturus	-	-	-	-	-	-	92.1/-----	50.0
5.	Crypt B8, burial 5	M	maturus	81.4	76.8	94.4	64.6	88.9	55.6	----/97.6	55.6
6.	Crypt B8, burial 6	M	mat-sen	82.4	73.1	88.7	70.0	97.8	58.5	88.6/88.6	44.6
7.	Crypt B9, burial 1	M	maturus	78.3	72.2	92.2	66.0	97.6	59.1	91.3/92.5	43.9
8.	Crypt B9, burial 4	M	35–40 yrs	87.8	75.0	85.4	64.6	92.0	55.1	88.9/95.3	40.3
9.	Crypt B9, burial 5	M	maturus	88.9	71.7	80.6	61.3	86.6	48.6	86.4/87.4	49.1
10.	Crypt B9, burial 8	M	adult	76.8	75.2	97.9	70.4	73.2	52.8	90.5/-----	42.1
11.	Crypt B9, burial 12	M	25–30 yrs	83.7	72.5	86.6	64.3	94.7	56.4	84.5/85.5	44.6
12.	Crypt B9, burial 13	F	mat-sen	86.6	72.6	83.8	66.2	90.9	59.5	90.0/94.9	41.1

CI – cephalic index (width-to-length ratio), **HLI** – height-to-length index, **HWI** – height-to-width index, **FPI** – fronto-parietal index, **TFI** – morphological facial index (total facial index), **UFI** – upper facial index, **OI** – orbital index, **NI** – nasal index

Table 7. List of cranial index values for individuals buried in other crypts

NO.	TOMB	SEX	AGE	CI	HLI	HWI	FPI	TFI	UFI	OI	NI
1.	Crypt K2 (Cloister), burial 5	M	maturus	86.4	76.3	88.2	70.6	-	56.1	72.1/73.8	49.0
2.	Crypt B5, burial 2	M	?	74.7	77.0	103.1	70.8	77.4	50.8	84.7/87.1	56.2
3.	Crypt B5, burial 12	M	mat-sen	81.7	71.7	87.7	69.4	88.4	55.0	77.6/76.7	68.1
4.	Crypt B5, burial 19	M	maturus	75.3	71.5	95.0	73.6	99.2	60.3	88.4/90.5	40.3
5.	Crypt B5, burial 11	F	mat-sen	82.9	74.7	90.0	63.8	85.0	54.3	83.3/85.3	40.6
6.	Crypt B5, burial 25	M	mat	81.2	72.6	89.4	63.6	83.3	50.0	81.7/83.8	46.8
7.	Crypt B5, burial 14	M	mat-sen	81.1	73.3	90.4	71.9	86.7	54.1	87.8/87.8	45.1
8.	Crypt B5, burial 10	M	maturus	78.9	75.0	95.1	65.5	89.2	52.3	82.1/84.2	46.2
9.	Crypt B5, burial 5	M	maturus	84.2	71.8	85.2	67.1	83.9	54.7	85.7/85.7	50.0
10.	Crypt B1, burial 5	M	maturus	81.9	72.9	88.9	71.0	99.2	59.4	85.0/85.0	50.0
11.	Crypt B3, burial 2	M	maturus	83.9	-	-	68.2	-	-	90.7	-
12.	Crypt B1, (Teofil Nowakowski)	M	maturus	86.5	79.4	91.8	68.7	-	49.6	80.5/79.3	52.1
13.	Crypt B2, burial 11	M	adultus	87.9	68.6	78.0	60.7	92.2	51.1	95.3/95.3	49.1
14.	Crypt B2, burial 2	M	maturus	-	-	91.6	65.6	-	-	-	-
15.	Crypt B3, burial 1	M	adultus	83.9	74.9	89.2	69.4	86.2	51.0	79.5/81.8	57.6
16.	Crypt B3, burial 5	F	ad-mat	-	-	-	-	-	-	-	-
17.	Crypt B3, burial 4	M	mat-sen	84.9	77.7	91.5	70.4	96.3	58.8	75.6/78.0	44.1
18.	Crypt B3, burial 3	M	maturus	-	-	-	-	-	-	-	-
19.	Crypt B3, burial 2	M	mat-sen	78.6	71.9	91.6	72.8	86.7	53.0	84.5/84.2	58.2
20.	Crypt K2, burial 3	D	infans I	-	-	-	-	-	-	-	-

CI – cephalic index (width-to-length ratio), **HLI** – height-to-length index, **HWI** – height-to-width index, **FPI** – fronto-parietal index, **TFI** – morphological facial index (total facial index), **UFI** – upper facial index, **OI** – orbital index, **NI** – nasal index

Table 8. Long bone measurements for individuals, with estimated stature

NO.	TOMB	SEX	AGE	Humerus (mm)		Radius (mm)		Ulna (mm)		Femur (mm)		Tibia (mm)		Fibula (mm)		S (cm)
				B	L	B	L	B	L	B	L	B	L	B	l	
1.	Crypt B2, burial 5	M	maturus	-	-	-	-	-	-	-	448	372	368	-	-	167
2.	Crypt B5, burial 2	M	maturus	323	-	245	238	261	255	440	440	-	350	-	343	168
3.	Crypt B5, burial 12	M	mat-sen	326	326	241	242	-	255	465	464	378	376	-	365	171
4.	Crypt B5, burial 19	M	maturus	330	320	249	245	266	261	446	448	-	370	-	364	171
5.	Crypt B5, burial 11	F	mat-sen	309	308	223	222	242	239	412	413	352	352	338	338	158
6.	Crypt B5, burial 25	M	maturus	-	321	232	-	256	-	465	465	374	373	357	356	170
7.	Crypt B5, burial 14	M	mat-sen	336	328	243	240	264	260	447	473	377	382	370	366	172
8.	Crypt B5, burial 10	M	maturus	315	318	225	224	234	234	446	450	357	357	344	344	166
9.	Crypt B5, burial 5	M	maturus	-	333	-	243	-	261	462	465	377	378	-	365	172
10.	Crypt B1, burial 3	M	adult	-	-	-	240	-	262	-	462	380	381	364	367	172
11.	Crypt B3, burial 2	M	adult													-
12.	Crypt B1, (Teofil Nowakowski)	M	maturus	342	342		246				486	382	382			175
13.	Crypt B2, burial 11	M	adultus	348	345	243	242	270	268	461	460	373	376	372	370	173
14.	Crypt B2, burial 2	M	maturus	362	354					496	496	402	400	418	408	180
15.	Crypt B3, burial 1	M	maturus	318		241	233	259	250	438	440	371	371	368		167
16.	Crypt B3, burial 5	F	ad-mat	-	302	215	214	235	232	427	425	349	345	336	334	159
17.	Crypt B3, burial 4	M	mat-sen	310	308	236	234	259	253	423	434	344	353?	335	347	167
18.	Crypt B3, burial 3	M	maturus			236					452		363?			169
19.	Crypt B3, burial 2	M	mat-sen	325	322	240	237	253	251	426	433	363	365	352	355	169
20.	Crypt K2, burial 3	D 18m	infans I	91.5								97.0		94.0		

Table 9. Long bone measurements with estimated stature for individuals buried in crypts B6, B7, B8 and B9

NO.	TOMB	SEX	AGE	Humerus (mm)		Radius (mm)		Ulna (mm)		Femur (mm)		Tibia (mm)		Fibula (mm)		S (cm)
				B	L	B	L	B	L	B	L	B	L	B	l	
1.	Crypt B6, burial 1	F?	adult	-	-	-	-	-	-	416	-	-	-	-	-	157
2.	Crypt B6, burial 2	F?	adult	-	-	-	-	-	-	403	-	-	-	-	-	154
3.	Crypt B6, burial 2	F?	adult	-	-	-	-	-	-	-	-	-	-	-	-	-
4.	Crypt B6, burial 5	?	adult	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	Crypt B6, burial 3	?	newborn	-	-	-	-	-	-	-	-	-	-	-	-	-
6.	Crypt B6, burial 5	M	adult	-	-	-	-	-	-	465	-	-	-	-	-	171
7.	Crypt B7, burial 1	F	maturus	325	319	236	233	252	248	466	461	370	371	359	360	167
8.	Crypt B7, burial 2	M	mat-sen	-	342	264	258	281	278	487	479	390	387	380	377	176
9.	Crypt B7, burial 3	M	maturus	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	Crypt B7, burial 4	M	maturus	326	321	236	233	251	249	430	432	-	-	-	-	167
11.	Crypt B8, burial 1	?	foetus, week 32	49	48.5	39	39	45	45	53	52	45	45	45	45	-
12.	Crypt B8, burial 2	?	month 1	-	-	54		-	-	85	83	68	67	61	61	
13.	Crypt B8, burial 4	M	ad-mat	332	328	252	-	275	-	457	-	388	381	381	-	172

Table 9. Long bone measurements with estimated stature for individuals buried in crypts B6, B7, B8 and B9 (continue)

NO.	TOMB	SEX	AGE	Humerus (mm)		Radius (mm)		Ulna (mm)		Femur (mm)		Tibia (mm)		Fibula (mm)		S (cm)
				B	L	B	L	B	L	B	L	B	L	B	l	
14.	Crypt B8, burial 5	M	maturus	336	333	241	242	259	260	467	470	-	389	-	382	173
15.	Crypt B8, burial 6	M	mat-sen	347	339	256	248	278	269	477	480	399	-	395	-	176
16.	Crypt B9, burial 1	M	maturus	325	322	-	232	248	245	411	408	-	354	-	339	165
17.	Crypt B9, burial 2	?	2.5–3 yrs	135	-	103	-	113	-	163	-	145	-	-	-	-
18.	Crypt B9, burial 4	M	35–40 yrs	333	321	244	238	263	257	461	464	376	376	-	-	171
19.	Crypt B9, burial 5	M	maturus	315	308	240	238	240	240	448	448	366	363	-	353	167
20.	Crypt B9, burial 8	M	adult	336	332	247	241	264	256	476	473	373	371	361	-	172
21.	Crypt B9, burial 12	M	25–30 yrs	-	323	249	239	-	261	442	438	366	369	359	364	170
22.	Crypt B9, burial 13	F	mat-sen	294	289	202	202	214	214	402	410	326	330	321	320	153

Table 10. Comparison of medium values of selected cranial indices in historical Southern Polish populations

SITE	SEX	CI	UFI	NI	OI	AUTHOR
Cracow, Market Square, 10th–11th century	M F	75.9 77.6	56.2 54.7	47.2 50.4	83.0 77.4	Głąb et al. (2010)
St Adalbert's	M F	77.8 79.6	49.8 56.4	52.9 49.6	76.2 82.2	Wróbel (2001)
St Mary's, Cracow	M F	83.6 83.3	51.6 50.7	47.7 49.4	78.1 79.8	Kaczanowski (1965)
St Mark's, Cracow	M F	81.3 81.4	50.2 52.1	49.7 48.5	78.6 77.5	Kaczanowski et al. (2001) Łuczak (1971)
Gliwice	M F	82.8 84.6	52.9 54.5	53.9 49.5	83.1 83.9	Głąb, Szostek (2003)
Cemetery, Stradomska 12, Cracow	M F	82.3 83.9	49.9 49.5	46.3 44.3	82.2 85.0	Szczepanek (2018)
Basilica Franciscans, Cracow	M F	82.1 84.4	54.7 55.7	49.7 43.6	84.9 85.8	Głąb (2019)

CI – cephalic index (width-to-length ratio), **UFI** – upper facial index, **OI** – orbital index, **NI** –nasal index

Table 11. Comparison of estimated stature of historical populations from various sites in southern Poland (S – stature, SDI – sexual dimorphism index)

SITE	MALES' STATURE	FEMALES' STATURE	SDI	AUTHOR
Cracow, Market Square, 10th–11th century	170.0 cm	157.0 cm	7.6%	Głąb et al. (2010)
St. Adalbert's, Cracow, 11th–12th century	171.2 cm	158.8 cm	7.6%	Wróbel (2001)

Table 11. Comparison of estimated stature of historical populations from various sites in southern Poland (S – stature, SDI – sexual dimorphism index) (continue)

SITE	MALES' STATURE	FEMALES' STATURE	SDI	AUTHOR
Ostrów Lednicki	168.3 cm	159.3 cm	5.3%	Kaźmierowska (1988)
Lubsko	170.0 cm	161.0 cm	5.3%	Świątek (2001)
Gliwice	171.6 cm	160.0 cm	6.8%	Głąb, Szostek (2003)
Basilica Franciscans, Cracow	170.7 cm	158.0 cm	7.4%	Głąb (2019)

Sarcophagus containing the remains of Boleslaus V the chaste

The sarcophagus contained the remains of at least three adult individuals. All skeletons are far from complete, making it difficult to assign bones to each individual. In addition, the task was made even more challenging by the bones having been covered with a substance of the consistency of resin or thick, colourless paint. As a result, the colour of the osseous material has been altered.

Skull A

Slightly deformed, of asymmetrical build. It is difficult to determine if the deformation occurred *pre-* or *post mortem*. Its striking characteristic is a definitely more prominent right superciliary arch. A supra-orbital notch on the right, and a foramen on the left. Non-specific stress markers in the form of *cribria orbitalia* and enamel hypoplasia were not observed.

The morphological features of the skull do not raise doubts as to the sex of the individual. The upper edges of the orbits are rounded, the mastoid processes of the temporal bones are well-developed, and the nuchal linea is clearly marked. The man presumably died at the age of 35 to 40.

In an incomplete right section of the maxilla, I^1,I^2, C, P^1 and P^2 were lost *post mortem*, and M^1 and M^2 are present. In the mandible: on the right side I_1 is present, and I_2, C, P_1 were lost *post mortem*. On the left, I_1 and I_2 are present.

Skull B

The alleged remains of Boleslaus V the Chaste. An incomplete, short skull of delicate build. Still, the superciliary arches are clearly marked. Upper orbital edges show intermediate configuration. Cribra orbitalia are visible on the right orbital vault. An osteoma is visible in the region of the coronal suture above the left greater wing of sphenoid bone. The nuchal linea is poorly marked. Cranial sutures are completely obliterated. The individual probably died after the age of 50.

The viscerocranium contains an almost complete left zygomatic bone with the frontal process, a fragment of the left maxillary bone containing M2 in the alveolus. The right maxilla contains P1, P2, with M1 and I1, I2 and C lost *post mortem*; the left side also features I1 present *intra vitam*. The left arm of the mandible contains a fragment of the shaft and the alveoli of M1, M2 and M3. A piece of the right maxilla with the palatal bone, and an M3 alveolus from another skull.

Skull C

The skull is fragmented. Preserved bones include: the occipital squama with a prominent nuchal linea, posterior parts of both parietal bones and three fragments of the inferior parts of temporal bones, the right temporal bone with its process partly broken off, the mastoid process, the external acoustic opening, the zygomatic process of the temporal bone and the temporal process of the zygomatic bone. The cranial *ossa tegumentaria* and their massive build indicate that the individual was a male who died at the *maturus/senilis* age.

Table 12. Long bone measurements from the sarcophagus of Boleslaus V the chaste

LONG BONE MEASUREMENTS		BONE LENGTH (MM)	S (CM)	SEX AND AGE
1	Right femur	460	170	Male, adult
2	Right tibia	389	176	Male, adult
3	Right tibia	370	170	Male, adult
4	Left ulna	274	174	Male, adult

The data in the table above suggest that the right femur (1) and the right tibia (3) belonged to the same individual. The right tibia (2) and the left ulna (4) belonged to another person. The post-cranial skeleton in the sarcophagus included over a dozen rib fragments from both sides of the body, a single lumbar vertebra of a male adult, the upper epiphysis of the right humeral bone, the right pelvic bone with strongly male characteristics, and a fragment of the left pelvic bone without the pubis and without part of the iliac crest. The pelvic bones could be associated with skull B. In addition, the material contained a fragmented sacrum, which should be linked with both pelvic bones. The condition of the sacrum does not allow it to be matched to the pelvic bones mentioned above. Extant bones of the feet include the right calcaneous bone and the left talus.

Table 13. List of values of cranial indices from the sarcophagus of Boleslaus V the chaste

No.	Boleslaus the Chaste's sarcophagus	Sex	Age	CI	HLI	HWI	FPI	TFI	UFI	OI	NI
1.	Skull A	M	ad-mat	73.9	70.2	95.0	68.3	-	52.3	80.9/78.6	47.1
2.	Skull B (supposedly Boleslaus)	M	mat-sen	84.0	76.0	90.5	-	-	-	-	-
3.	Skull C (fragmented, incomplete)	M	mat-sen	-	-	-	-	-	-	-	-

CI – cephalic index (width-to-length ratio), **HLI** – height-to-length index, **HWI** – height-to-width index, **FPI** – fronto-parietal index, **TFI** – morphological facial index (total facial index), **UFI** – upper facial index, **OI** – orbital index, **NI** – nasal index

Stable carbon and nitrogen isotope evidence for diets of 17–18th century elites

Laurie J. Reitsema, Anna Drążkowska, Marcin Nowak

This study reconstructs the diets of 17–18th century individuals buried in the Basilica of St. Francis of Assisi (Krakow, Poland) using stable carbon and nitrogen isotope ratios in human bone collagen (Reitsema, Drążkowska, Nowak 2020, p. 49–58). The 25 individuals studied were wealthy women and men, including one priest and three members of a prestigious faith community of laypersons, the Archconfraternity of the Lord's Passion (also known as the "Brotherhood of Good Death"), buried in different crypts within the church. Burial location within churches at this time in Europe is known to vary with differences in social standing of parishioners, with elites typically buried nearer the altar (Kloczowski, 2000). Differences in the social roles and daily lives of males and females are well documented in Poland during the medieval and post-medieval periods, including differences in food consumption (Bynum, 1987; Dembińska, 1999; Gieysztor et al., 1968; Zamoyski, 1988). Both burial location and sex are examined as factors potentially influencing diet of the individuals studied, offering the opportunity to examine differences in diet within a group of social elites. Together, the well-preserved skeletal remains from the Basilica permit a study of the daily eating habits of elites in Krakow in the 17–18th centuries.

Historical context for diet reconstruction

This biochemical approach to diet complements several rich, nearly contemporaneous historical records of Polish food history. Andrzej Wyczański's (1966) detailed survey and analysis of daily food consumption in 16–17th century households documents which food items were consumed and their relative amounts, as well as status-based differences in diet, demonstrating high amount of meat, fish, and spices in elite diets. Zbigniew Kuchowicz (1966) documents 18th century Polish diets using a variety of primary sources and focuses on nutrition and health, showing that 18th century Polish elites consumed ample alcohol, meat, and fats resulting in health problems such as gout, kidney stones, metabolic disorders, and arteriosclerosis. These historical studies show how wealth, access to resources through markets or from one's own produce, and the expectations and norms for one's social position profound-

ly shaped what people ate on a daily basis. Through records such as these and from archaeological evidence, we know that for Polish people during the 16–17th centuries, most daily calories (60–80%) came from grains in the form of bread, the dietary staple, and beer (Dembińska, 1999; Klonder, 2002; Kuchowicz, 1966; Wyczański, 1966). Rye and wheat were the most common grains used for bread, with wheat being considerably more expensive. Besides bread, gruels made of millet and barley were common. Beer, which made up approximately 15–20% of daily calories on estates and farms (Wyczański, 1966), was brewed from wheat and combinations of rye, barley, oats, and millet (Dembińska, 1999). Rice and wild-harvested manna (*Digitarium sanguinalis*) were expensive and much less common (Dembińska, 1999; Łuczaj, et al., 2012; Wyczański, 1966).

Vegetables such as peas, cabbage, turnips, and onions, as well as radish, cucumber, carrot, parsley, parsnips, kale, and asparagus also were important food items (Wyczański, 1966: 20). Fruits included apples, pears, plums and cherries that were grown in orchards and household gardens; these could be eaten raw or preserved dried and in jams.

The most commonly consumed meats in the 16–17th centuries were beef and pork, followed by poultry, and especially chicken (Grezak and Kurach, 1996; Wyczański, 1966). Most people probably consumed meat, milk, and cheese on a daily or near-daily basis, but the amount and type consumed would have varied by wealth (Dembińska, 1999; Klonder, 2002; Makowiecki, 2008; Wyczański, 1966). Fish are commonly present in household records from the 16–17th century regardless of status of the context, but make up a small proportion of estimated daily calories (approximately 1–5%) (Wyczański, 1966).

Background to stable isotope analysis

The reconstruction of human diet using stable carbon and nitrogen isotope ratios from bone is possible because isotopic ratios of foods are preserved in the tissues of consumers (van der Merwe and Vogel, 1978; Vogel and van der Merwe, 1977). Therefore, isotopic evidence for diet is a complement to historical and archaeological evidence that is both direct, coming from the human bones themselves, and individualized, reflecting the diet of a single and therefore a specific person. Stable carbon isotope ($\delta^{13}C$) ratios chiefly distinguish between plants using different photosynthetic pathways: C_3 plants (most grains, vegetables and fruits), which discriminate less against ^{13}C, and C_4 plants (millet, sugarcane), which discriminate more against ^{13}C and consequently exhibit higher $\delta^{13}C$ values (Hoefs, 2004). Stable carbon isotope ratios also differentiate terrestrial, freshwater and marine foods (Chisholm, et al., 1982; Katzenberg and Weber, 1999). Stable nitrogen isotope ($\delta^{15}N$) ratios are associated with an organism's trophic position in the local food web, with carnivores exhibiting higher values than omnivores, which exhibit higher values than herbivores (Minawaga and Wada, 1984; Schoeninger and DeNiro, 1984). The $\delta^{15}N$ values of marine and freshwater organisms often are higher than those of terrestrial animals, largely because of the longer lengths of aquatic foodwebs.

Materials and methods

Twenty-five adult individuals from six different locations within the Church of St. Francis of Assisi are included in this study (Table 14). Osteological sex estimations are available for 21 individuals, of which 16 are male and five are female.

Table. 14. Different locations within the church included in this study

BASILICA OF ST. FRANCIS OF ASSISI BURIAL LOCATION	NUMBER OF INDIVIDUALS ANALYZED
Crypt 2	2
Crypt 3	3
Crypt 5	10
Crypt 7	3
Crypt 8	1
Crypt 9	6
Total:	25

Human ribs were cut into small fragments and cleaned in the Bioarchaeology and Biochemistry Laboratory of the Department of Anthropology at the University of Georgia. Using a hand-held rotary tool and a diamond-embedded drill bit, the outer surface of bone was filed away and all trabecular bone removed. Collagen was extracted at the University of Georgia Center for Applied Isotope Studies using a protocol similar to that of Ambrose (1990). Cleaned bone was broken into small pieces, demineralized in 1.0 M HCl for 24 hours, and rinsed three times in ultrapure water. Bone pieces then were soaked in 0.1 M NaOH for five minutes to separate humic contaminants, filtered, and rinsed three times. Samples were flushed with 1.0 M HCl, rinsed twice in ultrapure water, and gelatinized at 70–90°C for 12–24 h, then drawn through a glass filter paper and freeze dried. Between 0.800 and 1.100 mg of powders were analyzed at the Center for Applied Isotope Studies in Athens, Georgia USA using a Carlo Erba NA1500 CN elemental analyzer coupled to a Thermo Delta V isotope ratio mass spectrometer via the Thermo Conflo III open split interface. Stable isotope ratios are expressed as a permil (‰) ratio of the heavier to the lighter isotope in the sample in relation to the ratio of the heavier to the lighter isotope in a standard substance (Vienna Pee Dee Belemnite for $\delta^{13}C$ and AIR for $\delta^{15}N$). Both carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) stable isotope ratios are reported according to the equation $[\delta = (R_{sample} - R_{standard})/R_{standard} \times 1000]$.

The preservation quality of collagen was evaluated using carbon and nitrogen content and collagen content in bone following Ambrose (1990) and DeNiro (1985). Statistical analyses were conducted using non-parametric Mann-Whitney-U (paired samples) or Kruskal-Wallis (more than two samples) tests, and p-values are considered significant at ≤0.05.

Results

The mean %C value is 42.9±0.8%, the mean %N value is 15.7±0.3%, and the mean CN ratio is 3.2±0.02 (Table 15). No samples fell outside the range deemed appropriate for adequate collagen preservation (Ambrose 1990; DeNiro 1985).

The faunal baseline used in this study (medieval and post-medieval animals from Toruń and Kałdus in North-Central Poland) have values of $\delta^{13}C$= –20.9±1.1‰ and $\delta^{15}N$=7.2±2.2‰ for terrestrial animals (n=21), and $\delta^{13}C$= –22.6±5.3‰ and $\delta^{15}N$=9.5±2.3‰ for fish (n=20) (Reitsema, et al., 2010; Reitsema, et al., 2017).

Results from the Basilica of St. Francis of Assisi are shown in Figure 105. Human stable isotope values range from -20.1‰ to –18.8‰ (mean: -19.3±0.3‰); $\delta^{15}N$ values range from 12.8‰ to 14.9‰ (mean: 13.7±0.6‰). Fauna and other humans from previous studies of Polish diet also are shown.

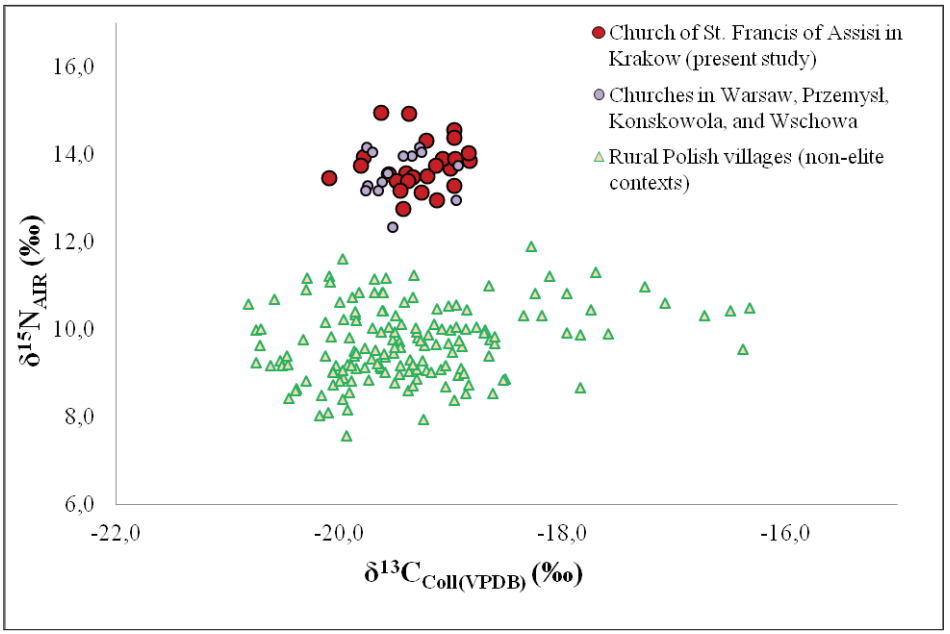

Fig. 105. Isotope data from the Basilica in comparison to other Polish stable isotope data.

There are no significant differences in the isotope ratios among crypts within the church ($\delta^{13}C$ p=0.09107; $\delta^{15}N$ p=0.8565; Fig. 106). Because some of the crypts have very small sample sizes, another test was carried out comparing the two crypts with the greatest number of individuals (crypts 5 and 9). Isotope ratios were not significantly different between these two crypts ($\delta^{13}C$ p=0.08888; $\delta^{15}N$ p=0.3003), although the $\delta^{13}C$ values of humans from Crypt 9 are on average lower than those of humans from Crypt 5 (Fig. 106). When males (n=16) and females (n=5) are compared, males exhibit significantly higher $\delta^{15}N$ values (Kruskal Wallis, $p<0.001$; 12.8–14.9‰ compared to 13.5–13.9‰ for females), but $\delta^{13}C$ values are similar (p=0.08447) (Fig.107).

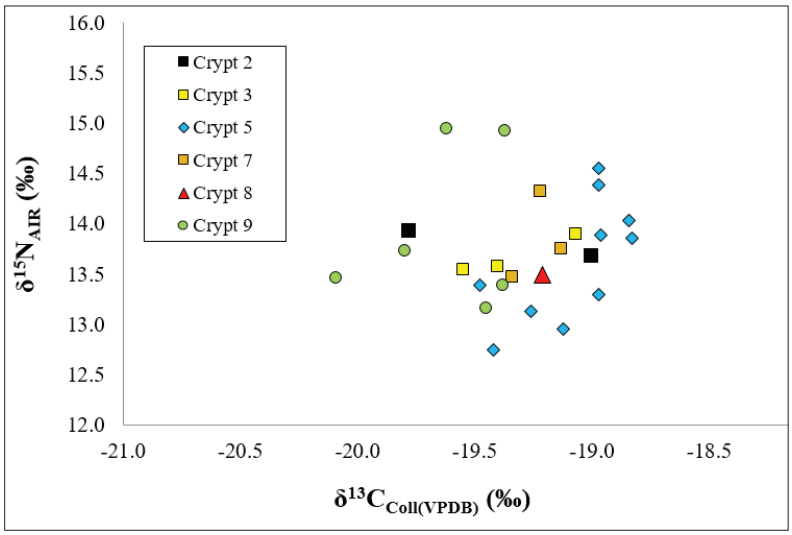

Fig. 106. Isotope ratios differentiated by burial location within the Basilica

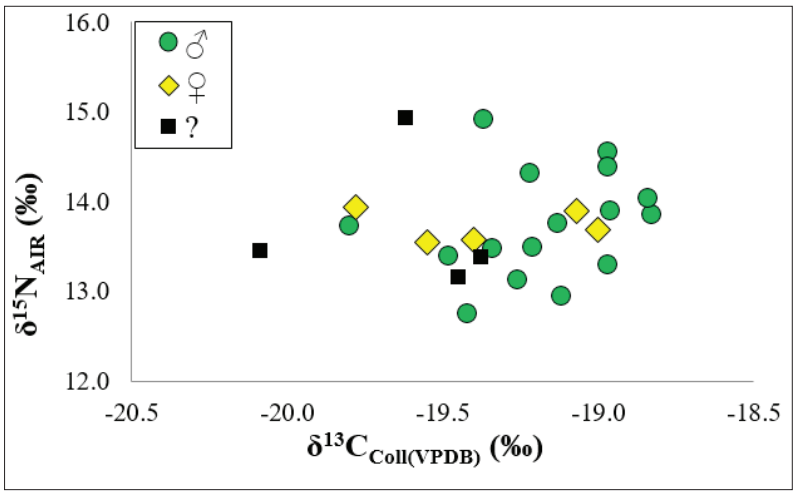

Fig. 107. Isotope ratios differentiated by sex within the Basilica

Table 15. Results

NO.	GRAVE	SEX	%C	%N	$\delta^{13}C_{VPDB}$(‰)	$\delta^{15}N_{AIR}$(‰)	CN
CRYPT B2							
K1	2	M	43,3	15,9	–19,3	13,1	3,2
K2	11	M	43,2	15,8	–19,0	14,6	3,2
CRYPT B3							
K3	1	M	42,8	15,7	–19,0	14,4	3,2
K4	2	M	43,4	16,0	–18,8	13,9	3,2
K5	4	M	43,4	15,8	–19,0	13,3	3,2
CRYPT B5							
K6	2	M	43,1	15,8	–19,4	12,8	3,2
K7	5	M	43,2	15,9	–18,8	14,0	3,2
K8	10	M	42,0	15,3	–19,0	13,9	3,2
K9	11	K	42,0	15,4	–19,0	13,7	3,2
K10	12	M	42,6	15,6	–19,1	13,0	3,2
K11	14	M	43,8	15,7	–19,5	13,4	3,3
K12	18		42,0	15,3	–19,4	13,4	3,2
K13	19	M	42,0	15,4	–19,2	13,5	3,2
K14	25	M	43,2	15,8	–19,1	13,8	3,2
K15	9	K	43,8	15,9	–19,8	13.9	3,2
CRYPT B8							
K16	5	M	41.1	15,0	–19,2	14,3	3,2
CRYPT B7							
K17	1	M	43,9	16,0	–19,6	13,5	3,2
K18	2	M	43,1	15,8	–19,3	13,5	3,2
K19	4	M	45,2	16,4	–19,8	13,7	3,2
CRYPT B9							
K20	1	M	42,6	15,5	–19,4	14,9	3,2
K21	2		42,3	15,6	–20,1	13,5	3,2
K22	8	K	42,6	15,6	–19,4	13,6	3,2
K23	12		43,5	15,9	–19,5	13,2	3,2
K24	13	K	42,4	15,6	–19,1	13,9	3,2
K25	5		42,9	15,6	–19,6	14,9	3,2

Discussion

Results of the isotopic analysis of human bone from the Basilica of St. Francis of Assisi suggest similar diets for all individuals studied. Diets were based on C_3 plants, terrestrial animals, and fish, likely anadromous varieties such as sturgeon and freshwater varieties, both of which tend to exhibit $\delta^{13}C$ ratios similar to those of humans reported here (Fuller et al., 2012; Grupe et al., 1999). Such diets are typical for elites in Poland at this time period (Kuchowicz 1966; Wyczański, 1966).

Furthermore, individuals from the Basilica isotopically resemble other previously studied elites in Poland and Lithuania during this time periods (Reitsema et al., 2016). These other elite contexts include churches and cathedrals in Warsaw, Przemyśł, Końskowola, and Wschowa (Reitsema, et al., 2016). Diets in elite contexts are quite different from those in rural villages, which include early medieval rural villages Giecz (Reitsema, et al., 2010), Kałdus (Site 1) and Gruczno (Sites 1 and 2) (Reitsema, et al., 2017). The main difference is the high amount of animal protein in elite diets, but greater consumption of millet among rural villages also is noteworthy. It also is likely that elite diets comprised not only more animal protein, but animals of higher trophic levels, such as water fowl (crane and heron), pigs, chickens, and large fish.

A priest, wealthy laypeople, and members of the elite Archconfraternity of the Lord's Passion, have diets similar to one another in comprising high animal protein, although the priest does exhibit the highest $\delta^{15}N$ value in the sample (14.9‰). There are no differences in diet depending on burial location within the church. Diets of people from the Basilica all are similar to diets of religious personnel in other studies from this time period in Poland and Lithuania, suggesting first, that there is no diet peculiar to clergy, and second, that the clergy consumed rich and by no means ascetic diets.

The presence of more animal protein in diets of males mirrors what already is known about the social standing of males versus females in historic Poland (Dembińska, 1999; Gieysztor et al., 1968; Zamoyski, 1988) but also demonstrates that sex-based differences in status are not only relevant among the working lives of the peasantry. The females in this study appear to have consumed similar amounts of animal protein to one another, while in contrast, males consumed much more variable amounts of animal protein. Possibly, there were more opportunities for food selectivity among men, or greater chance of variance in social status if one was male versus female during this time. For women, there were potentially more constraints on diet, despite both men and women eating from among the choicest foods.

Conclusion

This study reconstructed diets of 25 individuals interred in the 17–18th centuries in the Basilica of St. Francis of Assisi in Krakow using stable carbon and nitrogen isotope ratios of bone collagen. Results indicate elite individuals, including both wealthy laypeople and a priest, and both males and females, ate diets rich in animal protein, including fish (likely anadromous and freshwater varieties). There is no appreciable evidence for consumption of the C_4 plant millet, nor marine fish. Diets of individuals buried in different crypts are similar to one another. The diets of males and females differ, with males consuming more and more varied amounts of animal protein than females.

Acknowledgments

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Genetic analysis of haploid markers in samples of skeletal remains

Marta Gorzkiewicz, Tomasz Grzybowski

Introduction

In the early eighties of the twentieth century, a number of archaeologists turned their attention to molecular genetics. They realised that DNA analysis of human remains excavated all over the world might be useful in reconstructing population ancestry as well as a single person's genealogy (Gorzkiewicz, Grzybowski 2020, p. 42 –48). Indeed, the advanced techniques of molecular biology have ushered the study of the human past into a new era. Cooperation between archaeologists and geneticists gave rise to a new field of research called archaeogenetics (Renfrew 2000). Archaeogeneticists can reconstruct population history by applying various models of DNA variability to contemporary population samples (Soares et al. 2010), or directly examining ancient biological material taken from archaeological sites, museum specimens, relics, and such (Hagelberg et al. 2015). Depending on the research objective, the analysis can include DNA fragments inherited from both parents (nuclear autosomal markers) or from one parent only (haploid markers). Recently, the sequencing of whole genomes of ancient samples has also been made possible by technological advances in DNA analysis (Allentoft et al. 2015).

The autosomal markers commonly used in archaeogenetics include microsatellite sequences (short tandem repeats, STRs) and single nucleotide polymorphisms (SNPs), while mitochondrial DNA (mtDNA) and the non-recombining part of the Y chromosome (NRY) are commonly employed haploid markers. Unlike the nuclear autosomal markers, mtDNA and NRY in humans are inherited uniparentally without recombination (from the mother and the father, respectively). From the results of their typing, called haplotypes, one can draw inferences about an individual's biogeographic ancestry. Mitochondrial DNA (mtDNA) presents several characteristics useful for ancient DNA studies, including high copy number, circular structure and small size (about 16,539 base pairs). These characteristics make mtDNA molecules more abundant, and more resistant to the degradation that occurs in ancient specimens. The range of mtDNA sequencing can encompass the most polymorphic control region or complete mitogenome. Mitochondrial haplotypes are routinely reported in the format of nucleotide differences relative to the revised version of the first published human mtDNA sequence (rCRS). In turn, Y-chromosome analysis involves genotyping of short tandem repeats (Y-STRs) and/or single nucleotide polymorphisms (Y-SNPs). The collection of similar haplotypes of mtDNA

or Y chromosome, defined by a combination of characteristic polymorphisms inherited from a common ancestor, constitutes a haplogroup. Since the frequencies of particular haplogroups vary significantly between geographical regions, the haplogroup affiliation of a sample provides valuable information about the geographical origin of the paternal or maternal lineage that a sample represents. Based on the concept of the "molecular clock", assuming that DNA sequences evolve at a relatively constant rate over time, one can estimate the evolutionary ages of particular haplogroups. The evolutionary ages allow for assessment of the actual time needed for the diversification of haplotypes within particular haplogroups from a common ancestor and thus for the reconstruction of various episodes from a population history.

In this study, we have typed the mtDNA control region and Y-chromosomal microsatellites from bones and teeth originating from six persons whose remains were uncovered in the church of Saint Francis in Cracow. Based on the DNA typing results, we have drawn inferences about the relatedness and possible biogeographic origin of the maternal and paternal lineages represented by the studied individuals.

Materials and methods

Archaeological skeletal remains from six individuals of both sexes were used in the study. The samples dating back to the seventeenth and eighteenth centuries were taken during excavations conducted at the church of Saint Francis in Cracow. The skeletal material was processed under conditions designed to minimise contamination. All steps, including bone cutting, surface removal, powdering and DNA extraction were carried out according to the scientifically accepted safety guidelines developed for ancient DNA. The personnel involved wore disposable lab suits, masks, caps and sterile nitrile gloves. All equipment and working surfaces were bleached and UV-irradiated before use. For liquid handling tasks, molecular-biology-grade reagents and disposable, sterile filtered tips, sterile tubes and scalpels were employed. A reagent blank reaction was prepared in parallel with each extraction, and negative controls accompanied all PCR amplifications.

Bone surfaces were mechanically cleaned by scraping, followed by an extensive rinse in DNA-free water, dried, exposed to NaOCl 10% for five minutes, and then washed three times alternately with alcohol and sterile water. In the last step of decontamination, UV irradiation was applied on both sides of a bone sample for 20 minutes. Bone samples were ground into fine powders using a liquid nitrogen-grinding mill (Spex® SamplePrep, model 6875). For each sample, DNA extraction was performed at least twice using two different methods: PrepFiler™ BTA Forensic DNA Extraction Kit (Applied Biosystems) according to the manufacturer's protocol and a method by Yang et al. (2004) with the authors' own modifications. In brief, the powders were incubated with lysis buffer (0.5 M EDTA pH 8.0, 0.5% SDS and 100 μg/ml proteinase K) in thermomixer (Eppendorf) at 56°C for 48 hours. The extraction was performed using organic method. After centrifugation, supernatant was transferred to an Amicon® Ultra-4 (Millipore) for concentrating DNA samples. Then, extracts were passed through QIAquick™ columns (Qiagen) according to the manufacturer's protocol. The amount of bone powder used in the extraction was 0.05 g and 0.261 g, respectively, for the first and second method. The concentration of DNA recovered from samples was assessed by qPCR using the QuantiFiler™ Duo DNA Quantification Kit and ViiA 7 System (Applied Biosystems). MtDNA analysis was carried out according to the current recommendations of the International Society for Forensic

Genetics (Parson et al. 2014; Grzybowski et al. 2018). The HVS I and HVS II segments of mitochondrial DNA control region were amplified using an ABI 9700 thermocycler. The primers designed by Sullivan et al. (1992) and Gabriel et al. (2001) were employed in PCR amplification. The amplicons were sequenced with the BigDye Terminator v3.1 Cycle Sequencing Kit (Applied Biosystems), encompassing HVS I (15,999–16,400 bp) and HVS II (30–407 bp) regions. The capillary electrophoresis was performed on the ABI 3130xl analyser according to the manufacturer instructions. MtDNA haplotypes were determined relative to the reference sequence rCRS (Andrews et al. 1999). The frequencies of examined haplotypes were estimated by searching the EMPOP database v. 4/R12 (empop.org) containing 12,745 haplotypes belonging to haplogroups of European origin and the authors' own database containing 1,037 haplotypes from Russia, Poland, Ukraine, Czech Republic and Slovakia. The haplogroup affiliation of samples was determined using the global mtDNA phylogenetic tree available online, PhyloTree, build 17 (van Oven and Kayser 2009). The polymorphism of Y-chromosome microsatellites (Y-STRs) was determined including twenty-three loci: DYS385, DYS19, DYS389I/II, DYS390, DYS391, DYS392, DYS393, DYS437, DYS438, DYS439, DYS448, DYS456, DYS458, DYS481, DYS533, DYS549, DYS570, DYS576, DYS635, DYS643 and Y GATA H4, using the commercially available kit PowerPlex® Y23 System (Promega) and an ABI 9700 thermocycler. Genotyping products were separated by capillary electrophoresis carried out on a DNA ABI 3130 sequencer and analysed using GeneMapper ID v.3.2 software (Applied Biosystems). The Y-STR haplotype frequencies were estimated by searching the YHRD database, R61 (yhrd.org).

Results and discussion

Despite the fact that extraction methods employed in the study were specifically developed to recover DNA from ancient bone material, negative results of Quantifiler Duo were obtained for five out of six samples and an overall low PCR reaction efficiency of mitochondrial DNA was observed for all samples. Sample 6 was successfully amplified in Real Time PCR and genotyped for Y-STRs. As far as mtDNA amplification is concerned, most successfully amplified mtDNA segments were sized in the range 125–170 bp, while PCRs of longer fragments failed. It is worth noting that a decrease in PCR efficiency for longer amplicons is characteristic of severely degraded ancient DNA and strongly suggests the authenticity of the results (Cooper and Poinar 2000). The use of a number of PCR amplifications of overlapping mtDNA fragments resulted in obtaining haplotypes for all six samples (Table 16), while in some cases we did not succeed in the sequencing of HVS II fragments' downstream nucleotide position 302 bp. However, the length polymorphism between positions 302 and 310 bp (including common length heteroplasmy) is not essential for identification of maternal lineages (Parson et al. 2014) and sequence variants located below position 310 are mostly not crucial in the proper haplogroup assignment (van Oven and Kayser 2009). Comparison of haplotypes obtained for samples from 1 to 6 in the same sequence range revealed differences (Table 16), suggesting a lack of maternal relatedness between the studied individuals.

All haplotypes were assigned to mitochondrial haplogroups characteristic of West Eurasia (H, T1, U5a1 and I). Three haplotypes (samples 1, 3 and 4 in Table 16) represented haplogroup (hg) H, the most common mtDNA clade in Western Eurasia. Among Western and Eastern Slavs, hg H occurs with frequencies of 37–45% (Grzybowski et al. 2007; Mielnik-Sikorska et al. 2013; Malyarchuk et al. 2017).

Table 16. Haplotypes of mtDNA control region identified in samples with corresponding frequencies and haplogroup assignments. Positions in mtDNA haplotypes were named against the reference sequence rCRS (Andrews et al. 1999). For samples 1 to 5 the total database counted 13,782 haplotypes, for sample 6 – 11,243 haplotypes. The haplotype frequencies were estimated using (x+1)/n+1) algorithm, where x – number of the haplotype observations in database; n – total number of haplotypes.

Sample N°	Range of HVS I and HVS II regions	HaplotypeAPLOTYP	Haplo-group	Haplotype frequency	Range of database searching
1	16000–16360; 30–377	16093C 16183C 16189C 263G 315.1C	H1f	3,63e –04	16024–16365;73–290
2	15999–16353; 34–290	16126C 16163G 16186T 16189C 16294T 73G 195C 263G	T1a1	2,18e –03	16024–16365;73–290
3	15999–16320; 110–290	146C 195C 263G	H	1,02e –03	16024–16365;73–290
4	16115–16380; 34–290	16311C 195C 263G	H11	1,09e –03	16115–16365;73–290
5	15999–16365; 178–278	16256T 16270T 263G	U5a	7,11e –03	16024–16365;178–278
6	15999–16400; 40–280	16129A 16223T 16391A 73G 199C 250C 263G	I	1,78e –04	16024–16400;73–290

In the contemporary Polish population, the average frequency of H is 43.42% (Jarczak et al. 2019), while in Europe it reaches 45%. This clade most likely originated from the Middle East about 18 kya and appeared in Europe after the Last Glacial Maximum, about 15 kya (Soares et al. 2010). Contemporarily, haplogroup H is marked by a great inner diversity, including over 100 smaller sub-clades (van Oven and Kayser 2009).

The haplotype of sample 3 representing haplogroup H is widely distributed among European populations, so without the data from the mtDNA coding region we were not able to determine more specifically its sub-haplogroup affiliation and phylogeographic image. Nevertheless, a more detailed sub-clade classification within haplogroup H was possible for the remaining two samples. The presence of transition T16093C in sample 1 allowed us to assign its haplotype to sub-haplogroup H1f, while transition T16311C in sample 4 is diagnostic for subclade H11 (Table 16). It is worth noting that there is some uncertainty in these classifications, since neither T16093C nor T16311C are exclusive diagnostic markers for the above-mentioned sub-haplogroups and there is no information on haplogroup-specific mutations in the coding region (van Oven and Kayser 2009). Sub-haplogroup H1 occurs relatively often in the Polish population (15.42%), being most frequent among mtDNA sub-haplogroups within clade H (Jarczak et al. 2019). Complete mtDNA analyses suggest that haplogroup H1 dates back to the end of the Younger Dryas glacial relapse (11 kya), after which temperatures reached a stabilisation level similar to that of the present day. As a consequence, a resettlement of western and central Europe occurred, primarily from a Franco-Cantabrian refugium, where H1 is contemporarily observed with the highest frequency (Soares et al. 2010; Alvares-Iglesias et al. 2009). The haplotype of sample 1, belonging to H1f, was observed in the EMPOP database once in Poland and Finland and twice in Sweden. It is worth noting that sub-clade H1f was observed with high frequencies in the Finnish population, constituting nearly 25% of all haplotypes classified into haplogroup H. The most probable explanation of this phenomenon is a "founder effect" in the history of the Finnish population (Finnilä et al. 2001; Loogväli et al. 2004).

Haplogroup H11, represented by sample 4 (Table 16), is distributed mostly in central Europe, though it appears with relatively low frequencies close to 5% (Alvares-Iglesias et al. 2009). The average frequency of H11 in the Polish population is about 0.5%, while its highest

frequency (1.71%) was noted in Lesser Poland (Jarczak et al. 2019). A haplotype encompassing control region polymorphisms found in sample 4 was previously observed in the EMPOP database for Poland (3), Germany (2), Latvia (1), Macedonia (2), Romania (2), Slovenia (1), Croatia (1) and Serbia (1).

Table 17A. Y-STR haplotype and its predicted haplogroup affiliation obtained for bone sample 6

Table A

Y-STR locus	Sample 6	Y-STR locus	Sample 6
DYS576	19	DYS570	18
DYS389I	13	*DYS635*	22
DYS448	20	*DYS390*	24
DYS389II	32	*DYS439*	12
DYS19	N.O.	*DYS392*	11
DYS391	11	DYS643	11
DYS481	31	*DYS393*	13
DYS549	11	*DYS458*	17
DYS533	13	*DYS385*	N.O.
DYS438	N.O.	*DYS456*	15
DYS437	15	*YGATAH4*	N.O.
haplogroup	I		

Legend: N.O. – locus not determined
The loci shared by PPY23 and Y-Filer (YF) are marked in *Italics*.

Table 17B. Results of YHRD database searching for the PPY23 and YF range of loci

Frequency (PPY23)	
Number of haplotypes observed in database	0/62,737
n+1/N+1	1/62,738
Kappa	1/498,668
Frequency (YF)	
Number of haplotypes observed in database	7/225,098
n+1/N+1	1/28,137
Kappa	1/64,552

Sample 2 was classified into sub-clade T1a1 (Table 16) and its haplotype is widely distributed in Europe. Coding region transition T9899C (beyond the sequence range employed in this study) would be needed for ultimate confirmation of this haplogroup assignment (van Oven and Kayser 2009). The evolutionary age of T1a1 is estimated to 15.5 kya and it is assumed to have arrived in central and northern Europe from Anatolia after the Last Glacial Maximum (Pala et al. 2012).

Sample 5 represents sub-haplogroup U5a with the HVS I haplotype motif 16256–16270, which appears in many European populations and is considered to be a founder haplotype. However, it is relatively rare in Slavic-speaking populations from Central and Eastern Europe. The derivative haplotype with additional transition 16192 occurs more often (Grzybowski et al. 2007). U5a is one of two main sub-haplogroups within U5, and occurs in Europe with an average frequency of 7% (Malyarchuk et al. 2010). U5 representatives reached the Old Continent approximately 30–55 kya (Soares et al. 2010). Sub-haplogroup U5a dates back to 16–20 kya, implying that it evolved during the Last Glacial Maximum. In contrast, sub-haplogroup U5b is characterised by a pre-LGM time of divergence of 20–24 kya, depending on the mutation rate used. The phylogenies and evolutionary ages of several sub-clusters within U5a suggest a post-LGM re-expansion of U5a sub-clade from refugial zones between the Pyrenees, the Balkans and the Ukraine (Malyarchuk et al. 2010).

Interestingly, up to now the mitochondrial haplotype determined for sample 6 has been noticed only once in the Polish population (Table 16). It was classified into haplogroup I (sub-clade within N1a1b) that is geographically very widely distributed, but rarely among Europeans. Its average frequency in Poles is 1.76% (Jarczak et al. 2019) and it occurs with the highest frequency (up to 11%) in the Lemko populations of the Carpathian Highlands (Nikitin et al. 2009). It is believed that haplogroup I originated in the Near East and dates back to 20 kya. It has recently been suggested as a signal of dispersals into Europe from the Near Eastern refuge areas, during the Late Glacial period, 18–12 kya (Olivieri et al. 2013).

According to the YHRD database predictive algorithms, the Y-STR haplotype that we successfully determined for sample 6 (Table 17) belongs to haplogroup I, which is largely restricted to Europe. Several sub-clades of haplogroup I were suggested to have expanded within Europe from the Franco-Iberian and the Balkan refugia in the late glacial or post glacial period (Soares et al. 2010). Until now, incomplete Y-STR haplotype including eighteen of twenty-three examined loci had not previously been observed in the YHRD database. In the range of Yfiler (12 of 16 markers), there were six hits in the European population (from Poland, Hungary, Romania, Croatia, Ukraine, Russia) and one hit from Australia (Table 17), implicating Central- and Eastern European distribution of this haplotype. In summary, our results indicate strong DNA degradation within the excavated remains, a lack of maternal relatedness between the studied individuals, and the European origin of the samples. Indeed, most mitochondrial haplogroups identified in this study are widely distributed among European populations and one of them (H11) was previously observed with the highest frequency in the Lesser Poland region. The paternal lineage of one sample has also showed European ancestry, presumably originating in central-eastern Europe. Overall, our data received for skeletal remains excavated from the church of Saint Francis are consistent with the knowledge on diversity of haploid markers in modern European populations.

MICROBIOLOGY

Microbiological analysis of human remains and coffin parts

Maciej Walczak, Anna Drążkowska, Aleksandra Burkowska-But, Maria Swiontek Brzezinska

Introduction

Microorganisms are ubiquitous; that is, they are present nearly everywhere. Crypts are just one among a wide range of their habitats; in this environment, microbes can colonise walls and floors, human remains, burial clothes, and coffins and items placed in them. They can enter and migrate outside in bio-aerosols floating in the air (Walczak et al. 2020, p. 147–158). Microorganisms contribute to the degradation of organic and inorganic compounds, thereby causing damage to walls and objects (microbiological corrosion, biodeterioration) in crypts. In favourable conditions (the presence of organic compounds, high humidity) they multiply rapidly, accelerating the destruction of items of historical value. Rapid microbial growth is observed on materials that contain protein, fat, and sugars (including in the form of cellulose, e.g. wood, paper, linen, cotton, leather, parchment). Materials of mineral origin such as stone, mortar, bricks and metal are corrupted by acids and other microbial metabolites (Gutarowska et al. 2010, p. 15). Therefore, assessment of bacterial and fungal contamination seems crucially important for the protection of crypts against biological corrosion.

Archaeologists working in crypts are often unaware of the microbial threat to which they are exposed. Although the survival of the deadliest pathogens (e.g. plague bacteria or smallpox viruses) on coffins or human remains is rather improbable, some dangerous endospore-forming bacteria (e.g. *Bacillus anthracis*) can survive in this environment even for hundreds of years. Moreover, dust emission can also pose a health hazard; dust contains bio-aerosol, which, even though non-pathogenic, can cause irritation of the mucous membranes of the respiratory tract, allergy and asthma.

Moulds constitute a large, diverse group of heterotrophic organisms (25,000 species) found in soil, water and air, and on all surfaces. With enormous spore production, moulds spread easily. Tiny and lightweight, they float in the air for a long time. Spores, sclerotia and chlamydospores are often water-repellent and are resistant to desiccation and other forms of environmental stress. They are well adapted for dispersal and for survival, often for extended periods of time. After falling to the ground, they begin to germinate even with a small amount of moisture, developing a mycelium made up of threadlike cells called hyphae. Moulds can break down not only easily-digestible proteins, sugars and fats, but also more complex organic compounds such as lignin, cellulose, hemicellulose, or aromatic and non-aromatic hydrocar-

bons, which explains their high growth rate and the damage they cause to objects in crypts (Janińska 2000, p. 339, 341). To thrive, moulds need high moisture, and they can use humidity or dampness (water vapour) from the air or soil. For example, *Aspergillus flavus* grows best at aw>0.9 (water requirements of microorganisms are usually described using the water activity indicator aw). Moulds can have devastating effects on archaeologists and conservators working in crypts. Exposure to these microbes may cause allergies – not only relatively benign rhinitis and conjunctivitis, but also more serious bronchial asthma and extrinsic allergic alveolitis (Pałczyński et al. 2013, p. 42). In addition, recent studies have confirmed that under certain conditions (e.g. temperature much lower than optimum) many mould species produce mycotoxins, i.e. secondary toxic metabolites (e.g. aflatoxins, ochratoxins, patulin) (Janińska et al. 2000, p. 342).

Xerophilic fungi prefer environments with reduced water activity (aw<0.85) (Janda, Markowska-Szczupak 2014, p. 43). The adaptive abilities of their enzymatic systems enable them to colonise diverse ecosystems and successfully compete with other organisms for nutrients in very dry areas. It has been demonstrated that xerophiles cultivated on agar are capable of biosynthesising numerous enzymes, including catalases, ureases and DNAases. They also hydrolyse milk casein, gelatin, starch, and fats (Janda-Ulfig et al. 2009, p. 392–4). In dry environments enzymatic proteins undergo smaller conformational changes than membrane lipids, which means that water does not significantly affect the enzymatic activity of xerophilic fungi. This also indicates that these microorganisms can be powerful agents of microbial corrosion of human remains and objects in crypts. Some strains of xerophilic moulds (*E. herbariorum*) synthesise the following mycotoxins: sterigmatocystin, echinulin, cladosporin, neoechinulin A, B, C and D, flavoglaucine, auroglaucine, fyscionheis, isotetrahydrogen and epiheveadrid (Al-Julaifi et al. 1996, p. 22; Krikštaponis et al. 2001, p. 11; Butinar et al. 2005, p. 160; Kokič-Tanakov et al. 2007, p. 31–33; Slack et al. 2009, p. 484–6).

The surface of objects in crypts may also be colonised by Eubacteriales, including *Streptococcus* sp., *Micrococcus* sp., *Bacillus* sp., *Bacillus subtilis*, *Bacillus licheniformis*, *Bacillus megaterium*, *Bacterium* sp. and *Actinomycetales*. Eubacteria are unicellular, non-nuclear microorganisms, ranging in size from 1 to 5 μm. Inhabitants of all environments on Earth, they are also abundant in old crypts. With the right temperature and humidity and a range of organic substances, crypts offer perfect conditions for microbial growth. Heterotrophic bacteria that obtain energy from the decomposition of organic compounds are active in the destruction of fabrics, human remains and wooden objects. At the same time autotrophic sulphur-oxidising bacteria (e.g. *Desulfovibrio desulfuricans*, *Thiobacillus thiooxidans*) and nitrifying bacteria (*Nitrobacter* sp.) play a role in stone decay. In response to extreme stress such as low water availability, high temperature and nutrient shortage, some bacteria (e.g. *Bacillus* spp.) produce spores that can survive these environmental assaults. In crypts, aerobic spores are found on human remains and other organic materials in which bacteria, deprived of nutrients after initial intensive growth, have transformed into these dormant forms. Bacterial spores seem the main microbiological contaminants of the air in crypts and the air entering crypts upon their opening. Similarly to moulds, bacteria can pose a health hazard to people who work in crypts. They can cause infectious diseases or provoke toxic reactions, During cell growth and cell breakdown both Gram-negative and Gram-positive bacteria secrete exotoxins (active proteins) such as cytotoxins, neurotoxins and enterotoxins. Many of them are associated with infectious diseases, and some have inflammatory and immuno-modulatory properties (Pałczyński et al. 2013, p. 44).

Actinomycetales are prokaryotic, gram-positive bacteria, composed of filamentous pseudohyphae forming a so-called false mycelium. They destroy leather, parchment and paint

(*Streptomyces* sp., *Nocardia* sp.). Similarly to moulds, Actinomycetes may cause allergic alveolitis (Pałczyński et al. 2013, p. 45).

Research site and research methods

The research was conducted in crypts of the Church of St Francis of Assisi in Cracow. Samples were collected from the walls and floors of the crypt, plant material (wood), fabrics, human remains, and the bottoms and lids of coffins. The analysis was aimed at determining the concentration of the following groups of microorganisms:

a) mesophilic bacteria (on Plate Count Agar)
b) aerobic spores (on Columbia agar medium)
c) Actinomycetes (on Actinomycetes Isolation Agar)
d) moulds (on Czapek-Dox liquid medium)
e) xerophilic fungi (on Dichloran Glycerol DG 18 agar base).

For bacterial spore determination, the suspensions were pasteurised at 80°C for 30 minutes before inoculation in order to eliminate vegetative forms and stimulate spore growth.

Results

The results indicated that even in very dry and old crypts human remains were heavily colonised by microorganisms. Different microbial groups dominated depending on the conditions in the crypt and sample types. In crypt 2 (in the Salomea Chapel) mesophilic bacteria were the most abundant (581×10^6 cfu/g). The concentration of aerobic bacterial spores was similar. At the same time, non-xerophilic fungi (106×10^3 cfu/g) dominated in samples of human remains collected from crypt 2 (in the cloisters). In crypt 3 (in the Passion of Christ Chapel) mesophilic bacteria were the most abundant on human remains (14×10^3 cfu/g on average), while the concentration of the remaining microbial groups was 103 cfu/g. Moulds were the most abundant on coffin bottoms (up to 500×10^3 cfu/g). In crypt 5 non-xerophilic and xerophilic fungi were the most common on human remains (on average 39.3×10^3 cfu/g and 6.5×10^3 cfu/g, respectively). The fabrics were heavily contaminated with aerobic bacterial spores (3.4×10^3 cfu/g on average). In crypt 6 (in the church) mesophilic bacteria (478 cfu/g on average) and aerobic spores (406 cfu/g on average) prevailed on human remains. The average concentration of non-xerophilic fungi was 310 cfu/g, and 100 cfu/g for xerophilic fungi. The fabrics were heavily colonised by non-xerophilic fungi (39.8×10^3 cfu/g on average). In crypt 7 (in the church) aerobic bacterial spores (1.1×10^3 cfu/g on average) and mesophilic bacteria (maximum of 1.7×10^3 cfu/g) were prevalent on human remains. Non-xerophilic fungi, xerophilic fungi and actinomycetes were not abundant (on average 125 cfu/g, 50 cfu/g, 50 cfu/g, respectively). Fabrics were most heavily contaminated, mainly with mesophilic bacteria (230×10^3 cfu/g on average). The concentration of other microbial groups in the samples was 103 cfu/g. In crypt 8 (in the church), non-xerophilic fungi were the most common. Samples of human remains contained 2.6×10^3 cfu/g of these microorganisms and 1.4×10^3 cfu/g of actinomycetes. The concentration of other microbial groups was about 102 cfu/g. Compared to coffins, fabrics were heavily contaminated, mainly with non-xerophilic fungi (7.2×10^4 cfu/g on average). The concentration of other microbial

groups was 103 cfu/g. In crypt 9 (in the church), non-xerophilic fungi (56.3×10^3 cfu/g on average) and xerophilic fungi (38.7×10^3 cfu/g on average) prevailed on human remains. Mesophilic bacteria and their spores were also abundant (103 cfu/g). The fabrics were heavily contaminated with mesophilic bacteria (81.3×10^3 cfu/g on average). The concentration of xerophilic and non-xerophilic fungi was similar (approximately 103 cfu/g). The results indicate that fabrics were colonised mainly by aerobic bacteria and their spores. At the same time, human remains were contaminated mainly with moulds or aerobic bacteria (depending on the crypt). The present results differ significantly from those obtained in the crypts of the Cathedral of St John the Baptist in Przemyśl, where the predominance of xerophilic and non-xerophilic fungi, mainly of the genera *Penicillium* and *Aspergillus*, was observed (Walczak et al. 2015, p. 336). High concentrations of moulds have also been reported by other authors. In the crypt of Cardinal Peter Pazman, moulds were the second most dominant microbial group after bacteria (Pangallo et al. 2013, p. 293), with *Penicillium* and *Aspergillus* species dominating among the isolates. They also prevailed on the mummified body of Saint Martin (Škrlin et al. 2011, p. 924), the mummy in the Archaeological Museum in Zagreb (Čavka et al. 2010, p. 804) and clothes and human remains of members of the Kuffner family in the Kuffner Family Crypt, Slovakia (Šimonovičová et al. 2015, p. 161). Several other species were also identified: *Phoma* and *Alternaria* species in the Otranto Crypt by Diakumaku et al. (1995, p. 295), and *Cladosporium*, *Paecilomyces*, *Beauveria bassiana* and *Cunninghamella elegans* species in the crypt of Montecorona in Italy (Cataldo et al. 2008 p. 4). As has been repeatedly confirmed, microclimate in crypts promotes fungal growth. In the crypt of the Abbey Church of Saint-Savin-sur-Gartempe, white moulds had a negative effect on wall paintings (Leplat et al. 2017, p. 29). Cataldo et al. (2008, p. 3) also attributed damage to the crypt walls to mould invasion. High humidity facilitates spore transmission leading to the destruction of many objects.

Surprisingly, our results indicated that actinomycetes were not abundant. Classified as bacteria, these microorganisms are mainly aerobic and produce conidia – structures that allow them to survive adverse environmental conditions. This should enable them to live on dead bodies for extended periods of time, even in extremely dry crypts. Additionally, these microorganisms have the ability to break down non-readily-degradable substances, such as cellulose, lignin, keratin and phenolic compounds. For this reason, coffin interiors would seem a perfect environment for their growth. However, contrary to our expectations, actinomycetes were quite scarce in the collected samples. They were abundant only on coffin surfaces, which may indicate that they participate in the degradation of materials used in coffins. Similarly, low levels of actinomycetes were recorded in the crypts of the Cathedral of St John the Baptist in Przemyśl (Walczak et al. 2015, p. 339). In the Crypt of the Original Sin (Matera, Italy), actinomycetes were also sparse among the microorganisms colonising the walls (Caneva et al. 2019, p. 61). Moreover, the above articles were the only available sources of information on the presence of these microorganisms on the surface of human remains or other materials in crypt. Based on the present results it can be safely concluded that human remains in crypts were heavily colonised by microorganisms. Moulds were the most common, followed by mesophilic aerobes and their spores. At the same time, actinomycetes seemed to be scarce.

The presence of abundant microorganisms in the examined material raises a question about the safety of researchers and support staff during archaeological works in crypts. It would be recommended that microbiological analysis should be conducted prior to the archaeological investigation to determine microbial safety. The use of personal protective equipment and/or air disinfection might then be suggested.

ARTEFACTS CONSERVATION

Conservation and restoration of textile artefacts

Anna Drążkowska, Marcin Nowak

Conservation works were applied to a large set of silk clothes that were used as the funeral garments of the buried persons (Drążkowska, Nowak 2020, p. 173–179). The clothes included: żupans (Fig. 108, 109), czechmans, ferezja (Fig. 110), woman's dresses, skirts (Fig. 111), an apron, a chasuble, a stole and numerous items of headwear. Most of the clothes were made for repeat use and were worn during the wearer's lifetime. They were made of satin, damask, various types of velvet and rep. The materials included moire rep and rep with a golden thread. Additionally, two net belts made with sprang technique underwent conservation (Fig. 112), as well as a set of trimming elements: silk ribbons, bands, galloons made with metal thread, bobbin lace, braided ropes for trimming of the clothes, buttons and loops. Scapulars (Fig. 113) were another set of textile objects that were cleaned and secured (26 items). Conservation activities were performed on items of high value for studies on the history of clothes, artisanship and funeral culture.

The state of preservation varied. Some items were preserved almost completely, while others had numerous deficits or were preserved only in fragments. These differences depended on many factors, such as the type and method of preparation of the textiles, or conditions in the crypts. The essence of the problem has not been recognised so far, thus we can only describe these phenomena in general, superficial terms.

Usually, underground chambers isolated from the outside world preserve textiles relatively well. All the Cracow crypts containing clothes were bricked up and lacked ventilation openings, so no air from outside was present. The fact that a small area hosted a large number of bodies undergoing complex decomposition processes caused a high level of humidity, varying from 72% in crypt B3 to 98.2% in crypt B8. The average temperature reached *ca* 15–17°C. Such conditions meant that most skeletons, wooden coffins and small furnishing items were poorly preserved, and woollen and flax clothes were significantly destroyed, remaining only as small fragments. Undoubtedly these factors also significantly weakened silk fabrics, but the chemical composition of their fibres[41] strongly influences their level of resistance and durability compared to other fabrics. It should be mentioned, however, that regardless the material, for any type of artefact the most destructive factor is direct contact with a corpse undergoing decaying processes, with the secretion of various aggressive liquid substances and the multiplication of

[41] Silk is largely composed of fibroin, containing three amino acids – glycine 45%, alanine 29%, serine 12% – and is divided into two zones: crystalline and amorphic.

microorganisms. The studies in the crypt of the archcathedral of John the Baptist and the Assumption of Mary in Przemyśl (Drążkowska 2014, p. 56–69, 73–81) revealed that mummified bodies allow not only silk clothes but also those made of wool, cotton or flax to be preserved in good shape. This confirms the highly destructive action of decaying processes and microorga-

A.

B.

Fig. 108. Short żupan, crypt B7 burial 4: A) visible part covering the back, with deficits and stains, B) front part of the garment, before conservation, photo A. Drążkowska

nisms. In order to preserve bodies in a natural way that stops or significant slows the decaying process, favourable conditions must be present, such as low humidity and a constant inflow of fresh air, which is possible only if a crypt is equipped with a ventilation system. Cracow crypts did not have such systems, so the extent of damage to objects inside varied quite significantly, depending on the materials they were made of. All silk fabrics were discoloured, stained and creased. Some were compressed for a long time by being placed in damaged, crushed burials placed under a pile of coffins. Organic stains mixed with dirt and dust created a thick, hard layer tightly attached to the fabric surface. The dirt penetrated the thread structure and the fibres to a large extent. The largest concentration and thickest layers of dirt were located on the back parts of the garments, since the corpses were placed on their backs and all secreted substances were absorbed by these parts. The back parts were stained with large, dark, permanent spots that were impossible to remove by any conservation activities. Organic substances and small bone fragments had adhered to the inner parts of the garments, and elements of coffin padding and plant fragments to the outer parts. Fabric biodegradation was intensified by the humidity present in the chambers. The surfaces of clothes showed permanent traces of the presence of microorganisms. The destruction was aggravated by insect larvae feeding on the corpses.

Their presence is confirmed by large amounts of *pupa coarcata* covering the garments, in some places strongly adhering or even pressed between the thread structures, the stitches connecting parts of the fabric, or even folded fabric edges.

Fig. 109. Short żupan, crypt B7 burial 4, after conservation, photo A. Drążkowska

Fig. 110. Ferezja, crypt B8 burial 4: A) prior to conservation; B) after conservation, photo A. Drążkowska

A B

Fig. 111. Skirt, crypt B7 burial 1: A) prior to conservation; B) after conservation, photo A. Drążkowska

Fig. 112. Kontusz belt fragment, after conservation, crypt B8 burial 6, photo A. Drążkowska

Fig. 113. Scapular: A) *in situ*; B) after conservation, photo M. Łyczak, M. Nowak

They were present also under the bands stitched to the clothes and in the openwork eyes of laces created by properly woven threads. Because of these factors, as well as the oxidation of fibroin, the fibres have lost their flexibility and resistance against mechanical action, becoming brittle and falling apart under their own weight. In some places the clothes had pieces of various sizes missing – either small, oval or large holes covering wider fragments of the garments.

Sometimes whole sections were lacking, such as the front part of a żupan, a sleeve or a cuff alone, a stand-up collar or an element covering the back. The garments with these deficits had uneven, shredded edges. Most of the presented damage types observed on the Cracow textile objects can be found also on objects from other sites (Hryszko 1994, p. 141–52, 2017, p. 40–45; Rawa-Szubert, Hryszko, Kahl 1979, p. 72–78; Drążkowska 2005d; 2007c, p. 132; 2008, p. 21–23; 2009, p. 241–2; Drążkowska et al. 2015, p. 355–66; Chabracka 2013, p. 225; Grupa 2005).

Generally, the clothes from the Cracow crypts did not show traces of long usage before being deposited in the tomb with the body. It should, however, be noted that they had certainly been worn and were produced for repeated use. Apparently, the persons buried in the crypts of the St Francis of Assisi church in Cracow were not buried in very old and worn-out clothes. Certainly one should remember that this evaluation could only be made for the preserved silk garments. As exceptions within the discussed set, two liturgical garments draw our attention: a chasuble and a stole. They do not conform to the above description since they have numerous traces of darning and patching, and also – in case of the stole – modification. There are as many as seventeen patches identified on the chasuble. Before commencing conservation works the artefacts were disinfected and then photographic documentation and descriptions were made, including evaluation of the clothes' preservation state. The type and scope of stains influenced the decision of whether to clean the clothes with the wet method, bathing them in water with a surface-active agent, or with 1%–5% water solution of polyethylene glycol 200 (PEG 200). Long-term bathing brought good results. The fabrics softened and it was possible to straighten them delicately. Removal of stains with soft brushes was very time consuming. The duration of these activities depended on the type and amount of stains, as well as on the type of fabric and its state of preservation. Trimming details decorating the garments, such as lace or ribbons were delicately detached, marking the places where they were stitched. They were cleaned separately. Sometimes this procedure was interrupted, when continuing appeared to risk increasing the damage. Then, after washing out the agents, a slow drying commenced.

Items were then analysed in terms of weaving techniques, pattern composition and trimming techniques, and history of clothing, to inform the reconstruction of selected specimens. For each garment, patterns were prepared and used for cutting specific structural elements from a doubling fabric. After doubling, all structural elements were linked with threads and the original form of each of the garment was restored. Finally, all trimming elements were stitched.

Conservation of metal and wooden objects and objects of complex material composition

Marcin Nowak, Anna Drążkowska

The conservation of historical material originating from archaeological surveys is always a complex process. The varying state of preservation of the items reflects, among others, the conditions they were placed in and related factors, causing changes and levels of damage that are both visible and invisible at first contact. The entire analysed set comes from crypts located under the floor of the studied Cracow church. Identification of the factors influencing the status of preservation of archaeological artefacts was one of the goals of the project. Furthermore, the basic conservation goal was to inhibit the destruction processes and secure the object for study and potential exhibition or safe storage in a designated area.

Table 18. Conserved objects

CONSERVED OBJECTS	NUMBER
RINGS	2
METAL RING	1
WOODEN RING	1
RELIQUARY	1
ROSARIES	25
WOODEN CROSSES	2
WOODEN CRUCIFIXES	13
MEDALLIONS	16
METAL CROSSES	7
SCAPULARS AND SCAPULAR RELICS	25
TOTAL	93

Selected areas of the conservation and restoration works are described below (Nowak, Drążkowska 20020, p. 180–185). Conservation of metal artefacts included mainly works with

non-ferrous metal objects. Devotional items, represented by small crosses and medallions (Fig. 114C, D) elements of wooden Passion crosses, stylised skulls and INRI plates (*titulus*), and single items made usually as casts of alloys based on copper with an admixture of tin, zinc and lead predominated. These items are relatively well preserved when the thickness of the object is significant. Objects made of much thinner sheet, such as decorative ferrules of arm ends, the titulus mentioned above, or rings (Fig. 114A,B) were significantly degraded because of corrosion processes and the metallic core was reduced. In these cases the state of preservation must be defined as poor and a significant part should even be qualified as destructed items. Activities aiming to secure and stabilise the artefacts were chosen individually for each item. Corrosion is a process of gradual, unwanted destruction of metal or its alloys, and appears in all environmental conditions and affects all objects. It is expressed by the creation of corrosion products on the surface and degradation of the metallic core. One should note that some corrosion processes also result in the creation of specific insulating layers that "secure" an object, slowing down its degradation due by atmospheric conditions (Shreir 1966, p. 23–97). No full patina layers were recorded on the artefacts.

Fig. 114. A) B) Ring (destructed), crypt B9 burial 11 (11A/11B); C) obverse of medallion, crypt B3 from damaged burial; D) reverse of medallion, crypt B3 from damaged burial, status before conservation (left) and after (right), photo M. Nowak

In almost all cases the bronze artefacts were affected by "bronze disease", expressed in the appearance of nodular outgrowths on the surface. The presence of oxygen under the patina causes pitting corrosion and core degradation and in combination with humidity creates green, dusty layers (Tomaszewska-Szewczyk 2011, p. 494–534). All objects in the closed environment were exposed to humidity and oxygen. First, photographic documentation and descriptions were made, including microscopic observations. Next, the objects were disinfected with a high-percentage alcohol and covered with Paraloid B–44 and additionally secured with Cosmoloid 80H wax.

Better preserved materials were bathed in distilled water using ultrasonic washers. Next, in order to remove corrosive layers, depending on the alloys, low-percentage water solutions of potassium sodium tartrate, disodium salt dihydrate and tribasic ammonium citrate in an ultrasonic bath or mechanical action were used. BTA was used as a corrosion inhibitor. Finally, the surface was secured also with Paraloid B-44 and Cosmoloid 80H. Items made of organic materials are less numerous among the archaeological finds, although crypts favour the better preservation of such objects. The Cracow set included numerous crosses (Fig. 115), rosaries (Fig. 116, 117), and crucifixes made of various types of wood.

The basic obstacle for working with this group of artefacts is the predominance of complex, multi-material structures that include various metal alloys, glass and textile products. The merging of so many elements caused corrosion points to appear at intersection points. This weakened the structure, changed physical properties and sped decay. Such phenomena were observed on, among other things, torn rosary ropes; corrosion spreading from medallions had caused them to stiffen and increased their susceptibility to damage, as well as discolouring them. Similarly, "bulging" corrosion layers on nails or rivets fixing the Passion figures caused damage to wooden crosses. So in some cases, each time after an individual assessment of each of the objects, it was decided to disassemble some items down to single components for separate conservation. These were then re-assembled.

Fig. 115. Wooden cross with decorative motifs and inscriptions, crypt B2 burial 9, photo M. Nowak

Fig. 116. Wooden rosary *in situ*, crypt B3 burial 1, photo M. Łyczak

Fig. 117. Wooden rosary, crypt B3 burial 1, after conservation, photo M. Nowak

Some of the materials were already fragmented due to post-deposition processes, in which cases attempts were made to reconstruct their original structure. Similarly as in case of metal objects, the process of destruction of wood due to environmental conditions is called biological corrosion. Conditions present in the Franciscan church crypts, which had high relative humidity, probably created a humid, protective state for the wood.

A significant proportion of all recorded finds, including the coffins and their elements, as well as smaller objects such as crosses or rosaries, was clearly soft to the touch (giving the impression of being saturated with water). Clearly dry and brittle specimens were less numerous. Their state of preservation might have resulted from their additional securing (such as covering with tar or textiles). In most of the objects the presence of white, grey and yellow layers was observed, proving the activity of microorganisms. The surfaces of wooden items also exhibited changes caused by the intensive, but probably short-term, harmful activity of insects. Due to the character of the finds and locations of their extraction, the specimens were first photographed, described and divided into groups based on the state of preservation and structure. Items that might be subject to destruction or blurring of painted decoration were placed on grills in glass containers. On the bottoms of the vessels a very low-concentration p--chloro-m-cresol (PCMC) was introduced, dissolved in high-percentage alcohol. Tightly closed containers with the fumes of the agent were left for seven days. Items better preserved and less prone to damage were covered with a thin layer of PCMC and left for the same period tightly packed and closed. Then, after partial evaporation, the better preserved items underwent dry and wet cleaning with the use of brushes and swabs. Next, the materials were categorised based on the observations. Most of the set elements were impregnated with an alcohol-toluene low-concentration solution of Mowital 60HH, by placing in tight, glass containers (impregnation by capillary transport with exchange/supplementing of the solution). Objects that could not be dismantled into separate components due to their form (such as rosaries) were the most problematic. For better preserved specimens the conservation process included cleaning and disinfection followed by stabilisation of humidity level and only local impregnation with Mowital 60HH. After the soaking process, the objects in poorer shape, or destructed objects, were slowly dried, preventing sudden changes in temperature and humidity. After about fourteen days, a few days of air washing was performed to remove the characteristic smell of the solution. Then a solvent was used to remove the excess impregnating agent, but preventing its washing out. In case of objects remaining in numerous fragments or that had been disassembled, activities aiming to reconstruct their original form were undertaken. A thick solution of Mowital 60HH (about 10–15%) was used as an adhesive. This preparation did not leave any stains on the merged elements, allowing the merging of very small components made of different materials.

Archaeometric studies of the selected bands and laces

Beata Miazga

Archaeometric investigations of textiles are not particularly rare, even in the field of metal braids studies (Jaro et al. 2000, p. 95–105). However, their advancement is still far from perfect in modern Poland, where there are especially significant gaps in studies of fabrics from archaeological exploration (Cybulska, Maik 2007, p. 185–9). Textiles found during archaeological works represent varying degrees of craftsmanship and are good samples for the development of textile crafts, both in the field of costume design and technology studies (Good 2001, p. 209–26; Drążkowska 2015, Brandenburgh 2010, p. 41–79). Textiles are subjected to thorough microscopic examination (Grupa 2012), but the lack of common physicochemical studies (including on the metal braid of threads for finds from Polish territories) is cause for a certain dissatisfaction. In response to the plethora of questions posed during textiles studies, archaeometric methods are used, i.e. spectroscopic methods, and in particular non-destructive and minimally invasive methods (Enguita et al. 2002, p. 328–33; Muros et al. 2007, p. 229–44; Balta et al. 2015, p. 285–90; Šimić et al. 2018, p. 115–20). As a result of the work carried out, the raw materials used to prepare the metal braids were identified, but sometimes it was also possible to conduct further studies on the technology used in making thread elements.

Artefacts and method

Similar research goals were set for research into the textiles from the archaeological exploration of burials from Cracow (Miazga 2020, p. 186–204). Eight small fragments of laces, ribbons and tassel found in the church of St Francis of Assisi in Cracow were selected for investigation. Because the items were small and in a generally poor state of preservation, the non-destructive methods of microscopy and energy-dispersive X-ray fluorescence spectrometry (ED-XRF) were applied. Microscopic observations were carried out using the Olympus SZX9 stereoscopic microscope and the Hirox RH 2000 digital microscope, working in the magnification range of 6.3–2000×. Spectroscopic tests were performed on a Spectro Midex microspectrometer, built of an X-ray tube with a molybdenum anode. The excitation energy did not exceed 45 kV. A measuring spot of diameter 0.7 mm was used in the tests. The choice of place for testing was based on a visualisation system built from a CCD camera with 20× magnification.

Results and discussion
Fragment of lace from crypt B2 burial 9

A golden coloured fragment of an item was obtained for the study (Fig. 118). The microscopic observation showed that the artefact is now an entirely metal element. Inside the twisted tape, no textile core is visible (Fig. 119), only in one part of the braid was a structure reminiscent of mineralised textile thread registered (Fig. 120). Only mineral deposits are visible inside the twisted tape. Further microscopic observation at higher magnification showed three metal elements of different colours in the examined fragment: tapes that are golden on both sides (Fig. 121–1), and tapes that are silvery on both sides (Fig. 121–2 and 7f) and tapes with a silvery surface with a golden interior (Fig. 121–3). The first and third are most likely made of the same raw material, i.e. silver that had been gilded on both sides but that in the latter case subsequently lost its golden glow on the outer surface as a result of use, deposition and conservation works, e.g. cleaning (Fig. 122). This phenomenon of gold abrasion is completely normal and is associated with the extraordinary softness of this metal. The presence of gold and silver in the examined lace was confirmed by the ED-XRF study. Ten micro-areas on the lace surface were analysed, and the obtained data confirmed the presence of two different raw materials. The first is close to 98% silver and 0.5% gold (Fig. 123a). The second raw material, though in various states of preservation, is gilded silver, in which 93–98% silver was found with 3–4% of gold when the gold coating is well preserved and about 1–2% when it has been mechanically damaged. Analysis of spectral images shows different heights of gold signals for these lace elements. The perfectly preserved gold tape (the blue line in Fig. 123b) has a fairly high intensity of gold signals, while tape with a damaged (worn) golden glow has much lower peaks of gold (the red line in Figure 123b). The lace was also subjected to metric analysis, which showed that the gilded tape was about 0.35–0.40 mm wide and about 15 μm thick and was twisted into a metal "thread" with a diameter of about 0.40 mm (Fig. 124a, b, e). On the other hand, measurements made on the silver thread provided the following data (Fig. 124c, d, f): the tape is 0.45 mm wide and about 0.01 mm thick. The diameter of the twisted silver "thread" is 0.30 mm and it is thinner than the gold-plated one.

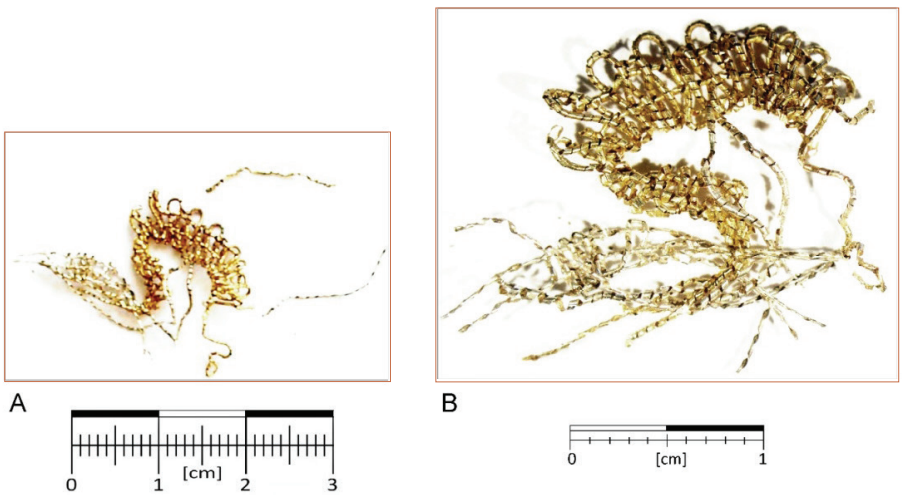


Fig. 118. Metal thread originally incorporated into lace, crypt B2 burial 9: A) microscopic; B) images, magnification 6.3×, photo B. Miazga

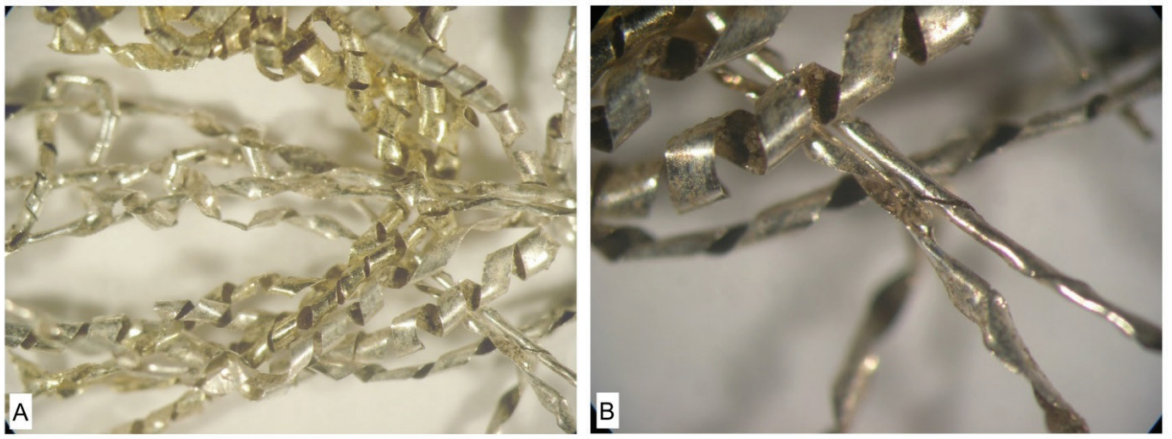


Fig. 119. Metal thread originally incorporated into lace, crypt B2 burial 9. Microscopic image of selected areas: magnification: A) 20×, B) 40×, photo B. Miazga

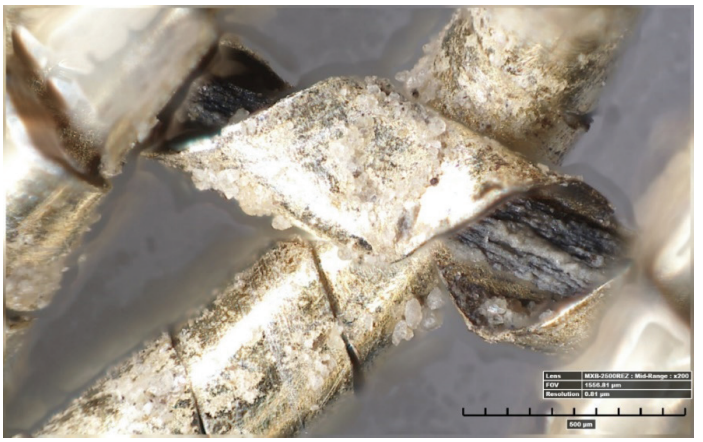


Fig. 120. Metal thread originally incorporated into lace, crypt B2 burial 9. Microscopic image of inner side of braid showing black fibrous structures, magnification 200×, photo B. Miazga

Fig. 121. Metal thread originally incorporated into lace, crypt B2 burial 9. Microscopic image of metal elements forming lace structure (magnification 60×), photo B. Miazga

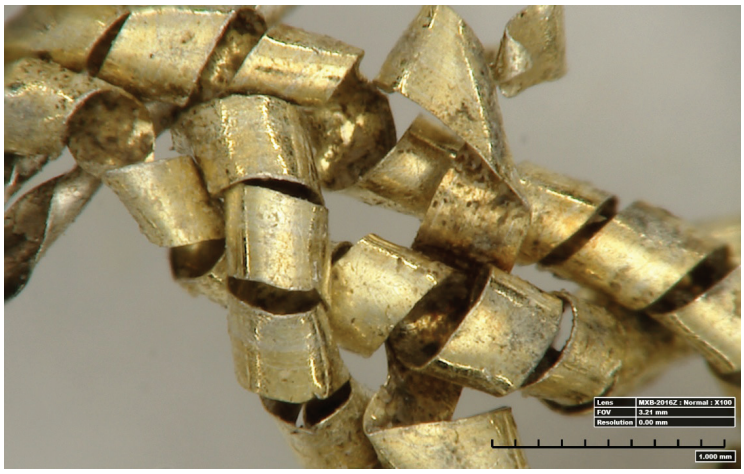


Fig. 122. Metal thread originally incorporated into lace, crypt B2 burial 9. Twisted metal tape. External surface shows damaged golden coatings, magnification 100×, photo B. Miazga

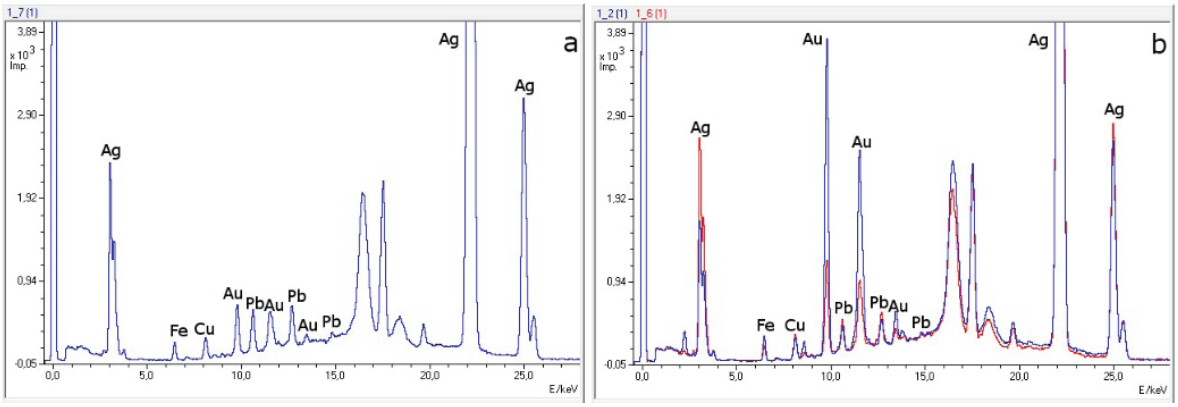


Fig. 123. Metal thread originally incorporated into lace, crypt B2 burial 9. XRF energy spectra of silver tape: A) and double-sided gilded silver tape; B) different intensities of gold signals in the gilded tape resulted from different state of gilding and heavier damage to gilding in the tape (red line)

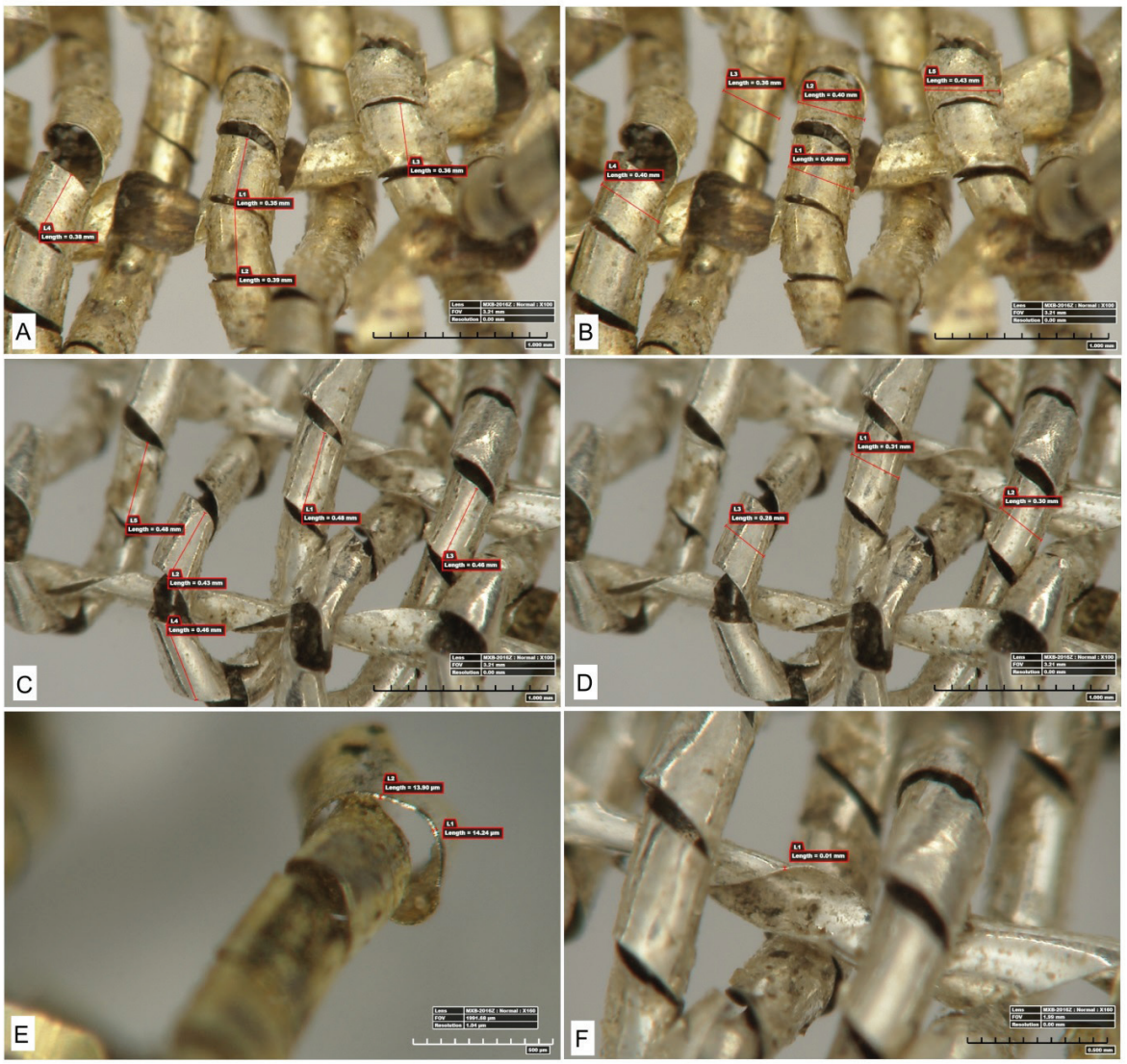


Fig. 124. Metal thread originally incorporated into lace, crypt B2 burial 9. Results of metric analysis, photo B. Miazga

Fragment of band from coffin, crypt B2 burial 11

Another examined artefact is a very residually and poorly preserved fragment of tape, so fragile that it became fragmented in the course of the study (Fig. 125). Microscopic observation at low magnification provided data on a practically unpreserved metal braid, most often seen as a green coating on a textile core. Only in a few areas of the artefact were the remnants of the braid visible, but it is dramatically corroded (Fig. 126). Also, the condition of the textile fibres is very poor, being heavily cracked and mineralised.

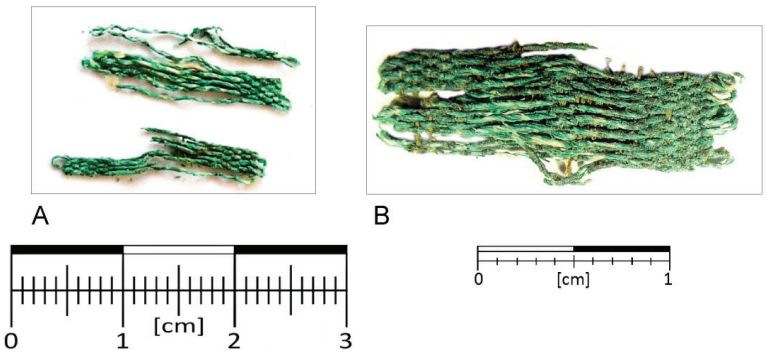


Fig. 125. Band, crypt B2 burial 11: A) macroscopic image; B) microscopic image, magnification 6.3×, photo B. Miazga

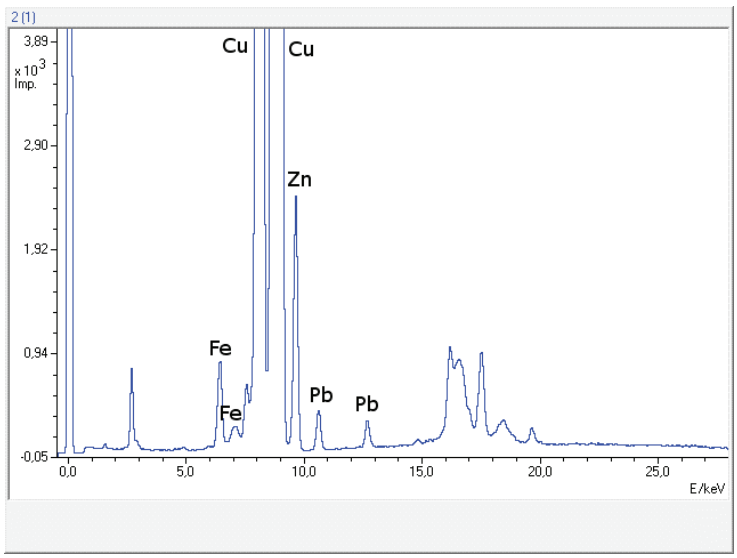


Fig. 126. Band, crypt B2 burial 11. ED-XRF spectrum of artefact

Metric studies of the metal braid were made impossible by its excessive degradation. Similar difficulties were encountered for elemental analysis of the analysed band. The heavy damage to the artefact affected the amounts of metals determined by XRF, with the calculated sum of the elements sometimes being in the range of 20–85%. This confirms the terrible condition of the item. However, despite these difficulties, it was possible to carry out qualitative and quite uncertain semi-quantitative spot analysis, which showed the presence of copper (approx. 84%), zinc (approx. 12%) and small amounts of lead (approx. 0.5%), as well as iron and nickel (Fig. 127). On this basis, it can be concluded that brass was used to prepare the metal braid. In the past, the surface of the thread probably had a golden colour, but now only the intense green colour of the tape is visible, after significant oxidation of copper and the process of dezincation.

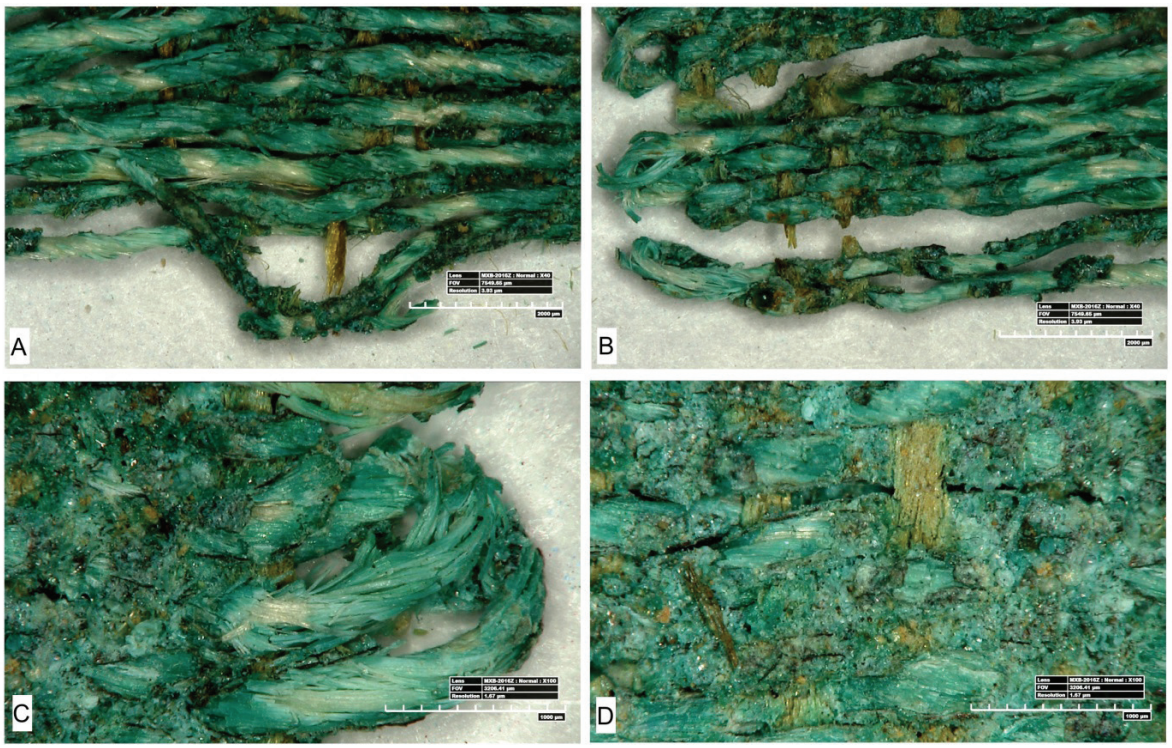


Fig. 127. Band, crypt B2 burial 11. State of preservation: A), B) 40×; C), D) 100× magnification, photo B. Miazga

Fragment of lace, crypt B2 burial 3

Archaeometric examination was carried out on a fragment of a golden-coloured lace containing both threads with a metal braid and a metal band/tape (Fig. 128). The artefact was in relatively good condition – the metallic phase is clearly visible, which allowed for more accurate microscopic studies. This resulted in the recognition of several structural elements of the tested lace. The first is a metal band, the second is a thread with a metal braid described as "thin", and the third is a thread with a braid, which is described as "medium", and a fourth "thick" metal thread (Fig. 129). Further analysis of the image reveals interesting ribbed structures (gouges) on the surfaces of both the tape and the metal braid (Fig. 130). The parallel striations were probably created during tape production (perhaps a sheet rolling process). In the course of further research, the dimensions of the lace elements were determined (see Table 19). Figure 131 presents the selected results for one of the threads forming the lace of golden colour. The raw material responsible for the lace colour was determined using the XRF method. The qualitative research showed that the main component of the alloy is copper with small amounts of silver and lead. The average level of copper content is 98%, indicating the use of copper raw material contaminated with natural ore elements, rather than the use of some copper alloy. It is worth noting that the lace was probably not made of one raw material, which is confirmed by slight differences in the XRF spectra of individual elements. An example would be a comparison of the spectrum of thick thread against the spectrum of the band, where the difference in lead content is visible (Fig. 132).

Table 19. Size of elements forming the lace

Element size [mm]	band (N° 1)	*Thin* thread (N° 2)	*Medium* thread (N° 3)	*Thick* thread (N° 4)
width	0.90	0.34	0.32	0.36
diameter	-	0.28	0.40	0.58
thickness	0.03	0.01	0.01	0.01

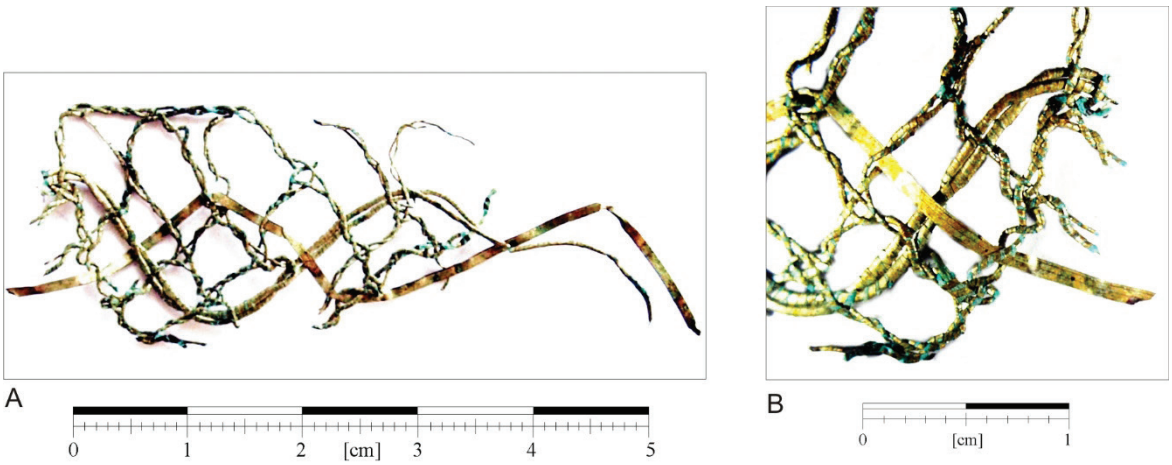


Fig. 128. Fragment of lace, crypt B2 burial 3: A) macroscopic image; B) microscopic image, 6.3× magnification, photo B. Miazga

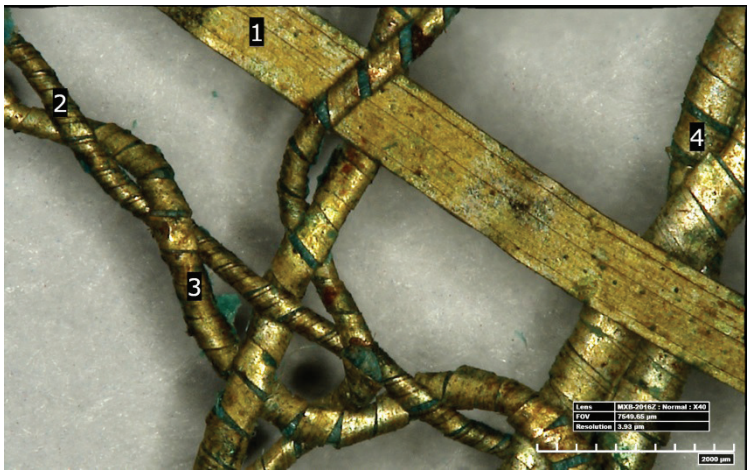


Fig. 129. Fragment of lace, crypt B2 burial 3. Microscopic image of examined lace. Numbers 1 to 4 indicate various elements of the lace as identified during microscopic observations (40× magnification), photo B. Miazga

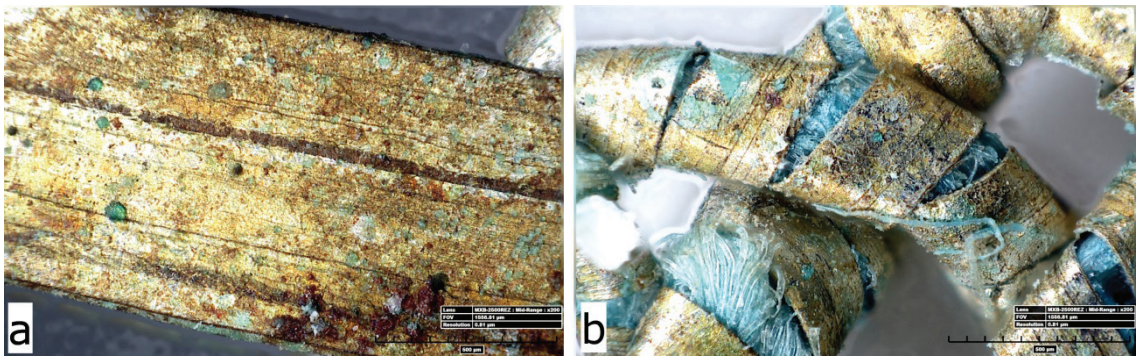


Fig. 130. Fragment of lace, crypt B2 burial 3. Microscopic image of lace elements showing longitudinal grooves on surface, 200× magnification, photo B. Miazga

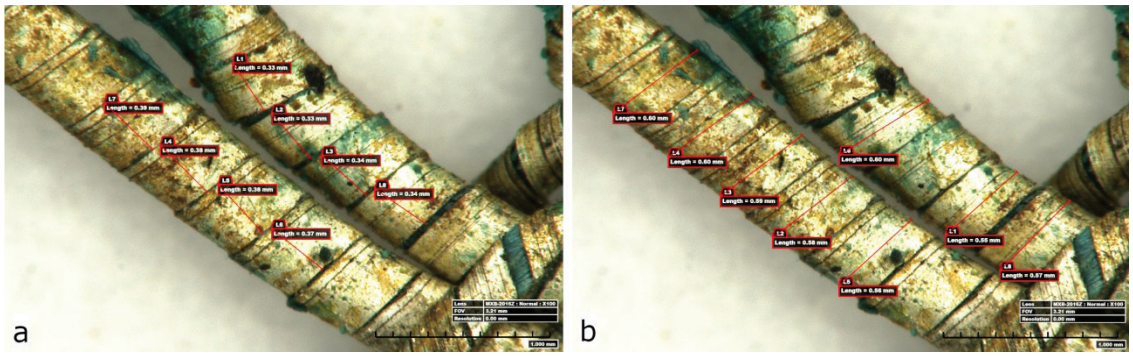


Fig. 131. Fragment of lace, crypt B2 burial 3. Selected results of braiding tape width and diameter for thread defined as "thick", photo B. Miazga

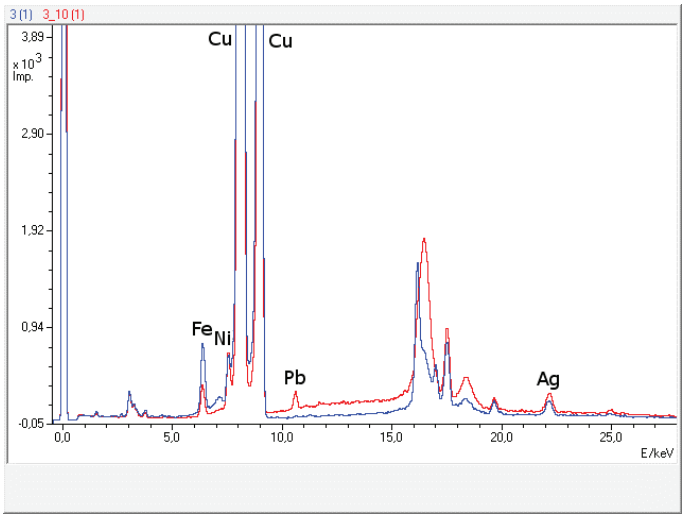


Fig. 132. Fragment of lace, crypt B2 burial 3. Comparison of XRF energy spectra for selected parts of tested lace: metal tape (blue line) and *thick* thread (red line)

Fragment of tassels from dress, crypt B2 burial 9

In addition to the lace, a tassel was found in the burial 9. The fragments of this tassel were obtained for archaeometric studies (Fig. 133). The tassel's threads are in various states of preservation, from the silvery metallic phase to grey threads devoid of metallic shine (Fig. 134). The thread chosen for the study was a well preserved one without corrosion deposits, because the presence of corrosive layers would change the size of any thread. Microscopic observation of the threads from the tassel showed that they were made by twisting two elements together with a metal braid, which are damaged, making the thread's textile core more visible. The silvery colour of the braid of the two threads forming the tassel thread is made by a 0.32-mm-wide band. Winding this band onto a textile core produced a 0.44-mm-wide thread (Fig. 135). The colouring of metallic and corroded threads suggests that the braid was made of silver, as confirmed by XRF tests (Fig. 136). The strongest spectral signals belong to silver, and much weaker signals to iron. Peaks of other metallic elements, especially gold, are at the background level. This is an important conclusion, practically ruling out the silver braid having been gilded.

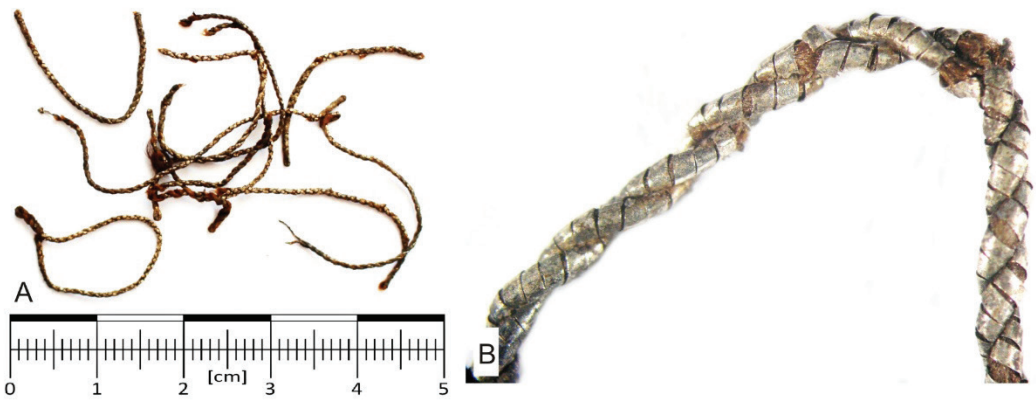


Fig. 133. Fragment of tassels from dress, crypt B2 burial 9: A) macroscopic image; B) microscopic image, 20× magnification, photo B. Miazga

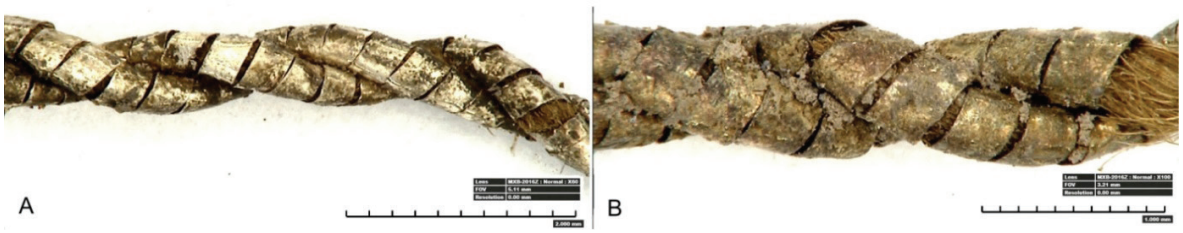


Fig. 134. Fragment of tassels from dress, crypt B2 burial 9. Threads in various states of preservation: silvery metal braid almost without corrosion, 60× magnification; B) thread corroded with visible mineral deposits, 100× magnification, photo B. Miazga

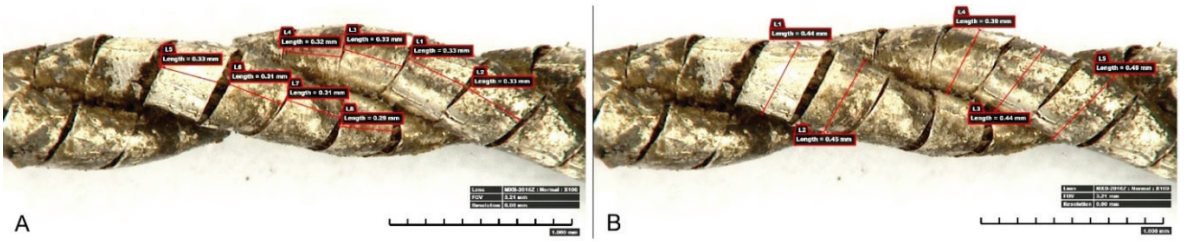


Fig. 135. Fragment of tassels from dress, crypt B2 burial 9. Results of braiding tape width and diameter for selected thread, photo B. Miazga

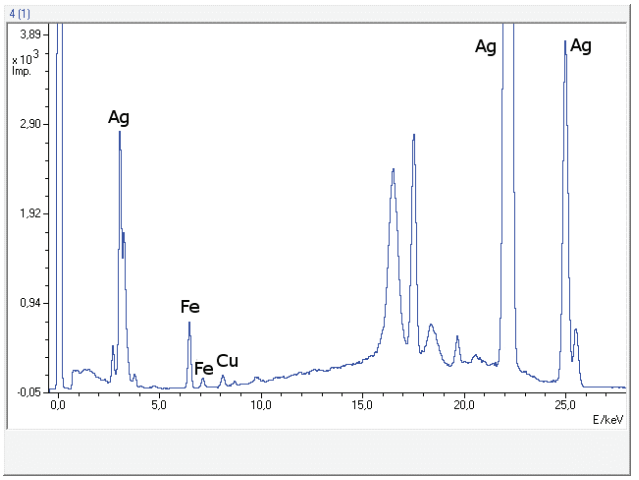


Fig. 136. Fragment of tassels from dress, crypt B2 burial 9. XRF energy spectrum of selected thread

Ribbon from coffin, crypt B9 burial 14

The next examined element came from a coffin and was a fragment of a golden and greenish ribbon (Fig. 137). It was preserved in various states: some braids were highly mineralised, while others retained their metallic golden hue, as shown in Figure 138. Metric analyses were performed using a microscope for the element with a metallic shine, skewing the results for the artefact towards that shiny element as opposed to fully representing the artefact's actual state. The braid of the threads was made of tape with an average width of 357 μm, and the threads wrapped with it were 429 μm wide. The braiding shift for well-preserved threads was less than 100 μm. Chemical analysis of the raw material showed that the braid was made of brass with 75% copper and 23% zinc (the XRF spectrum is presented in Fig. 139). In addition, a small amount of lead, iron and nickel (less than 0.5% each) was also found.

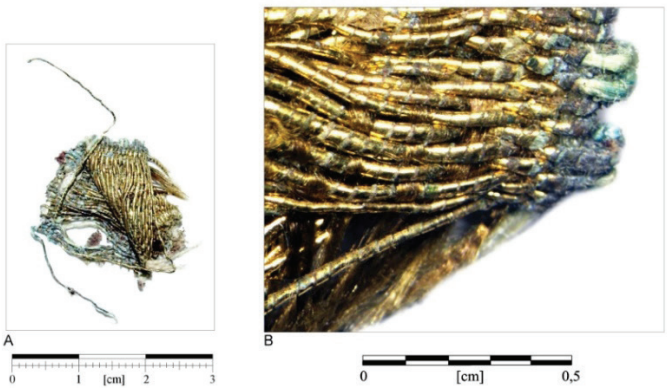


Fig. 137. Ribbon from coffin, crypt B9 burial 14: A) macroscopic image; B) microscopic image, 6.3× magnification, photo B. Miazga

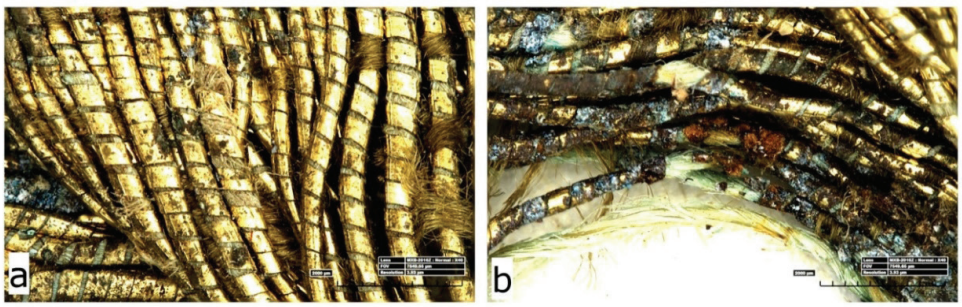


Fig. 138. Ribbon from coffin, crypt B9 burial 14. Threads in various states of preservation: A) golden metal braid without thick corrosion layers, 40× magnification; B) corroded threads with visible damage and mineral deposits, 40× magnification, photo B. Miazga

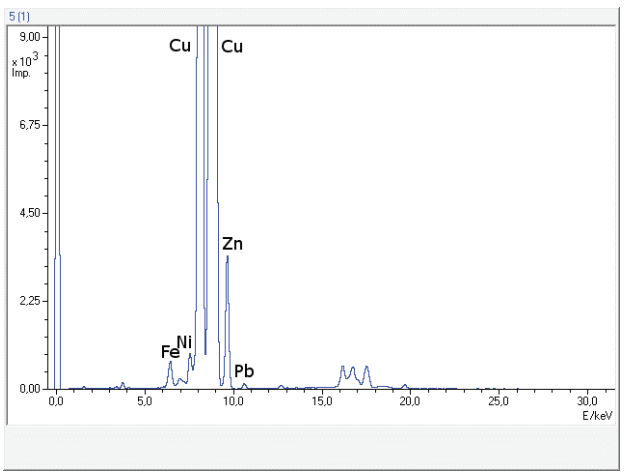


Fig. 139. Ribbon from coffin, crypt B9 burial 14. XRF energy spectrum of selected thread

Band (ribbon) from decoration of child's coffin (galloon with metal threads), crypt B8 burial 1

The band from the next burial was an extremely interesting object made of various raw materials. As can be seen from the interpretation of Figure 140, the ribbon has braided threads and a wide metal band. The whole is joined by a transversely interwoven metal wire. The condition of the ribbon is far from ideal: there are numerous defects in the metal braid, corrosion products are visible on the surface of the metallic structures, and the textile core of the thread has a greenish colour (Fig. 141). Observing the artefact at significant magnification identified numerous transverse grooves (fringes) on the surface of the tape, braid and wire (Fig. 142). This information has a technological significance because it may indicate how the metal elements were prepared (sheet rolling, wire drawing). However, these grooves did not prevent the size of individual elements of the tape being calculated, as shown in Table 20 and Fig. 143. The raw material(s) used to make the tape were determined by XRF microspectrometer. The collected data proved that the ribbon was made of copper raw materials (Fig. 144). The wide band running close to the band edge is made of a material containing 97% copper and 2% zinc. A bit more zinc was found on the surface of the wire, but this can be explained by the process of selective metal oxidation (zinc is less noble than copper and migrates faster to the surface). Similar results were obtained for the braid of threads, where a local increase in the concentration of zinc was noted. Therefore, the interpretation of the results of semi-quantitative analysis of the often heterogeneous artefacts carried out by surface methods (e.g. XRF) should be taken very carefully.

Table 20. Size of elements forming band of child's coffin, crypt 8

Element size [mm]	band (№ 1)	wire (№ 2)	braid of thread (№ 3)
width	0.96	-	0.43
diameter	-	0.12	0.29
braiding shift	-	-	0.10

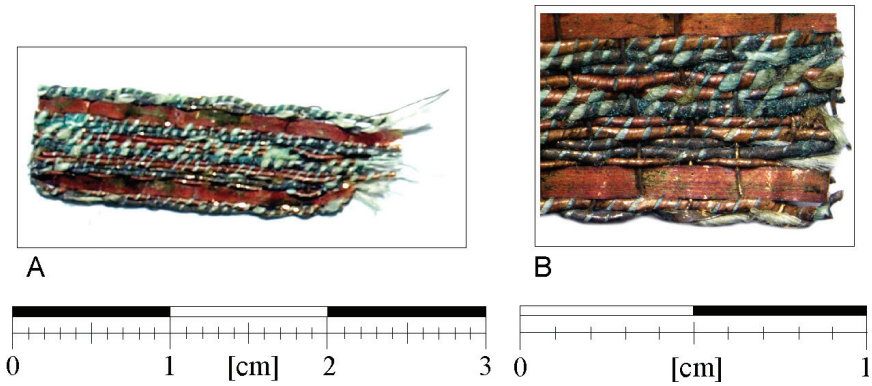


Fig. 140. Ribbon from decoration of child's coffin, crypt B8 burial 1: A) macroscopic images; B) microscopic image, 6.3× magnification, photo B. Miazga

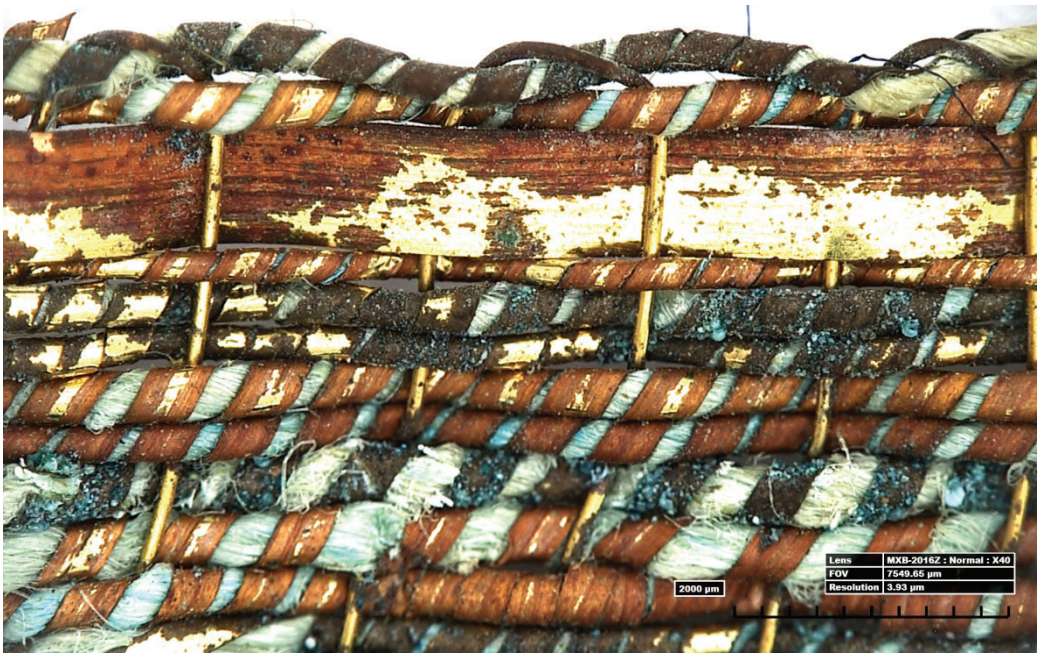


Fig. 141. Ribbon from decoration of child's coffin, crypt B8 burial 1. State of preservation of band, 40× magnification, photo B. Miazga

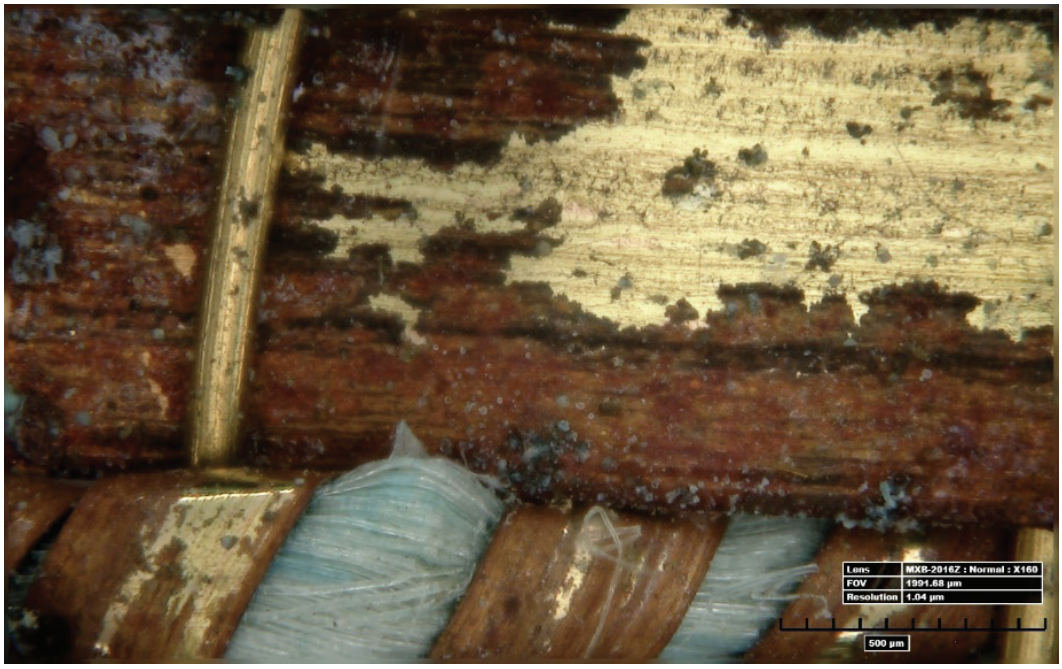


Fig. 142. Ribbon from decoration of child's coffin, crypt B8 burial 1. State of preservation of surface of elements forming band, 160× magnification, photo B. Miazga

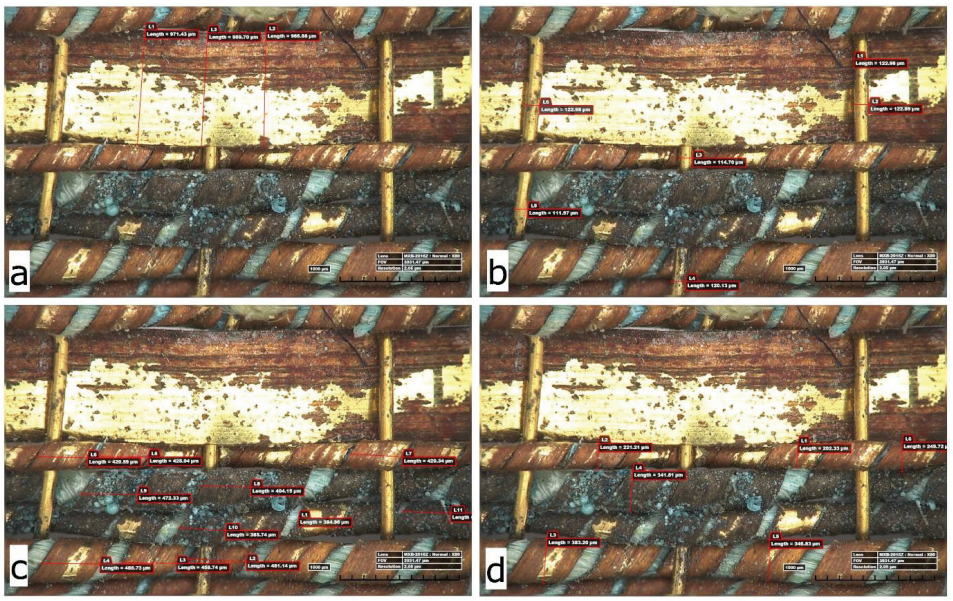


Fig. 143. Ribbon from decoration of child's coffin, crypt B8 burial 1. Selected results of measuring: A) band; B) wire; C, D) braided thread, photo B. Miazga

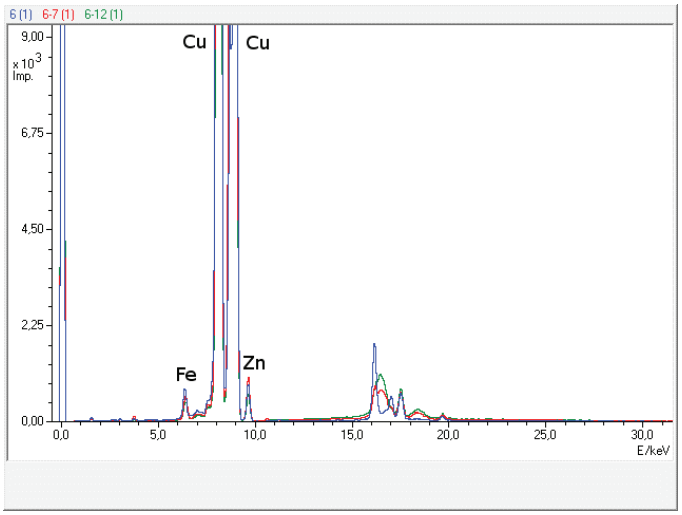


Fig. 144. Ribbon from decoration of child's coffin, crypt B8 burial 1. Comparison of XRF energy spectra for selected parts of ribbon: metal band (blue line), wire (red line), thread braid (green line)

Laces from bonnet, crypt B8 burial 2

Two several-centimetres-long fragments of the bonnet's laces were also subjected to archaeometric studies. Microscopic observations indicated that they were made of various elements in silver-greyish and goldish colours (Fig. 145). Further observation indicated significant corrosion changes of the lace with the band. Not only was the presence of metal oxidation prod-

ucts (grey coating) found on its surface, but so too were deposits of mineral substances in the form of yellowish lumps (Fig. 146a). The surface of the second fragment of the lace is partially changed; there are places with a metallic shine, and areas affected by corrosion (deposits of mineral layers, damage to the metal braid, breaking and unravelling of the textile thread visible in Fig. 146b). Therefore, metric tests were carried out in areas unchanged by corrosion products. The data are presented in Table 21 and Figure 147. It should be pointed out that, in places of damage to the metal braid, some numbers are completely different, such as the braid shift. The destruction of the threads also did not make it easier to determine the lace's raw material. The fragment with the band was made of almost pure silver (about 99.3%) with 0.3% gold (Fig. 148). Metal braids also contained more than 99% silver and about 0.2% gold. Such a quantitative similarity does not exclude the raw material sources of the band and braid being one and the same. The second element of the lace was also prepared from a material with a high concentration of silver (on average 95–96%), but with a ten-fold higher gold content, as determined on the outer surface of the braid. A gold concentration of 3% is not a natural level in silver ore and is evidence of the silver band having been gilded. Furthermore, qualitative comparative analysis of the damaged braid found that both sides had been gilded (Fig. 149). The comparative study also confirmed that the gilding had been abraded on the front of the braid. This is recorded as a slightly lower intensity of gold signal in the spectrum compared to that of the internal surface on which the gilding had not been degraded.

Table 21. Size of elements forming lace decoration from bonnet

Element	lace with band (Fig. 145c)		lace (Fig. 145b)
size [mm]	band	thread	
width	1.16	0.40	0.34
diameter	thickness: 0.03	0.34	0.30
braiding shift	-	0.05	0.03

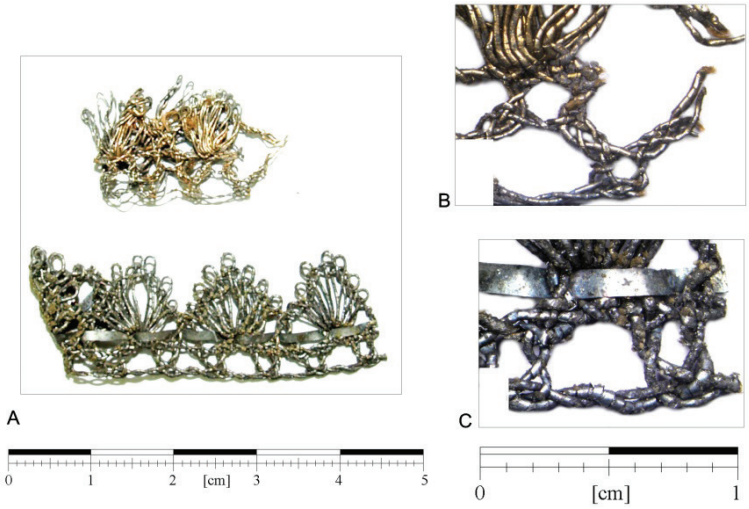


Fig. 145. Laces from bonnet, crypt B8 burial 2: A) macroscopic image, B) microscopic image, 6.3× magnification, photo B. Miazga

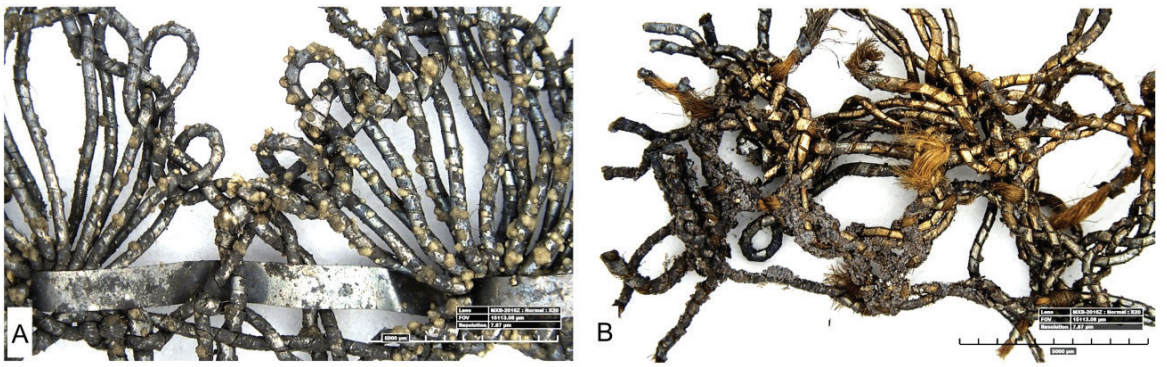


Fig. 146. Laces from bonnet, crypt B8 burial 2. Microscopic image of corrosive changes, 20× magnification, photo B. Miazga

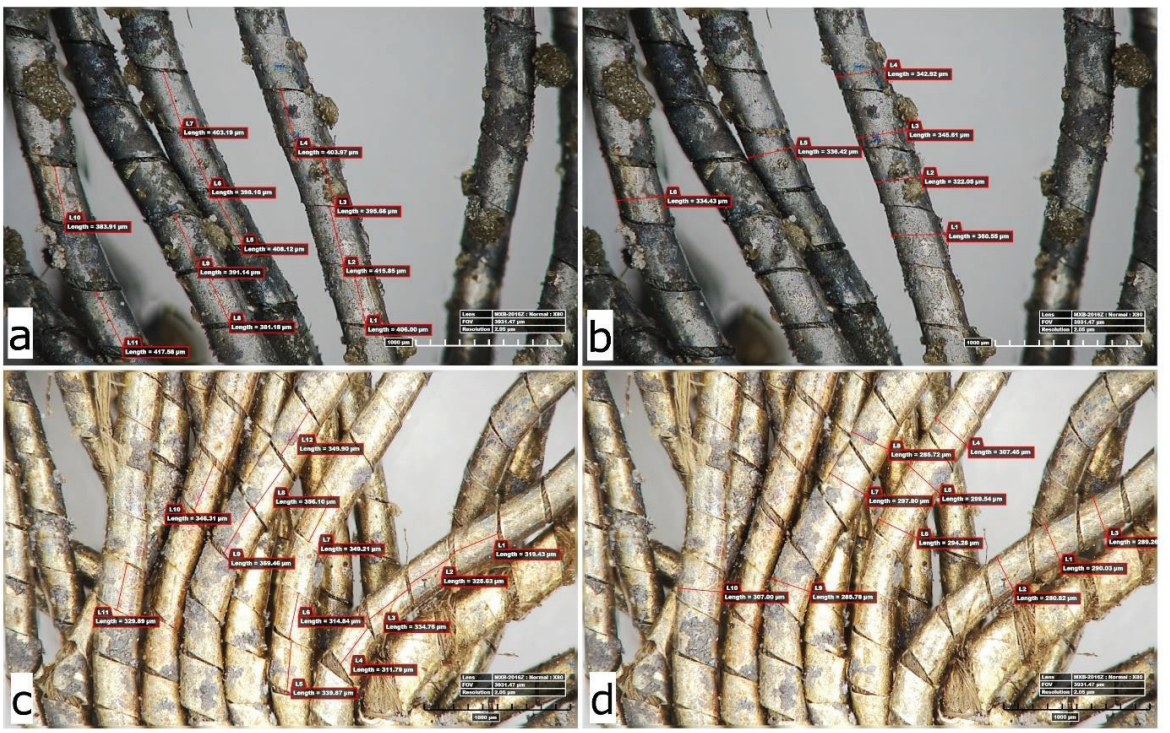


Fig. 147. Laces from bonnet, crypt B8 burial 2. Selected results of measurements of braided thread, 20× magnification, photo B. Miazga

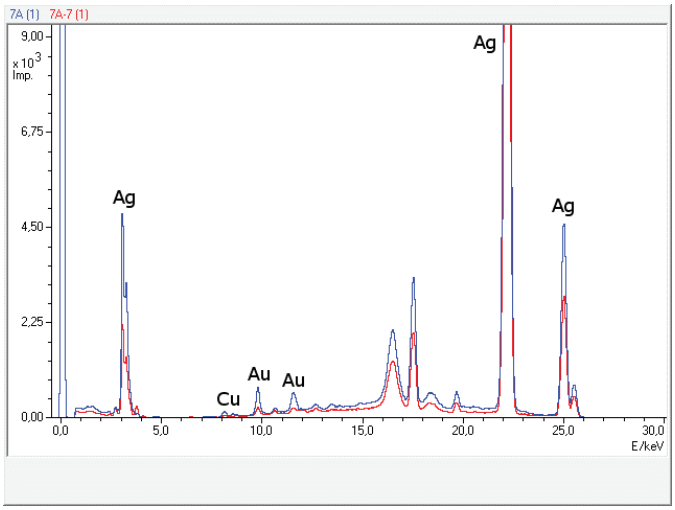


Fig. 148. Laces from bonnet, crypt B8 burial 2. Comparison of energy spectra of silver band (blue line) and braid of thread (red line) of lace shown in Fig. 145c

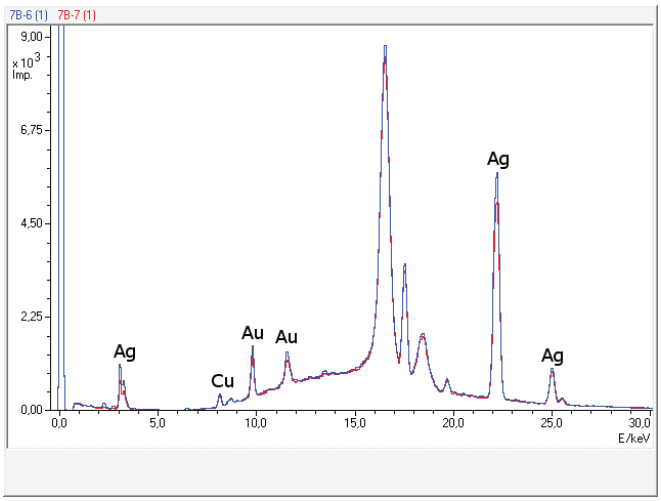


Fig. 149. Laces from bonnet, crypt B8 burial 2. Comparison of energy spectra of braid of outer surface (red line) and inner surface (blue line) of lace shown in Fig. 145b

Summary

Archaeometric studies of archaeological fabrics are possible even in the face of considerable damage, including with the use of non-destructive methods. The present results constitute information of significance to further studies on the state of craftsmanship or social tastes. They have determined not only the raw material that was used to produce metal elements of textiles, but also how the range of available techniques has changed. The study of eight fragments of products from Cracow even determined that golden additions to textiles were not always made using gold or brass, but also almost pure copper, which can be easily formed into plates, braids or wire. In turn, silver alone is responsible for the silvery glow of the tested braids. No replace-

ment in the form of any other silver-coloured metal was found here, such as the tin that was often used in the Middle Ages and modern times in the manufacture of various items, including jewellery and clothing accessories (Egan, Pritchard 2008; Miazga 2014, p. 57–79). In turn, combining different analytical tools has expanded the scope of the obtained results. Microscopic observation often shows us how a given piece was made. The longitudinal stripes on the surface of the wire should be associated with its having been drawn; similarly, traces of strip rolling can be identified (Fig. 120 and 130). Therefore, despite the considerable knowledge of textile crafts from preserved written sources and previous research, it is worth continuing to conduct archaeometric studies on archaeological finds.

Analysis of artefact elemental composition

Artur Ginter

The survey conducted in the crypts of St Francis of Assisi church in Cracow, led by professor Anna Drążkowska PhD, has revealed large sets of artefacts made of various materials (Ginter 2020, p. 205–219). The structures of some are complex. It is impossible to identify and fully describe them without specialist analyses. The unique character of the artefacts has permitted only non-invasive research and analysis methods. X-Ray Fluorescence Spectroscopy (XRF) and stereoscopic microscope observations at various magnifications were used. The former method is one of the most popular analyses of elemental composition of archaeological artefacts due to its aforementioned non-invasive character, the relatively easy access to the hardware (including portable pXRF) and, importantly, the low cost per single analysis (Verma 2007).

The discussed method is based on directing onto the artefact a primary X-ray beam that excites a secondary X-ray beam to be emitted by the atoms present in the object: the secondary X-ray beam has characteristics that will be unique to the atoms that emitted it, allowing the constituent elements in the artefact to be identified (Miazga 2017, p. 59–62).

The result is graphically presented as a spectrum with peaks of various widths and heights reflecting the elemental composition of the artefact, with the exception of so called Rayleigh peaks, which are a signal resulting from the interaction of the primary beam with the X-ray lamp structure. It has to be emphasised that the spectrum sometimes contains additional escape peaks and sum peaks that do not reflect the elemental composition of the object (Kępa et al. 2014, p. 50).

The EDXRF analysis described in the present paper has both advantages and some serious disadvantages in terms of analytical process. They must be considered during the measurements and during the later interpretation of the results. The undisputable advantages include primarily the speed and simplicity of measurements, which account for the relatively low cost of the activity. One measurement cycle allows analysis of multiple elements, both main and trace elements (it is possible to analyse both quality and quantity). An object does not require any special preparations prior to the completely non-invasive measurement. It is also possible to measure objects of complex geometries.

The main disadvantages include the inability to determine light elements, including carbon, oxygen and sodium, which are so important for archaeometry. The metal limit of detection is accepted at 100 ppm (Milazzo 2004, p. 229), while the used device was set closer to 130–150 ppm.

The beam diameter is usually constant and depends on the collimator used. At EDXRF the beam penetration depth is relatively small, and ranges from 0.01 to 0.1 mm, and this property can be regarded as both an advantage and a disadvantage, depending on the artefact type and the research objective. A shallow penetration depth allows measurement of thin decorative layers (such as gold or silver coatings) without the composition of the core onto which they are applied. Still, it must be clearly noted that mutual analysis of multiple elements, surely considered an advantage of EDXRF devices, can sometimes be a disadvantage, especially if peaks of two or more elements overlap making it difficult to correctly identify them qualitatively.

Exact spectroscopic analyses that focus on defining the elemental composition of an archaeological artefact are possible only in areas where conservation works have been applied to remove all corrosion products. At the same time, the measurement process must be performed before protective coatings are applied, since shallow beam penetration would make it harder to obtain proper results. Furthermore, the spectrum can also reveal the elements of which the applied coatings are composed.

The application of analytical methods based on the influence of electromagnetic radiation on matter has been used in archaeological and conservation studies for many years. Defining the elemental composition of artefacts provides knowledge of production processes and the way the artefacts were used. It also provides knowledge of post-deposition processes. Thus it is the key issue for understanding the character of activities undertaken in the past, but it is also an important factor for planning conservation works.

Despite this, it seems that the use of spectrometry for studies of archaeological artefacts discovered in our country is still very rare, especially in light of the massive rescue survey effort that has been carried out for many years. This endeavour has resulted in an unprecedented, gigantic increase in the number of excavated artefacts. Without doubt the situation is being improved by ever more numerous specialist monographic studies presenting smaller or larger groups of artefacts. They still seem to relate, however, mainly to prehistoric and medieval artefacts (Miazga 2017; Auch2016; Greiner-Wronowa 2017). It seems that spectrometric analyses of artefacts originating from highway surveys are an important trend, while the commercial character of these works does not guarantee their publication. Unfortunately, in this case the analyses are also almost exclusively limited to pre-modern era artefacts. Thus, the database of results available for archaeological artefacts analogous to those analysed in this chapter is not very large.

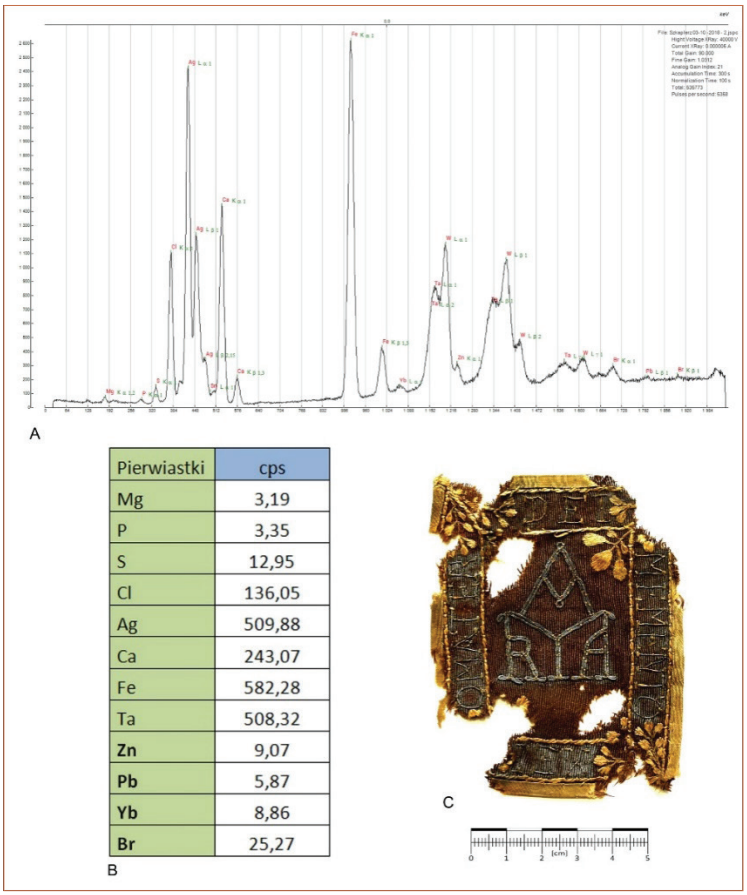
The present study focuses on chemical analysis of the surfaces of eight artefacts originating from the archaeological survey performed in the crypts of St Francis church. The measurements were performed with an XRF PI-MKON 0.1.XRF 01 POLON-IZOT spectrometer with dedicated SpcArcheo software. The device was equipped with an X-ray lamp with 4 W power, 50 kV voltage, 132 μA current and a tungsten anode.

In all studied cases identical lamp settings were used: 40 kV, 5 μA and 300 seconds of accumulation time (the software normalises all results to 100 seconds, regardless of the actual accumulation time). The tungsten peaks visible in the spectra are the Rayleigh peaks mentioned above that result from the use of a tungsten anode, and are not related to any component of the studied artefacts. Meanwhile, argon is a basic component of the air present between the lamp and artefact during measurement.[42]

[42] Our spectrometer is not capable of performing vacuum measurements.

The spectrograms produced during the study were processed with a Savitsky–Golay smoothing filter and *Peak Stripping* background elimination. This allowed a set of elements to be identified in specific areas of the artefact. The results are presented in the tables and graphs below. Due to the very complex structure of all the artefacts, a semi-quantitative analysis was omitted and the results were presented as cps (counts per second).

Artefact analysis
Metal-wrap strand from scapular, crypt B7 burial 1



A

B

Pierwiastki	cps
Mg	3,19
P	3,35
S	12,95
Cl	136,05
Ag	509,88
Ca	243,07
Fe	582,28
Ta	508,32
Zn	9,07
Pb	5,87
Yb	8,86
Br	25,27

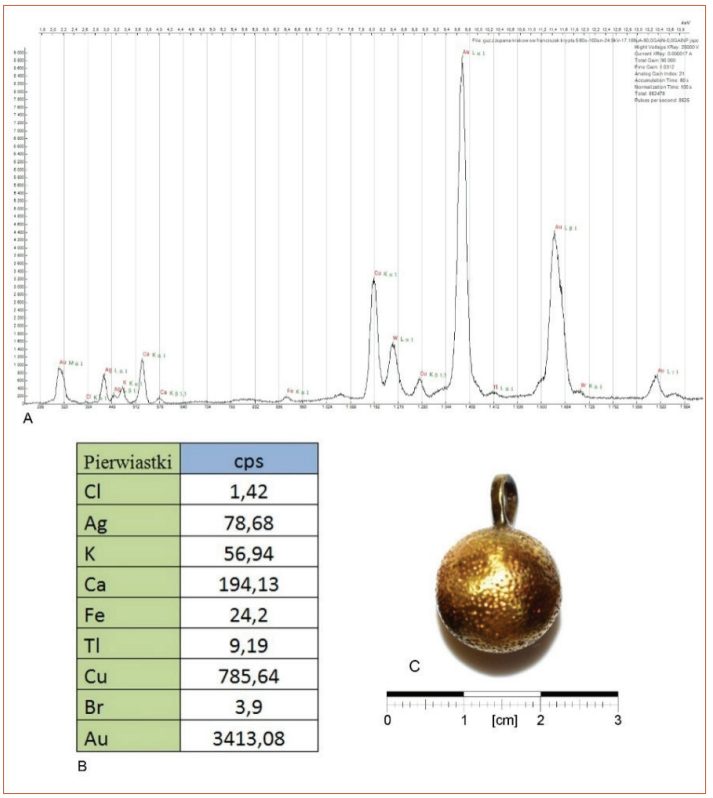
C

Fig. 150. Metal-wrap strand from scapular, crypt B7 burial 1: A) Energy XRF spectrum of strand wrap; B) table compilation (*pierwiastki* – elements); C) Scapular, photo M. Nowak

Spectrometric analysis of the scapular reveals the elemental composition of the metal-wrap strands used for the production of the artefact (Fig. 150). The results surely prove that part of the strand wrap (measurements performed in two locations) are made of silver, additionally supported by the presence of sulphides and chlorides clearly visible in the spectrum (which are the effect of its corrosion), as well as traces of lead (suggesting galena as a possible source of silver). The scapular was woven with organic materials, and this is probably the rea-

son for the presence of peaks of phosphorus, bromine, magnesium, zinc and iron in the spectrum. These conclusions require further specialist studies.

Żupan garment button, crypt B5 burial 14



Pierwiastki	cps
Cl	1,42
Ag	78,68
K	56,94
Ca	194,13
Fe	24,2
Tl	9,19
Cu	785,64
Br	3,9
Au	3413,08

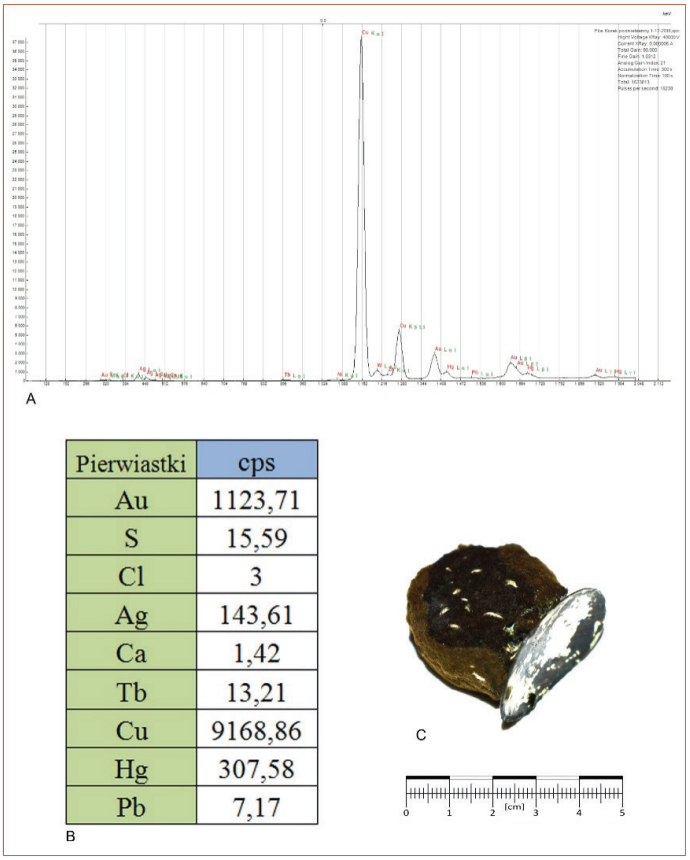
Fig. 151. Żupan button, crypt B5 burial 14. XRF energy spectrum of button, photo M. Nowak

The żupan button was made of gold and copper alloy, with gold being the predominant element (Fig 151). We also identified numerous alloy admixtures, including silver and thallium, which is a common copper ore component. Due to the porous structure of the artefact it is possible that the calcium, bromine, potassium and iron are remains of the decomposition of organic material that had been in contact with the studied button. Traces of chlorine, analogous to other copper artefacts discussed in this paper, prove corrosion (copper chlorides) that was mostly removed during conservation activities.

Palate prosthesis, crypt B7 burial 1

The artefact discovered in a person's mouth should be without any doubt considered unique, both due to its primary designed function and its extraordinary structure (Fig. 152). The decision to perform a spectrometry of the convex plate that was an integral part of it was motivat-

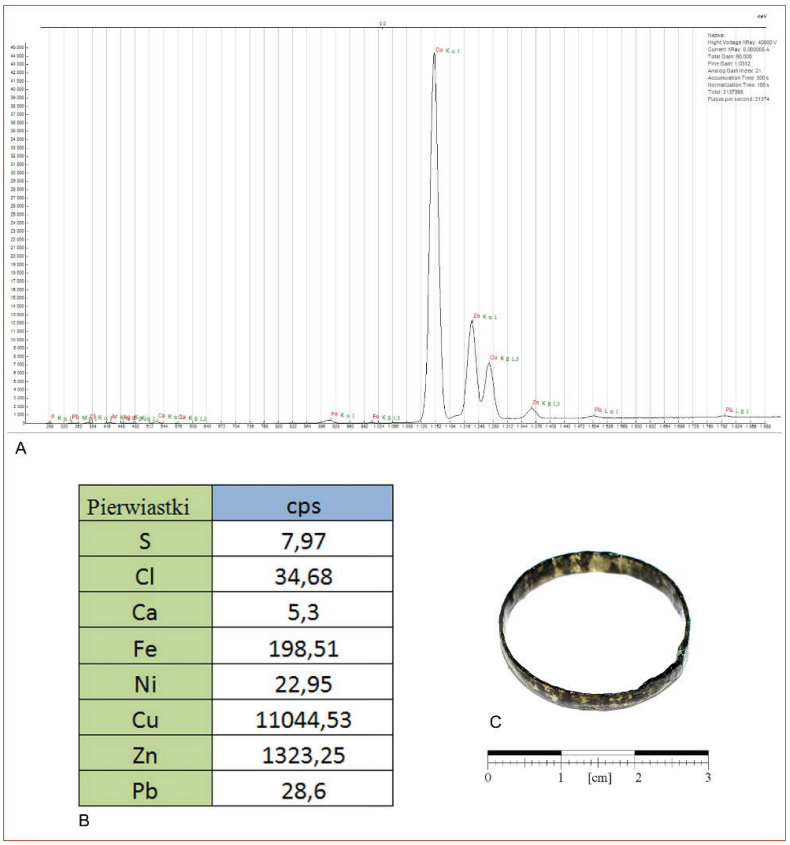
ed mainly by difficulty in identifying the metal used in its manufacture. The colour and state of preservation of the metal suggested gold, while a thick layer of copper oxides clearly weakened this hypothesis. After the measurements and observations with a binocular microscope we determined that the artefact was made of copper that was first coated with a thin layer of silver (possibly for antiseptic reasons), and then a layer of gold amalgam providing chemical neutrality within the mouth. The small lead admixture is probably related to the silver having been produced from galena, while a rare admixture of terbium (being a component of monazites) is worth mentioning, but certainly accidental. Traces of sulphur and chlorine, components of copper sulphides and chlorides are products of copper corrosion.



Pierwiastki	cps
Au	1123,71
S	15,59
Cl	3
Ag	143,61
Ca	1,42
Tb	13,21
Cu	9168,86
Hg	307,58
Pb	7,17

Fig. 152. Palate prosthesis, crypt B7 burial 1. XRF energy spectrum of prosthesis, photo M. Nowak

Ring, crypt B9 burial 11a/11b



Pierwiastki	cps
S	7,97
Cl	34,68
Ca	5,3
Fe	198,51
Ni	22,95
Cu	11044,53
Zn	1323,25
Pb	28,6

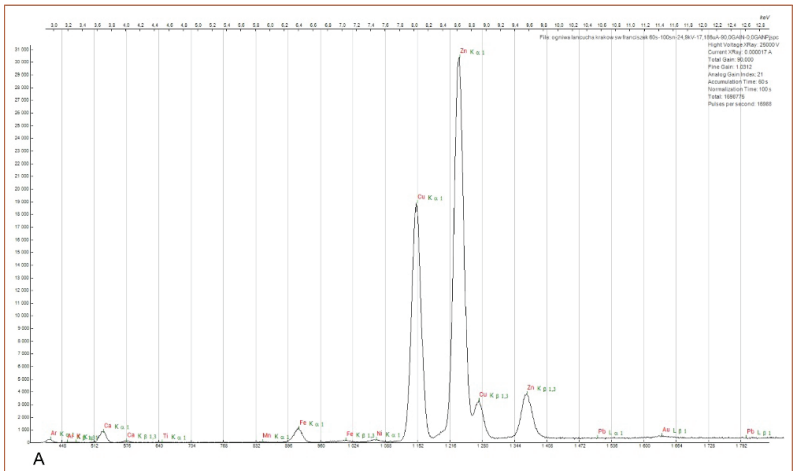
Fig. 153. Ring, crypt B9 burial 11A/11B. XRF energy spectrum of ring, photo M. Nowak

The studied ring (Fig. 153) is made of tombac (copper and zinc alloy, with copper content above 80%) with a slight admixture of iron, nickel and lead. Its surface is covered with typical copper corrosion products, including copper sulphides and chlorides (mostly removed in the conservation process prior to examination).

Chain links, crypt K2 loose find

The performed spectrometric analysis of the chain artefact (Fig. 154) revealed that it is composed of a copper and zinc alloy. The proportions of the metals are quite unique. The literature defines brass as an alloy containing 40% zinc, while the studied artefact seems to have almost the opposite proportions (identification of actual percentage composition of specific elements would require quantitative analyses). The presence of a small amount of manganese and iron suggests it is a manganese bronze, but this hypothesis would require additional measurements with another type of spectrometer (such as an electron microscope with EDX spectrometer).

In the case of this artefact, the discovery of a small amount of gold is very important, and probably suggests that the link surface originally had a delicate gold coating.



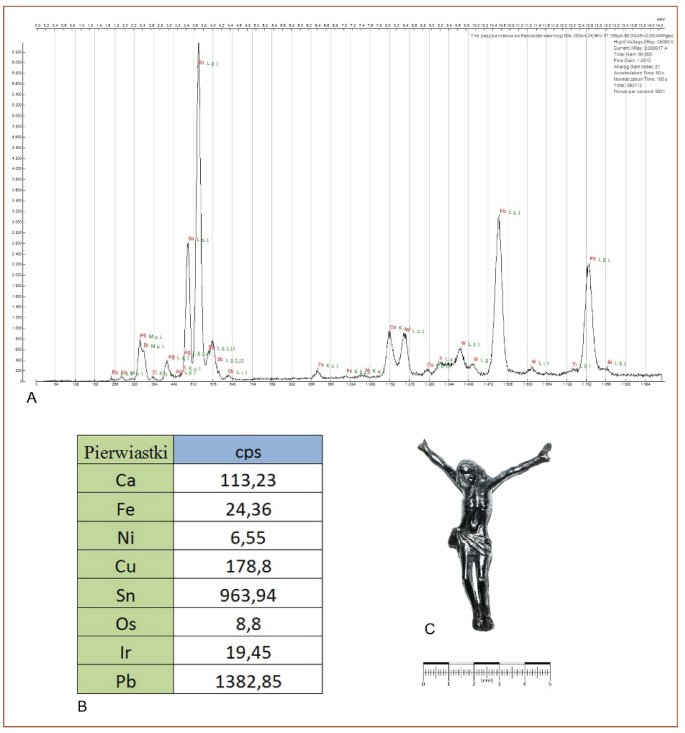
Pierwiastki	cps
Ca	152,95
Ti	2,91
Mn	5,81
Fe	222,33
Ni	31,37
Cu	4424,6
Zn	7268,73
Au	37,16

B

Fig. 154. Chain links, crypt K2 loose find, XRF energy spectrum of chain, photo M. Nowak

Passion cross, crypt B5 burial 4

Two spots, on internal and external side of the passion cross (Fig. 155) were measured in order to determine if they had initially differed in terms of surface finish. As a result of XFR and microscope analyses, it was stated that the artefact was made of lead (or equally probably of tin and lead alloy) and then covered by an additional layer of tin to achieve a better effect.



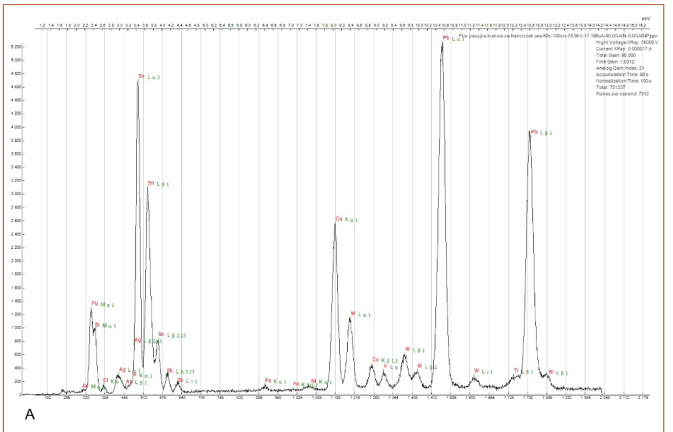
A

Pierwiastki	cps
Ca	113,23
Fe	24,36
Ni	6,55
Cu	178,8
Sn	963,94
Os	8,8
Ir	19,45
Pb	1382,85

B

C

Fig. 155. Passion cross, internal leg part, crypt B5 burial 4. XRF energy spectrum of passion cross, photo M. Nowak



A

Pierwiastki	cps
Fe	13,87
Cu	574,02
Sn	1163,46
Sb	55,9
Os	3,09
Ir	29,25
Pb	2501,85
Bi	267,65
Ag	47,77

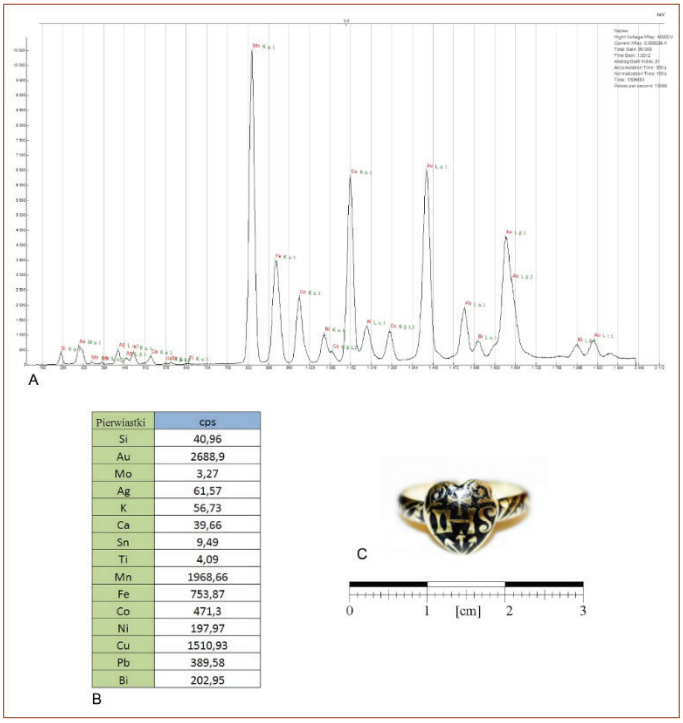
B

C

Fig. 156. Passion cross, external part, crypt B5 burial 4. XRF energy spectrum of passion cross, photo M. Nowak

A small amount of silver was identified on the external side and the state of preservation makes it difficult to determine whether the whole artefact or only its parts were originally silver-coated (Fig. 156). Especially interesting in terms of chemistry is the presence of two elements: osmium and iridium in the form of a rare mineral – osmiridium. The small number of measurements and trace presence of these elements in the spectrum require that confirmation be provided in the form of additional analyses by, for instance, LIBS spectroscopy.

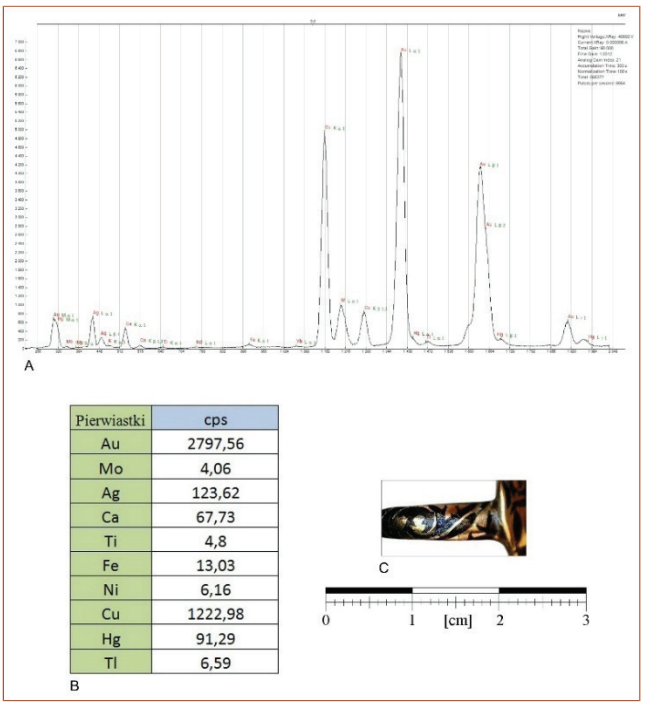
Ring with ihs monogram, crypt B7 burial 1



Pierwiastki	cps
Si	40,96
Au	2688,9
Mo	3,27
Ag	61,57
K	56,73
Ca	39,66
Sn	9,49
Ti	4,09
Mn	1968,66
Fe	753,87
Co	471,3
Ni	197,97
Cu	1510,93
Pb	389,58
Bi	202,95

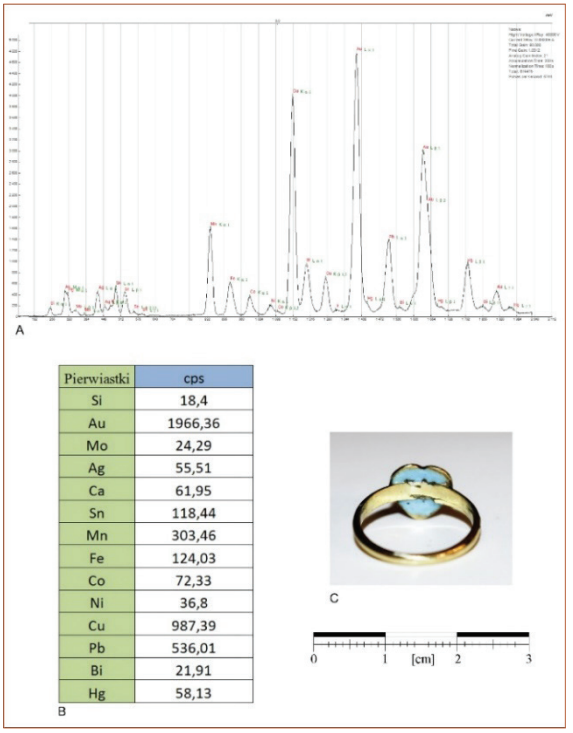
Fig. 157. Ring with IHS – bezel, crypt B7 burial 1. XRF energy spectrum of ring bezel, photo M. Nowak

The ring with IHS monogram was the most structurally complex artefact in the examined group and one of the most complex in the history of our laboratory (Fig. 157). Due to the beam width and difficulties in positioning the artefact, it was impossible to make a bezel measurement covering only the black filler. The filler composition was therefore defined based on the difference between the results for the bezel and the hoop. The ring hoop is made of an alloy of gold, copper, silver and mercury, with several trace elements (molybdenum, titanium, iron, nickel and thallium). The ornament was probably made of lead glass, coloured black with manganese and cobalt with a participation of bismuth, a common pollutant in Celtic lead ores (Greiner-Wronowa 2017, p. 56, 71–79).



Pierwiastki	cps
Au	2797,56
Mo	4,06
Ag	123,62
Ca	67,73
Ti	4,8
Fe	13,03
Ni	6,16
Cu	1222,98
Hg	91,29
Tl	6,59

Fig. 158. Ring with IHS – hoop, crypt B7 burial 1. XRF energy spectrum of ring hoop, photo M. Nowak

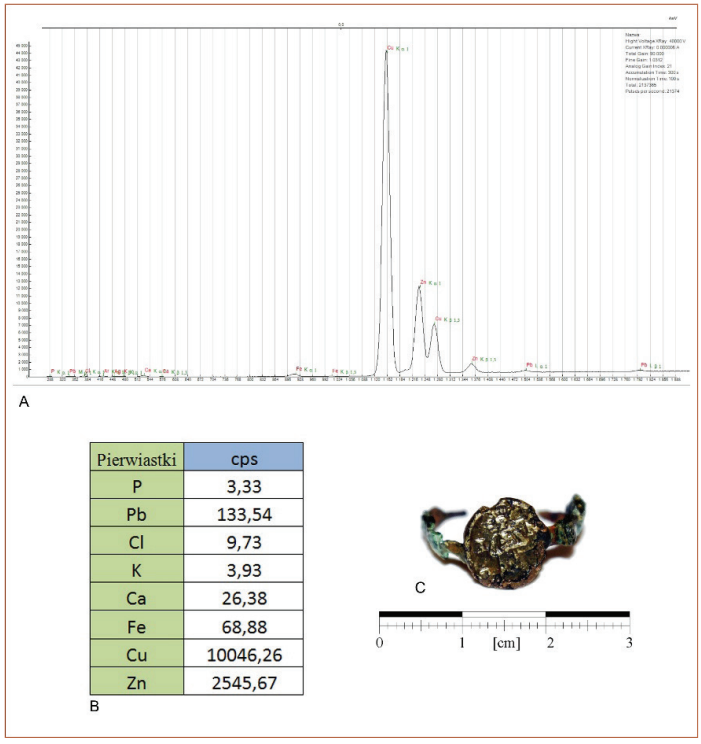


Pierwiastki	cps
Si	18,4
Au	1966,36
Mo	24,29
Ag	55,51
Ca	61,95
Sn	118,44
Mn	303,46
Fe	124,03
Co	72,33
Ni	36,8
Cu	987,39
Pb	536,01
Bi	21,91
Hg	58,13

Fig. 159. Ring with IHS – binder, crypt B7 burial 1XRF energy spectrum of ring hoop, photo M. Nowak

A doubt related to the type of filler used results from difficulties in proper identification of the main glass components, namely silicon and potassium, with the use of XRF method and measurement in the air (Miazga 2017, p. 114–20). The identification could be confirmed by electron microscope with an EDX spectrometer, which allows light elements to be recorded. Similarly to the black bezel ornament, it is also impossible to unequivocally identify the composition of the binder while only using XRF analyses. It seems that in this case, too, we are dealing with lead glass coloured with manganese and cobalt, and both elements are clearly less abundant here than in the bezel ornament. This results in a bluish instead of black colour. Here too, a small amount of bismuth was identified.

Ring, crypt B3 burial 4



Pierwiastki	cps
P	3,33
Pb	133,54
Cl	9,73
K	3,93
Ca	26,38
Fe	68,88
Cu	10046,26
Zn	2545,67

Fig. 160. Ring, crypt B3 burial 4. XRF energy spectrum of ring, photo M. Nowak

The ring is made of brass polluted with a large amount of lead. The presence of chlorine proves the appearance of copper corrosion products on the surface, while other elements in trace amounts may constitute both alloy admixtures and remains of post-deposition processes.

The technological conclusions presented in this chapter should be considered an introduction to further discussion. The XRF analyses clearly show the complexity of the problem. It is difficult to unequivocally state whether such a rich elemental composition (especially the presence of unique and naturally rare trace elements) relates to a significant increase in ava-

ilability of various raw materials in modern times due to a growth in trade routes (including intercontinental ones) and the exploitation of new raw material deposits. Without any doubt, however, in order to understand an artefact's composition, analyses by a variety of techniques are necessary and fluorescence method plays an important role here. This is commonly emphasised by experts in archaeometry. Close cooperation between archaeologists and other specialists, from historical object conservators to chemists and geochemists, is very important.

LIST OF FIGURES

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NOTE ABOUT AUTHORS

ALEKSANDRA BURKOWSKA-BUT
Nicolaus Copernicus University in Toruń, Faculty of Biological and Veterinary Sciences, Department of Environmental Microbiology and Biotechnology

STANISŁAW CECHOSZ
Cepla Studio and Partners Monument Conservation

MARIA CYBULSKA
Lodz University of Technology, Faculty of Material Technologies and Textile Design, Institute of Architecture of Textiles

ANNA DRĄŻKOWSKA
Nicolaus Copernicus University in Toruń, Faculty of History, Instytut of Archeology, Department of Mediaeval Period and Early Modern Period

ARTUR GINTER
University of Lodz, Faculty of Philosophy and History, Instytut of Archeology, Thermoluminescence Dating and Spectrometry Laboratory

HENRYK GŁĄB
Jagiellonian University in Cracow, Faculty of Biology, Institute of Zoology, Department of Antropology

MARTA GORZKIEWICZ
Nicolaus Copernicus University in Toruń, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Faculty of Medicine, Department of Forensic Medicine

TOMASZ GRZYBOWSKI
Nicolaus Copernicus University in Toruń, Ludwik Rydygier Collegium Medicum in Bydgoszcz, Faculty of Medicine, Department of Forensic Medicine

ŁUKASZ HOLCER
Cepla Studio and Partners Monument Conservation

MONIKA ŁYCZAK
Archaeological company FRAMEA Cracow

BEATA MIAZGA
University of Wroclaw, Faculty of Historical and Pedagogical Sciences, Laboratory for Archaeological Conservation and Archaeometry

MARCIN NOWAK
Nicolaus Copernicus University in Toruń, Faculty of History, Instytut of Archeology,

LAURIE J. REITSEMA
University of Georgia, Department of Anthropology

HALINA ROJKOWSKA-TASAK
Management of Communal Buildings in Cracow

MARIA SWIONTEK BRZEZINSKA
Nicolaus Copernicus University in Toruń, Faculty of Biological and Veterinary Sciences, Department of Environmental Microbiology and Biotechnology

MACIEJ WALCZAK
Nicolaus Copernicus University in Toruń, Faculty of Biological and Veterinary Sciences, Department of Environmental Microbiology and Biotechnology