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ANIMAL'S PAWPRINTS ON THE BRICKS OF MEDZHYBIZH CASTLE

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Abstract

Occasional marks on bricks or other architectonic composites, with their potential to unveil environmental conditions at the time of their formation, attract scientific attention. The object of our research is the pawprints on bricks, a discovery made during the archaeological excavations of the historically significant Medzhybizh Castle (also known as Medzhybizh Fortress), located in the village of Medzhybizh, Khmelnytskyi region, Ukraine. Brick, a popular building material, was continually used to construct palaces and residential and household objects of the Castle's architectural ensemble. The studied collection of bricks, dating to the 15th-19th centuries, is the second most widespread material, after stone blocks, for constructing various elements of the Castle complex.

This study aims to identify the animal species responsible for the pawprints found and showcase the valuable informational potential of animal pawprints on bricks as an archaeological resource.

The findings of the study reveal that the imprints can be attributed to canines, felines, swine, even-toed ungulates, and domestic fowl (chickens). Animal tracks present on the brick blanks indirectly reflect the environmental elements. In the context of the brick materials utilized in the construction of Medzhybizh Castle, the animal imprints indicate the presence of animals associated with the proprietors of the brickyard or those from neighbouring households and farms. Animals could have unintentionally traversed the brick blanks while roaming freely, possibly attracted by the mineral components of the brick mortar. The dimensions of a dog's pawprints enable an estimation of the size of certain individual dogs and their count. The small size of the hoofed mammal's tracks suggests they belonged to young individuals, indicating the spring-

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summer season during which the brick blanks were created. The positioning of the tracks on the brick provides insights into the speed patterns of the animals' movements on the blanks.

Therefore, the results of the pawprint study on bricks and other ancient ceramic products not only contribute to our understanding of the past but also have practical applications in the scientific and museological spheres, making this research highly relevant and its applications tangible.

Keywords: Medzhybizh Castle, fortification, archaeology, archaeozoology, brick, animal tracks (pawprints, imprints)

СЛІДИ ТВАРИН НА ЦЕГЛІ МЕДЖИБІЗЬКОГО ЗАМКУ

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Анотація

Випадкові сліди на цеглі, або інших будівельних сумішах привертають увагу тим, що є джерелом умов навколишнього середовища їх формування. Об'єктом дослідження цієї роботи є відбитки слідів тварин на цеглі, яка була виявлена під час археологічних досліджень Меджибізької фортеці, що розташована в с. Меджибіж Хмельницької області. Досліджувана колекція цегли датується 15–19 ст. Вона є другою по рівню розповсюженості, після кам'яних блоків, матеріалом для будівництва різних елементів фортечного комплексу.

Ціллю цього дослідження є визначення видового складу тварин, яким належали сліди, а також демонстрація інформаційного потенціалу слідів тварин на заготівках цегли в якості археологічного джерела. Результати визначення свідчать, що сліди належали собакам, котам, свиням, парнокопитним тваринам та курці домашній. Сліди тварин на заготовках цегли опосередковано вказують на елементи зовнішнього середовища. У випадку матеріалів цегли Меджибізької фортеці сліди тварин вказують на тварин, які належали власникам цегельні або тварин суміжних з цегельною господарств. Тварини могли потрапити на цегляні заготівки випадково під час вільного вигулу. Їх могли приваблювали мінеральні складові цегляного розчину. Довжина слідів собак дозволила реконструювати приблизний розмір деяких особин, а також їхню кількість. Невеликий розмір слідів парнокопитних тварин вказував на їхню приналежність особинам дитячого віку, що може вказувати на весняно-літній сезон створення цегляних заготівок. Спосіб розташування слідів на цеглі вказує на темп пересування тварини по її заготівкам.

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Отримані результати дослідження слідів на цеглі та інших давніх керамічних виробках можуть мати практичне застосування у науковій та музейнознавчій сфері.

Ключові слова: Меджибізька фортеця, фортифікація, археозоологія, цегла, сліди тварин

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Introduction

Medzhybizh Castle, located in the Medzhybizh village near Khmelnytskyi, Ukraine, is a part of the medieval fortress and stands as a significant monument of archaeology and architecture spanning the 12th to 18th centuries. Its strategic position at coordinates N49.4370 and E27.4118 adds to its significance, making it a renowned defensive structure of Ukraine (Fig. 1).



Рис. 1. Меджибізькій замок на мапі України
Fig. 1. Mezhybizh castle on the map of Ukraine

This architectural marvel invites analysis from the perspective of architectural archaeology, encompassing typology, appearance, functional purpose, and the sequence of decor styles. Furthermore, a stratigraphic analysis systematizes the construction stages in chronological order.

The construction of Medzhybizh Castle relied on two primary groups of building materials.

The first group comprised natural local detrital limestones and sandstones of the Sarmatian stage of the Neogene era, forming the central massif for building the walls and most of the architectural fortification objects. The limestone components utilized varied in size, ranging from 20–40 cm to substantial fragments exceeding one meter, depending on the era and construction techniques employed.

The second group included architectural and construction ceramic products such as bricks, floor tiles, eaves details, and decorative elements.

The historical overview of the stone construction stages of Medzhybizh Castle traces back to the late 14th century, coinciding with the final period of the Grand Duchy of Lithuania. The transition to Gothic-type tiles and other architectural and interior innovations marked the end of the 14th and the beginning of the 15th centuries. At the same time, the widespread use of bricks likely commenced in the 15th century.

The methodology for the scientific study of bricks involves recording various signs, markings, and traces indicative of the production technology and dating. Notably, studying the tracks on bricks or their fragments from the Medzhybizh Castle plays a pivotal role in understanding the brick collection's archaeological significance, shedding light on the conditions in which these bricks were formed. Noteworthy occasional traces include animal paw prints, often found on bricks from different historical periods, suggesting the circumstances under which brick-making occurred, including in the open air, under a canopy, or in a room with animals' free access to it.

This study aims to comprehensively describe and analyze animal tracks on bricks or their fragments, emphasizing the informative value of such bricks as an archaeological source from the Medzhybizh Castle.

Analysis of the latest research and publications

The practice of studying animal pawprints on ancient bricks or other architectonic composites is globally recognized. Dr. Povilas Blaževičius studied the dog pawprints found on the bricks of medieval artifacts in Vilnius, Latvia¹. The researcher managed to reconstruct the approximate size of the dogs, determine their hair length, and identify potential animal diseases. The author's methodical techniques laid the groundwork for studying the brick collection at Medzhybizh Castle. Scientists G. Musto and L. Cram conducted research on animal tracks found on Roman-era bricks². Researchers have been trying to figure out the breed and size of the dogs that left traces on ancient Roman bricks and tiles. A group of researchers led by M. Kralik studied random traces on Lelekovice Castle (Czech Republic) bricks. The researchers discovered a mix of animal and children's tracks. They suggested that children and animals could have been stepping onto the brick blanks while the animals were grazing, with the children actively participating as shepherds³.

Random animal and rain traces were found on brick samples from medieval archaeological sites in Kyiv, Pereiaslav, and Grodno, located in Ukraine⁴. Researcher

¹ Blaževičius P. Vilniaus miesto sunu pedsaku tyrimai. *Lituanica*. 2021. T. 125, № 3. C. 194-210.

² Musto G., Cram L. Pawprints in clay: Romano-British dogs in a math class. *Significance*. 2010. T. 2, № 7. C. 93-96.

³ Kralik M., Urbanova P., Hlozek M. Finger, hand and foot imprints: the evidence of children on archaeological artifacts. *Children, Identity and the past* / ed. by. H. Dommasnes and M. Wrigglesworth. Cambridge, 2008. P. 1-16.

⁴ Раппопорт П.А. Строительное производство Древней Руси X-XIII веков. Санкт Петербург: Наука, 1994. С. 5-18.

D. Elshin has provided instances of markings found on the plinth-type brick of the Church of Tithes, which include traces from rain, grass, and animals. However, the descriptions of these markings remain at a generalized level⁵. Therefore, this underscores the relevance of conducting a comprehensive study of this category of traces.

Materials and methods

Brick was a widely used building material in the construction of palaces, residential buildings, and household objects in the architectural ensemble of Medzhybizh Castle. Different types of bricks used in the Castle can be associated with its historical stages of construction and reconstruction. Since construction ceramic products have their own technological and production specifics, it is possible to draw connections between the use of volumes and types of bricks in the Castle and the development of the town of Medzhybizh itself, where such bricks were used in private construction.

“Longitudinal stamp type” brick is the oldest type of brick used in the construction of Medzhybizh Castle. The clay mixture and blanks were likely hand-formed without standardized dimensions, directly in the clay quarries near the Castle. During the moulding process, harrows were applied using fingers or a scraper on one side of the brick. The technology involved the use of non-standard forms, different densities of filling, and different methods of applying grooves. This led to the fact that it is practically impossible to produce two identical “Longitudinal stamp type” bricks. However, as with any bulk material, general trends in the overall size and weight of bricks can be observed. The earliest form of bricks was approximately 26×15×8.5 cm in size. Since the 17th century, recorded dimensions were about 18×13×5.5 cm⁶. The longitudinal stamp brick was predominantly utilized in the construction of structures during the 16th and 17th centuries and continued to see secondary use in later periods. Examination of Rakochi Castle, a part of which was constructed using longitudinal stamp bricks, facilitated the precise dating of this brick type. Situated approximately two kilometres from Medzhybizh, the ruins of the Rakochi Castle, originally erected in the first half of the 16th century and subsequently destroyed by the century’s end, provided crucial evidence for dating this particular brick type.

In the 18th and 19th centuries, a different type of brick was used, distinguished by smaller sizes and the presence of marks compared to the “longitudinal stamp type”⁷.

In the studied collection, the “longitudinal stamp” brick is predominant – 106 specimens, at the same time, bricks from the 18th and 19th centuries – 8 specimens.

⁵ Елшин Д.Д. Новые исследования древнерусской плинфы: итоги и перспективы. *Археологія і давня історія України*. 2010. Вип. 1. С. 395–407.

⁶ Акмен І.Р., Погорілець О.Г., Тарасов В.В. Архітектурно-будівельні керамічні вироби з замку-фортеці Меджибіж. *Збірник «Проблеми дослідження, збереження та реставрації історичних фортифікацій»*. 2015. № 7. С. 15.

⁷ Барановський А.В. Будівельні матеріали Меджибізької фортеці. *Збірник матеріалів Археологія і фортифікація України*. 2019. № 9. С. 118–120.

The method developed by P.G. Oshmarin and D.G. Pikunov was utilized for species identification of animals. The calculation took into account the 8% attributed to the drying process of bricks when determining animal pawprint size⁸. Thus, 8% of its length was added to the actual size of each paw-print. This is the average apparent drying of bricks, which could range from 5% to 15%, depending on the components of the brick solution⁹. It was feasible to distinguish individual pawprints by species; however, measuring the traces was unattainable due to fragmentation or indistinct edges. The reconstruction of the dog's dimensions in relation to its paw print size was conducted following the Muttluks brand correlation scheme for dog shoes¹⁰.

During such reconstructions, it is necessary to consider its inaccuracy because the breeds and sizes of dogs in ancient times may not match up with modern breeds of dogs, most of which were bred several centuries ago. The reconstruction of dog sizes, in our case, is conditional and approximate to the actual sizes and should be considered as such. When counting the number of animal tracks represented on the brick, it is essential to consider the varying degrees of penetration into the wet and dried brick blanks. This difference can result in a discrepancy of 1-2 mm in the track length of an individual animal. Refer to Table 1 for further details.

Results

The collection comprises 114 samples of bricks or their fragments, containing a total of 146 animal pawprints and 3 human prints. The identified animal pawprints include 53 samples of dog pawprints, 75 samples of cat tracks, 4 samples of pig prints, 10 samples of small hoofed animals, and 4 samples of domestic chicken prints (refer to Fig. 2 and 3; Table 1). Three bricks with human footprints, two with fingerprints, and one with a human footprint were recovered. These samples were obtained in 2020. Given the ongoing archaeological research at the Medzhybizh Castle, it is plausible that additional finds of bricks with animal tracks may emerge in the future.

Dog's paw prints. A total of 53 dog paw prints were observed and analyzed. From this sample, measurements were taken to determine the positioning relative to the front (anterior) or back (posterior) side of the body from 17 paw print samples. The pawprints of dogs, so as other animals, were found on both fresh clay with clear edges and on more dry clay, where the paw prints of the animal are less embedded in the brick composition and are not so distinct. In some cases, both types of prints were found on the same brick unit, indicating the cycle of its drying stage readiness.

To estimate the size of the paws, measurements of the length of the footprint without the claw of the dogs' front paws were considered.

⁸ Ошмарин П.Г., Пикун Д.Г. Следы в природе. Следы ног животных на почве и снегу. Практическая классификация следов ног зверей и птиц. Москва: Наука, 1990. 296 с.

⁹ Blazeivicius P. Vilniaus miesto sunu pedsaku tyrimai. *Lituanica*. 2021. T. 125, № 3. С. 194-210.

¹⁰ Muttluks sizing. URL: <https://chillydogs.ca/muttluks-sizing-chart/>

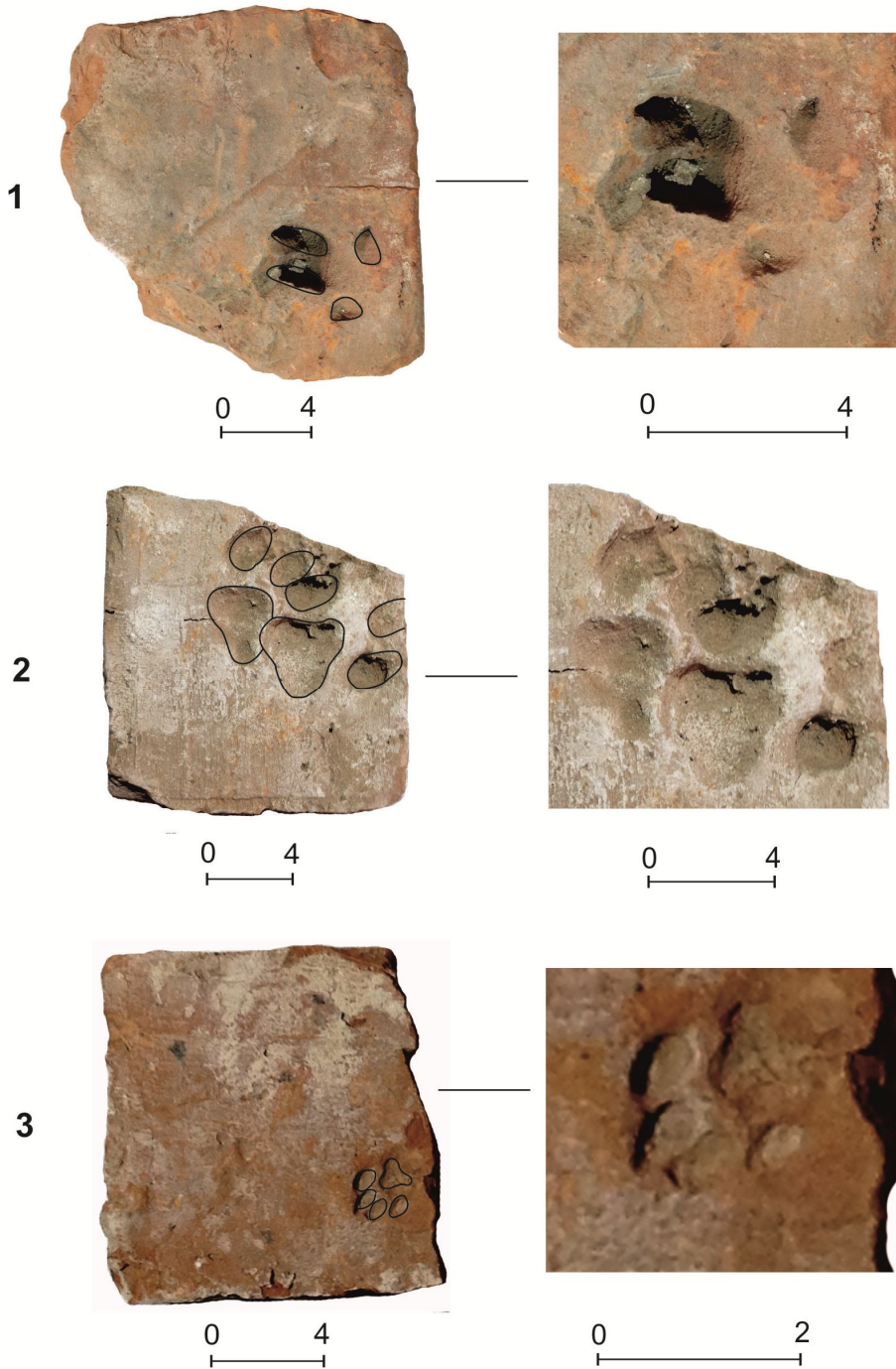
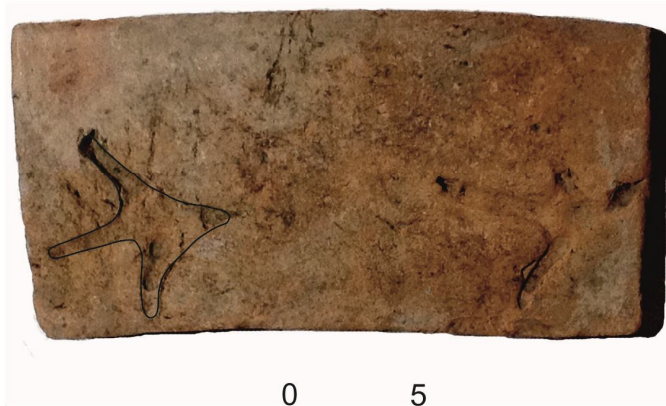


Fig. 2. Bricks with paw prints of different animal species:
 a – paw prints of a cat; b – chicken paw prints; c – traces of human fingerprints
 Рис. 2. Цегла з відбитками слідів різних видів тварин:
 а – сліди kota; б – сліди курки; с – сліди відбитків пальців людини



a



b



c



Fig. 3. Brick fragments with different animal's paw prints:
 a – a single pawprint of a pig; b – “covered” pawprint of a dog; c – a single pawprint of a cat
 Рис. 3. Фрагменти цегли з різними відбитками слідів тварин:
 а – одиничний слід поросся; б – перекритий слід собаки; с – одиничний слід kota

Таблиця 1. Довжина слідів тварин Меджибізького замку
Table. 1. The length of animal pawprints of the Medzhybizh castle

Species	The length of the pawprint on the brick sample (mm) (taking into account the drying of the brick by 8%)	Number
Dog (Anterior paw print)	65	6
	76	3
	91	1
Dog (Posterior paw print)	71	1
	72	2
	78	2
	80	1
	110	1
Domestic pig	45	1
	30	2
	50	1
Small hoofed animals (domestic pig, goat, sheep)	30	2
	40	2

The measurements of the tracks obtained reveal the presence of an individual with front paws measuring 65 mm (6 samples), 76 mm (3 samples), and 91 mm (1 sample). Additionally, the measurements of the hind paw tracks indicate the presence of traces in the following dimensions: 71 mm (1 sample), 72 mm (2 samples), 78 mm (2 samples), 80 mm (1 sample), and 110 mm (1 sample).

Based on these findings, it is possible to identify distinct groups of pawprints that may belong to three individual dogs: the first one with front paws measuring 65 mm and hind paws measuring 71-72 mm, the second one with front paws measuring 76 mm and hind paws measuring 78-80 mm, and the third one with front paws measuring 91 mm and hind paws measuring 110 mm.

Based on the dimensions (length) of the dogs' front paws and their association with specific dog breeds used by manufacturers of dog footwear, we have deduced the size of the dogs corresponding to these paw prints. In accordance with our data, a front paw imprint measuring 65 mm is indicative of a dog akin in size to the Beagle breed. Beagle breeds typically exhibit a withers height ranging from 36-50 cm and a weight of approximately 7.7-16 kg.

A dog with a paw print length of 76 mm is comparable in size to the Border Collie breed. Dogs of this breed typically have a height at the withers ranging from 48 to 56 cm and a weight of 15 to 20 kg.

Table 2. Types of animal's paw prints of the Medzhybizh Castle
Таблиця 2. Типи слідів тварин Меджибізького замку

Type of the paw print	Dog	Cat	Small hoofed animals	Pig	Chicken
Single	45	75	9	4	3
Uncovered	7	3	1		
Covered		3			
Overlapping	1	2			

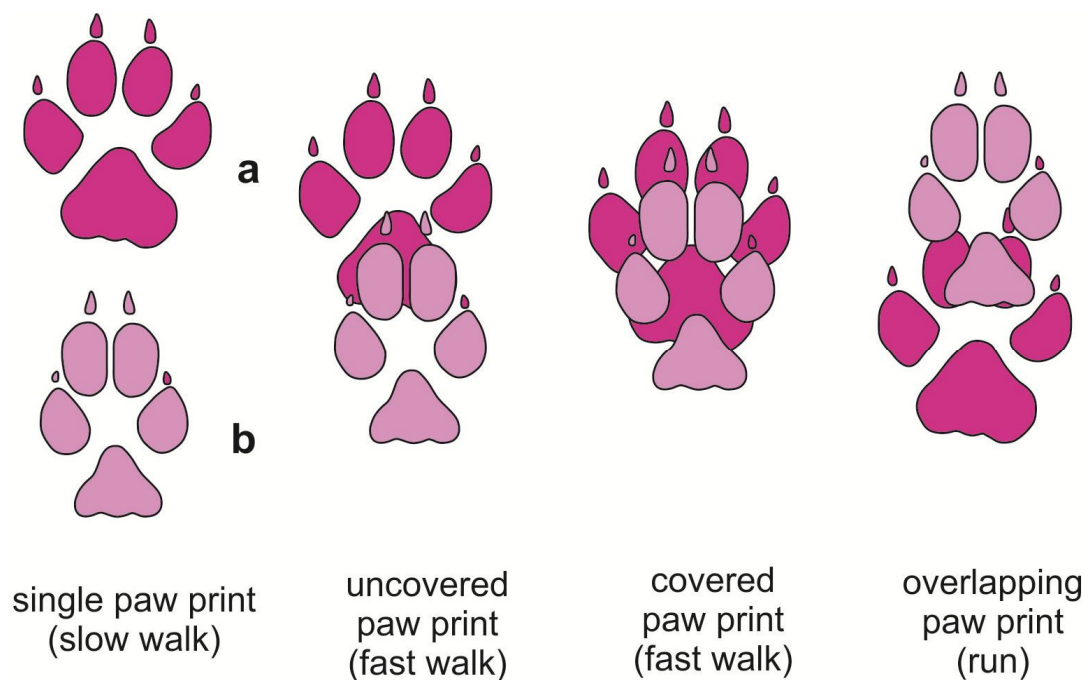


Fig. 4. Types of pawprints on the example of the dog's movement:

a – an anterior paw; b – a posterior paw.

Figure is according to: BlazeVICIUS 2021, figure 4, p. 199.

Рис. 4. Типи слідів на прикладі пересування собаки:

a – слід передньої лапи; b – слід задньої лапи.

Ілюстрація подана згідно: BlazeVICIUS 2021, рисунок 4, с. 199.

The next pawprint supposedly belonged to a Labrador breed dog, characterized by a height at the withers of 54 to 57 cm and a weight of 25 to 40 kg.

In analyzing the composition of brick surfaces, the sequential arrangement of dog tracks provides valuable insights into these animals' movement patterns and speed (refer to Table 2; Fig. 4).

Canines are a species of animals that primarily rely on the pads of their front and hind paws for movement.

“Single” pawprints characterize a leisurely (slow) walking pace. Our examination of bricks from the Medzhybizh Castle revealed 45 single dog tracks.

“Uncovered” and “covered” occur when the hind paw wholly or partially covers the front paw print, indicating a swift gait. Those two track types denote faster movement. The collection at Medzhybizh Castle has been found to include 7 instances of uncovered tracks but no covered tracks.

Furthermore, “overlapping” paw prints, where the hind paw imprint is positioned higher than the front paw print, signify running behavior. Within the collection of examined bricks, we identified a single sample of overlapping paw prints.

The speed of the animal’s movements can indirectly indicate whether the bricklayers intentionally tried to drive the animals away from the brickwork or did not pay particular attention to it.

Cat’s paw prints. The feline tracks are the most prevalent within the examined brick samples, constituting 88 specimens. Their morphological uniformity makes it challenging to ascertain the precise size of the felines relative to the footprints. Single footprints are the most prevalent within the entire sample, totalling 75 specimens, followed by partially covered footprints with 3 specimens, and fully covered cat footprints with 3 traces. This suggests unhindered movement of the felines on the brick surfaces. Notably, in two instances, clusters of cat tracks are situated very close to each other, indicating potential periods of stationary rest for the felines.

Traces of hoofed mammals. The remains of hoofed mammals are also found among the tracks, including four traces attributed to a pig, with distinguishable finger impressions of second and fifth toes. Notably, the pig’s third phalanges are situated in close proximity to the third and fourth toes, distinguishing them from other hoofed ungulates. While the specific species of the remaining tracks remains undetermined, it is likely that they were made by domestic pigs, goats, or sheep. Even after considering their desiccation, the dimensions of the even-toed ungulates track range between 2-4 cm, indicating an association with infant-age individuals. Conventional breeding practices for domestic pigs, goats, and sheep involve birthing newborns during spring to enhance ease of care and sustenance for the cubs throughout the warmer months.

Bird’s pawprints. During the examination of the brick collection, four tracks attributed to domestic chickens were identified, with measurements consistent with those of adult chickens.

Human tracks. During the examination, two bricks bearing human fingerprints were identified. These imprints were left as a result of handling the brick blanks prior to their complete hardening. Furthermore, one of the bricks exhibits a substantial fragment of a human footprint, likely from a shoe.

Discussion

The presence of animal tracks on the brick blanks at Medzhybizh Castle serves as

an indirect indication of the influence of external environmental elements. These tracks likely originate from animals belonging to the brickyard owners or from farms adjacent to the brickyard. It is plausible that animals inadvertently traversed the brick blanks during their free movement. Notably, Dr. P. Blaževičius suggests that the animals may have been drawn to the mineral components of the brick mortar, leading them to ingest small quantities of it. This consumption could potentially have provided the animals with supplementary nutrition containing beneficial substances¹¹.

Scientists M.I. Poroh and S.F. Tataurov suggested that the presence of animal tracks on brick blanks may indicate a form of ritual behavior. This behavior, known as “building bloodless sacrifice”, involves using animal remains or tracks as the foundation of a structure during its construction¹². Traces of similar ritualistic practices, involving the use of animal bones, have been documented in the historical records of Ukraine, specifically in settlements dating back to the early Middle Ages. Notably, S. Horbanenko detailed the discovery of a beaver skeleton beneath the eastern corner of a dwelling at the Volyntsev stage of the Lytvynovichi 3 settlement (located in the Krolevets'kyi district of the Sumy region). Additionally, a beaver jaw, along with astragalus bones (also known as the talus bone) of small horned cattle, were found within the confines of a semi-subterranean dwelling dating from the 10th to 11th centuries, unearthed within Khotyn Castle (castle-fortress situated in Khotyn city, Chernivtsi region)¹³. However, there is no convincing evidence that the animal tracks in the Medzhybizh Castle collection are ritual.

Conclusion

Animal pawprints on ancient bricks, as well as imprints of plants and traces of rain and hail, belong to random signs that indirectly indicate the elements of the surrounding environment of the places of formation and drying of bricks before their firing. This study aimed to demonstrate the informational potential of the animal tracks on brick blanks as a valuable archaeological resource. The analysis of the bricks from Medzhybizh Castle revealed the number of different species of animals that left paw prints, with at least three dogs identified. The size of the tracks allowed us to estimate the approximate size of the dogs. The small size of prints belonging to even-toed ungulates suggests that they were made by infant-age animals, indicating that the brick blanks were likely made during the spring or summer season. The position of the tracks on the bricks gives us insight into the animals' movements, particularly their pace. The findings suggest that there are only a few instances of rapid animal movement on the brick mixtures, which

¹¹ Blaževičius P. Vilniaus miesto sunu pedsaku tyrimai. *Lituanica*. 2021. T. 125, № 3. С. 194–210.

¹² Порох М.И., Татауров С.Ф. Методика исследования кирпичей из археологических памятников русского населения 17 – начала 20 вв. *Вестник Южно-Уральского Государственного Университета*. 2012. Т. 291, № 32. С. 41–44.

¹³ Горбаненко С.А. Домобудування і закладна жертва. *Магія повсякдення давніх слов'ян. Нариси.* / ред. С.А. Горбаненко. Київ, 2022. С. 131–147.

indirectly indicates that the craftsmen allowed animals to be present during the brick-making process.

The findings from the examination of traces on ancient ceramic artifacts have potential practical implications within the realm of museology. Animal paw print bricks are an excellent addition to themed exhibits and a suitable material for hosting workshops.

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