

MYSTERIUM INSOLUTUM

Fragments of Roman Dodecahedrons from Hurbanovo and Chotín¹

Petra Dragonidesová

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Abstract: Curiosity and fascination with mysteries have captivated humanity for eternity. These enigmatic phenomena, encompassing intangible events and tangible artefacts, have fueled our imagination and driven us to seek explanations across diverse disciplines, ranging from science and logic to mythology and the supernatural. One such enduring enigma is the Roman dodecahedron, a twelve-sided object discovered across the Roman Empire. This object's purpose and meaning remain shrouded in obscurity, with no known written references from antiquity. This study delves into this enduring mystery by exploring existing theories and explanations surrounding the dodecahedron's function. Our focus centers on three recently discovered dodecahedron fragments found in southwestern Slovakia. These fragments hold particular significance due to their unique context. Unlike the majority of known dodecahedrons, typically unearthed within Roman territory, these fragments were discovered in Chotín and Hurbanovo (SK), located outside the Empire's borders, within the territory of Germanic settlements. This unique context presents a compelling opportunity to re-evaluate existing theories and explore new avenues for understanding the dodecahedron's purpose and its potential connection to the environment of Germanic tribes.

HISTORICAL BACKGROUND OF RESEARCH

In 1739, the inaugural discovery of a Roman dodecahedron occurred in Aston, Great Britain. According to a report presented by Mr. North to the members of the Society of Antiquaries in London, the unearthed object was described as “*a piece of mixed metal consisting of twelve sides, with an equal number of perforations within them*” (SAL/02/003/117). For nearly three centuries, the enigmatic Roman dodecahedron has captivated the attention of scholars and enthusiasts alike. Over 200 individuals, encompassing both professional historians and dedicated amateurs, have endeavoured to unravel the mystery surrounding its function and intended use. This enduring fascination highlights the object's unique allure and the ongoing quest to understand its role within the Roman world (Guggenberger 2013, 56). The most famous of these was Léopold Hugo – the nephew of Victor Hugo – who can be considered as the pioneer of research in the topic of dodecahedrons (Grüll 2016, 148). The famous French archaeologist and historian Julien de Saint-Venant was the first to write a monograph on this object (1907). Among mathematicians, this mystery was considered worthy of investigation by Moritz Cantor (1829–1920), Ferdinand von Lindemann (1852–1939; Guggenberger 2013, 56) and Benno Artmann (1993; 1996). Despite their association with the Roman Empire, the distribution of dodecahedron finds presents a curious geographical anomaly. While over a hundred examples have been unearthed across Europe, none have been definitively identified within the territories of present-day Italy, Africa, or the former Eastern Roman provinces (Fig. 1). The northernmost piece was found along Hadrian's Wall, and the westernmost object turned up at Fishguard, Wales (Grüll 2016, 148). One of the newer fragments from the dodecahedron, which comes from the village of Deonica, Serbia, is the southeasternmost example (Vujić 2021, 37–40). This conspicuous absence within the core areas of the Roman Empire raises questions about its production and distribution patterns. Dodecahedrons discovered within the western regions of the former Roman Empire are typically dated, based on archaeological context, to the 2nd to 4th centuries AD. However, the majority of these artefacts were acquired through the antiquities market, lacking documented information about their original find circumstances. Consequently, the specific contexts of their discovery remain unknown. Material analysis reveals that these dodecahedrons are primarily composed of copper alloy,

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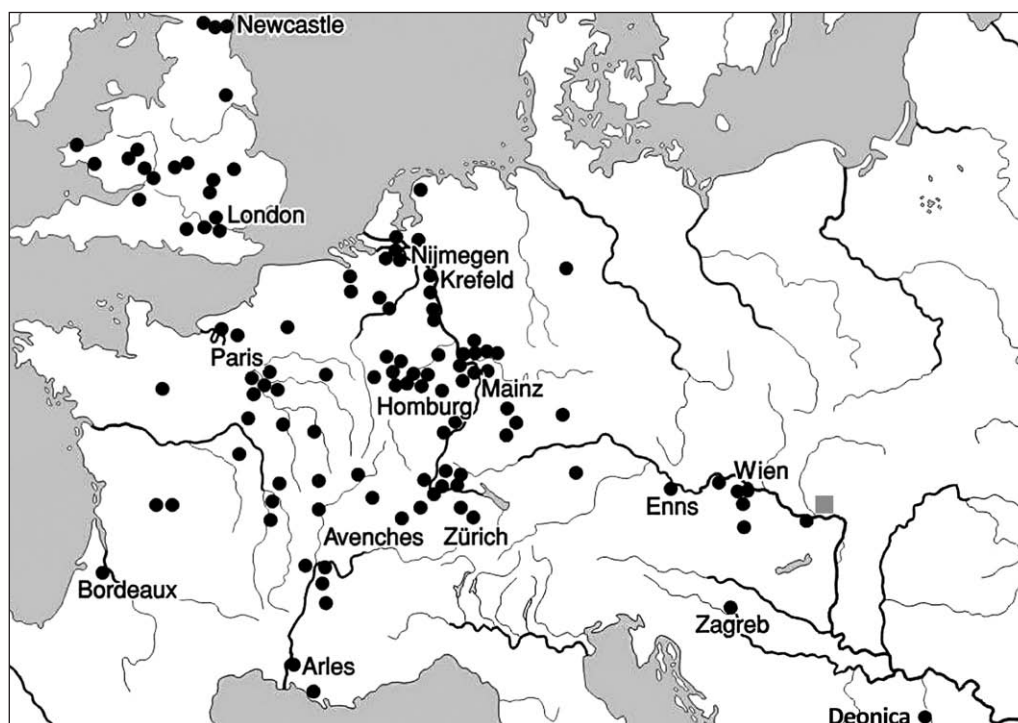


Fig. 1. Distribution map of Roman dodecahedra. Sites Chotín and Hurbanovo are highlighted with gray square (after *Grüll 2016*, 149, edited by P. Dragonidesová).

with bronze being the most commonly identified material (*Grüll 2016*, 148). It must be stressed that most of the finds come from the former north-western Roman provinces centred in Gaul, areas heavily influenced by Celtic traditions (*Guggenberger 2013*, 58). Based on this, some scholars see its significance in the cult sphere as a symbol of the mistletoe (*Nouwen 1993*, 64).

Despite the widespread presence of dodecahedrons, the discovery context remains unknown for the majority of them. Even when contextual information exists, it often fails to shed light on their specific use. These objects have been found in diverse locations, including military camps, public baths, temples, theatres, tombs, wells, and even within a coin hoard (*Grüll 2016*, 151; *Nouwen 1993*, 15). Three riverbed finds found near Nijmegen, Trier, and Zürich potentially suggest a votive purpose (*Grüll 2016*, 151). B. A. Greiner mentions two exemplars coming from Barbaricum (*Greiner 1996*, 14).² Unfortunately, only a limited number of these artefacts have been unearthed through controlled archaeological excavations. One such example is a richly furnished 4th century female grave No. 3040 discovered at the Krefeld-Gellep burial site in Germany (*Pirling/Siepen 2000*, Taf. 153). A dodecahedron was found in proximity to a bone object resembling a handle, but its poor preservation prevented its complete removal and analysis (*Grüll 2016*, 152, 153).

Beyond the Krefeld-Gellep discovery, archaeological excavations have yielded additional insights. At the Noviodunum site in France, a dodecahedron was unearthed within a small building with a cellar, dating to the late 2nd to early 3rd century based on associated coins and pottery (*Grüll 2016*, 153; *Guillier et al. 2008*, fig. 11). Most recently, ongoing research at the Norton Disney site in Britain uncovered another dodecahedron within a structure interpreted as a waste pit. This pit contained various materials, including roofing fragments, pottery sherds, and animal teeth, alongside the dodecahedron (*Brundle 2024*).

DESCRIPTION AND USE OF DODECAHEDRONS IN THE ROMAN WORLD

The Roman dodecahedron exhibits a distinct geometrical form characterized by the following features (Fig. 2). It has twelve pentagonal faces which form the entirety of the object's external surface. The object has thirty edges

² In the list of sites on pages 26–36 of his article, only Hartwerd, located in the present-day Netherlands, is mentioned.



Fig. 2. Roman dodecahedron found at Brigetio, nowadays Szöny (after Kolník 1979, obr. 59).

which are of equal length, contributing to the object's symmetrical construction. Dodecahedrons possess twenty vertices. Each vertex features a raised, spherical projection, adding a decorative element. Each pentagonal face incorporates a circular hole in its center, with diameters varying from 0.6 cm to 4 cm. The object is hollow, lacking internal compartments. The outer surface is smooth, excluding the raised projections on the vertices. In contrast, the inner surface remains rough and unfinished. Dodecahedrons exhibit a range in size, with diameters spanning from 4–11 cm (excluding the projections). Their weight typically falls between 35 and 580 g, with a single documented outlier weighing 1,000 g (Grüll 2016, 148–149). The majority of Roman dodecahedrons exhibit decorative features on their pentagonal faces. These decorations primarily consist of one or more engraved concentric circles surrounding the central hole, hallmarking and parallel lines to the edges of the faces. It is noteworthy that no examples of dodecahedrons

have been identified with any inscriptions, such as letters, numerals, or other markings (Grüll 2016, 150; Guggenberger 2013, 56). However, there are also specimens without any decoration (Nouwen 1993, 12). The fabrication of a Roman dodecahedron necessitates a high degree of technical proficiency, particularly in the realms of geometry and metalworking. Researchers concur that the most likely production method employed a lost-wax casting process, followed by additional shaping techniques such as lathe work or other methods (Nouwen 1993, 17).

In nature, we can find the shape of a natural twelve-sided wall when examining minerals. The mineral pyrite crystallizes into this form (Guggenberger 2013, 57). While the name “dodecahedron” originates from the Greek words “dōdeka” (twelve) and “hédra” (face of a geometrical solid), potentially implying a connection to fire through the Greek word “pyr”, this association appears unfounded. The historical use of “pyrite” for foundations in the Stone and Bronze Ages does not translate to a similar function for dodecahedrons. Therefore, attributing a fire-related purpose to dodecahedrons based solely on this etymological link is unconvincing. Researchers continue to explore various hypotheses regarding the object's function, with candlestick holders being one of many possibilities, but not necessarily supported by the aforementioned connection (Artmann 1993, 52). This theory was supported by researchers in the past because of traces of wax found in one of the examples (Hill 1994, 292). However, it seems illogical to create such an elaborate shape as a candlestick holder, and we can discard this theory. Weiss (1975, 221–224) in addition to his theory on its potential use as a measuring device, posits a thematically similar hypothesis. He endeavors to elucidate the function of the dodecahedron in conjunction with a medieval candlestick holder, contending that the dodecahedron provides an ideal fit for the candlestick holder. However, we must reject this theory due to the apparent incongruity of combining objects from distinct historical periods.

An alternative theory regarding the wax found within the dodecahedron proposes its use as a die, marked with specific symbols on the wax filling. However, the feasibility of this theory is challenged by the uneven weight distribution within the object. Due to the differing sizes of the openings on their faces, the dodecahedra exhibit a tendency to rest on the side with the smallest opening radius (Greiner 1996, 17).

Despite the widespread presence of Roman dodecahedrons, their intended use remains an enigma. No concrete evidence, such as iconographic or written mentions, has been unearthed from antiquity to shed light on their functionality (Grüll 2016, 151). However, the dodecahedron's geometric form has a documented history within the realm of mathematics. Its appearance dates back to around 480 BC, with mention by Hippiasus of Metapontum, a student of Pythagoras (Artmann 1993, 53). Dodecahedron held profound symbolic significance for the Pythagoreans and Platonists. Within their philosophical frameworks, it represented the universe itself. While the four other regular polyhedrons were associated with the four elements (tetrahedron – fire, octahedron – air, icosahedron – water, hexahedron – earth), the dodecahedron served as an all-encompassing symbol representing the universe (Guggenberger 2013, 57, 58). In one of his dialogues, Plato mentions the geometrical shape of dodecahedron: “And seeing that there still remained one other compound figure, the fifth, God used it up for the Universe in his decoration thereof” Pl. Tim. 55c (Lamb 1926).

Modern scholars have proposed nearly fifty diverse theories regarding the dodecahedron's purpose. Notably, the notion of its use as a weapon has been largely dismissed (Guggenberger 2013, 59). Among the more prevalent hypotheses are:



Fig. 3. Twelve-sided beads crafted from gold wire and granules, from Hepu necropolis (after *Zhaoming 2014*, fig. 9).

1. **Measuring instrument:** The dodecahedron's precise geometry potentially lends itself to applications such as rangefinding or astronomical measurements (*Nouwen 1993*, 68; *Sparavigna 2012a*).
2. **Decorative object:** Its unique form and potential decorations might have served a purely aesthetic purpose as an elaborate household item (*Grüll 2016*, 150).
3. **Religious or symbolic object:** Some speculate it may have held religious significance as a cult object or symbolic representation (*Nouwen 1993*, 64–69).
4. **Toy:** The object's shape and size might have facilitated play activities, potentially resembling nowadays a cup-and-ball game (*Grüll 2016*, 150; *Nouwen 1993*, 63). One theory proposes throwing and catching the dodecahedron with a stick, with points awarded for catching it through the smaller hole. The external protrusions, in this scenario, could have served as protective elements (*Nouwen 1993*, 61).

Some researchers have proposed the dodecahedron's use as a scepter pommel (*Nouwen 1993*, 60).

The inconsistent size variations observed in both the dodecahedrons and their central openings render them unsuitable for precise measurements, a key function of a yardstick (*Grüll 2016*, 151; *Nouwen 1993*, 72). Additionally, the absence of any numerical markings or graduations undermines this hypothesis.

However, an intriguing discovery from Geneva in 1982 offers a potential link to celestial studies. This lead dodecahedron, dated to the 4th century, features engravings of the twelve zodiac signs. Considering both the material and decorations, scholars have suggested a possible association with astronomy or astrology (*Nouwen 1993*, 68).

The dodecahedron shape was also known in the Etruscan environment. An example, crafted from soapstone and dated to around the 6th century BC, was discovered at Monte Loffa (*Nouwen 1993*, 14). This dodecahedron might have been used as a die in a game. Each of its faces is decorated with roughly hemispherical carvings, lines or markings (*Sparavigna 2012b*, fig. 2).

The dodecahedron's form extends beyond the Roman world. In southern China, near the city of Hepu, a vast necropolis dating to the Han Dynasty (206 BC–220 AD) through the Southern Dynasties (220–589) has yielded over 1 000 excavated tombs, with estimates suggesting over 10,000 remain (*Zhaoming 2014*, 1229). Believed to be the maritime branch of the Silk Road's home port based on imported finds, these tombs contain twelve-sided beads crafted from gold wire and granules (Fig. 3). Similar finds have been unearthed on the east coast of India, Vietnam, Thailand, and Burma (*Zhaoming 2014*, 1236). This raises intriguing questions: could these dodecahedral ornaments have reached the Roman world through trade, later being imitated as a symbol of far-flung cultural or economic contacts? Alternatively, if not a Roman invention, perhaps these objects were produced and utilized differently by Roman citizens, imbued with diverse meanings and functions.

EXEMPLARS FROM THE SLOVAK AREA

Three fragments, likely originating from two separate dodecahedrons, have been discovered in southwestern Slovakia, all crafted from a copper alloy (Fig. 4). The larger fragment was unearthed during surface exploration near the village of Chotín, specifically in the "Pri ošipárni" area. Chotín has been at center of archaeological

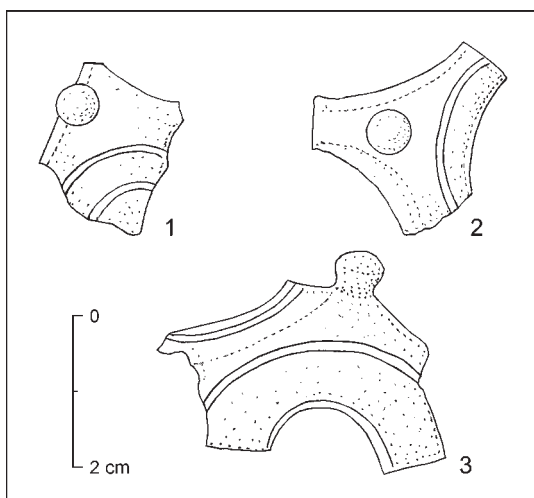


Fig. 4. Drawings of dodecahedra fragments. 1, 2 – Hurbanovo; 2 – Chotín (drawing by J. Marettová, edited by P. Dragonidesová).

focus since the 1950s, with ten archaeological sites documented within its boundaries (Chotín I to X) spanning the prehistoric to medieval periods (*Rajtár/Kolníková/Kuzmová 2017*, 173; *Ratimorská 1979*, 36, 45, 46). Since the 1990s, systematic surface surveys have been conducted in Chotín, yielding significant evidence of intensive settlement activity, particularly during the Roman Period (*Ratimorská/Žundálek 1992*, 101, fig. 63: 9, 11, 12). These surveys have identified a portion of a Germanic settlement containing multiple residential and economic structures within a relatively extensive area (*Rajtár/Kolníková/Kuzmová 2017*, 173).

Intensive settlement activity has been documented in Chotín, with aerial surveys revealing that the settlement encompassed an area of approximately 5 km² (*Blažová/Kuzma/Rajtár 2000*, 38). Its origins date back to the late 1st century BC at the latest, followed by a significant expansion during the 2nd century. Evidence suggests that the local Germanic population maintained close ties with the nearby Roman world during this Period. This is supported

by the presence of artefacts like glass fragments, Roman-provincial pottery, and Terra sigillata. This interaction was likely influenced by the settlement's strategic location, situated only 6 km from the Roman border on the Danube River, where the Roman fort of Iža stood within the vicinity of Brigetio (*Rajtár/Kolníková/Kuzmová 2017*, 174). Further evidence indicates that the Germanic settlement persisted in Chotín throughout the 3rd and 4th centuries, with numerous 4th century coins being unearthed (*Rajtár/Kolníková/Kuzmová 2017*, 176, 180, 184). These findings, alongside other artefacts, suggest that the settlement remained inhabited even during the early 5th century, a period marked by significant population migrations (*Rajtár/Kolníková/Kuzmová 2017*, 184).

Similar to Chotín, the present-day town of Hurbanovo, situated in close proximity, also boasts a dense settlement history spanning from the prehistoric period to the Middle Ages. The first indications of extensive settlement activity in Hurbanovo came to light in 1988 during gas pipeline relocation trench inspections and a subsequent survey in 1991. Subsequent systematic collections at the site unearthed a substantial amount of artifacts, primarily dating to the Roman Period. These finds encompass a significant number of Roman coins and fibulas, alongside ceramic materials like Germanic and Roman provincial pottery, and fragments of Terra sigillata (*Rajtár 2004*, 145). Mirroring the approach in Chotín, the Hurbanovo site also underwent aerial surveys (*Hanzelyová/Kuzma/Rajtár 1995*, 55). The earliest evidence of settlement at the site is demarcated by a coin minted during the reign of Emperor Nero in 65 AD. The latest datable artefacts suggest the abandonment of this settlement occurred during the early 5th century AD (*Rajtár 2008*, 168).

Description of finds

Finds from Hurbanovo (Fig. 4: 1, 2): Two small slightly deformed fragments, likely originating from the same dodecahedron, were unearthed in 2002 during surface exploration. Both fragments represent sections where three flat faces of the dodecahedron converged. Each fragment features a single raised, spherical protrusion at its apex. Traces of decoration, consisting of multiple concentric circles, are visible on the better-preserved sections of the faces.

Fragment from Chotín (Fig. 4: 3): A third dodecahedron fragment represents a corner section where three flat faces met. A raised, spherical protrusion is preserved on the outer aspect of the corner. The fragment exhibits slight deformation. The best-preserved face reveals a portion of the original circular hole, bordered by a single engraved line near its edge. The hole's estimated diameter is approximately 1.4 cm.

The closest geographically similar artefact of this type (Fig. 2) originates from the vicinity of present-day Szőny-Brigetio, Hungary. This dodecahedron, with a maximum diameter of 7.2 cm, is interpreted by T. Kolník as a "mysterious magical-cult or measuring object". It is currently housed in the Danube Region Museum in Komárno, Slovakia (*Kolník 1979*, 109, obr. 59).

THE SIGNIFICANCE OF DODECAHEDRONS IN BARBARICUM

The function and meaning of dodecahedrons in societies beyond the Roman world remains challenging to decipher. While the exact purpose of these objects within the Roman sphere remains unknown, evidence suggests that barbarian communities utilized them differently. This hypothesis is supported by the state of preservation of the dodecahedron fragments discussed in this paper. The broken and fragmented nature of these finds suggests intentional modification for secondary use as raw material. This practice finds parallels in discoveries like the Zohor settlement at the Piesky site, where fragmented bronze objects prepared for melting and repurposing were unearthed (Elschek 2002, 245, 246).

Due to their relative scarcity, the dodecahedron fragments likely reached barbarian hands through one of two potential routes:

- Raiding Expeditions: Germanic tribes may have acquired these items during raids on a Roman military camp in Iža or legionary camp in Brigetio and its surroundings, e.g. *canabae legionis* or *vicus*.
- Post-Destruction Recovery: Alternatively, the barbarians living in nowadays areas of Chotín and Hurbanovo might have retrieved the objects from the Roman fort at Iža following its destruction in 179 AD (Daňová 2021, 25). This hypothesis suggests they scavenged the site for valuable or usable items, potentially including the dodecahedron. Consequently, we may anticipate the presence of a metalworking area within the settlements located in Chotín or Hurbanovo. Such an area might resemble the metalworking workshops previously identified in the Barbaricum of the Middle Danube Region. For instance, we may mention the workshops discovered in Stupava (Turčan 1985, 114), Cífer-Pác (Cheben/Ruttkay 1995, 68) and Pasohlávky (Tejral 2006, 134–141, 164; 2015, 68).³ In all these cases, a common prerequisite for the establishment of a metalworking workshop appears to be the accessibility of bronze raw material from Roman military or civilian settlements. It is further speculated that the fragments of dodecahedron from Chotín and Hurbanovo might have reached the Iža camp from the nearby Brigetio military camp, mirroring the origin of another dodecahedron example currently housed in the Danube Region Museum, Komárno (Kolník 1979, 109).

CONCLUSIONS

The dodecahedron, a complex geometric object with twelve faces, has intrigued scholars and historical enthusiasts for centuries, particularly in its appearance within the Roman world. The precise purpose and significance of Roman dodecahedrons remain shrouded in mystery. Despite a lack of specific written references and missing definitive evidence of their function, scholars have proposed various possibilities. Some hypothesize a practical application, suggesting its use as a measuring tool (Sparavigna 2012a), a gaming device (Grüll 2016, 150) or even a religious object (Nouwen 1993, 64–69). Others posit a more symbolic role, potentially associated with astronomy or astrology (Hill 1994, 292). The presence of dodecahedrons in diverse contexts, including military camps, hoards and even tombs, further complicates the task of identifying a single, unifying purpose.

It is conceivable that a single dodecahedron might have served multiple purposes depending on the context. For instance, research suggests that a dodecahedron discovered in a female grave at Krefeld-Gellep may have been used as a scepter imbued with protective powers (Grüll 2016, 155). Researchers further propose a potential connection to astrology or divination based on the twelve holes, potentially representing celestial bodies (Sun, Moon, planets, stars). Without signs, marks and characters they cannot be unambiguously identified with them (Grüll 2016, 155; Hill 1994, 292). Alternatively, T. Grill suggests its use as an amulet, albeit acknowledging the impracticality of wearing such a complex object (Grüll 2016, 155). While the limited number of known dodecahedrons suggests exclusivity, readily available materials likely prevented them from being exceptionally rare (Guggenberger 2013, 60). However, we can assume that their costly production process indicates they were not considered common items.

These intriguing finds from Hurbanovo and Chotín highlight the complexity of interpreting Roman artefacts within Germanic contexts. Further investigation and analysis, alongside comparisons with dodecahedron discoveries from other locations, are crucial for understanding their potential use and significance. By incorporating archaeological context, historical knowledge of Germanic societies, and detailed analyses of the fragments themselves, researchers can strive towards a more comprehensive understanding of these captivating artefacts and the interactions between the Roman and Germanic worlds.

³ For additional information on workshops and artifacts related to metalworking in this region, read Bazovský 2009, 433–438.

The Roman dodecahedron compels us to acknowledge the limitations of our knowledge while simultaneously inspiring continued exploration. It is important to acknowledge that none of these mentioned theories have been conclusively proven, and the true purpose of the dodecahedron remains an ongoing subject of scholarly investigation.

Translated by author

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Mysterium Insolutum

Fragmenty rímskych dodekaedrov z Hurbanova a Chotína

Petra Dragonidesová

Súhrn

Fascinácia neznámym a snaha o objasnenie záhadných fenoménov sú neoddeliteľnou súčasťou ľudskej histórie. Zvedavosť a túžba po poznaní podnecujú človeka k hľadaniu odpovedí na nevysvetliteľné otázky v rozličných sférach, siahajúcich od rôznych vedných disciplín až po mytológiu a náboženstvo. Jednou z týchto dodnes nevysvetliteľných záhad je rímsky dodekahedron, objekt s dvanástimi stenami zhotovený predovšetkým zo zliatiny medi, ktorého nálezy sú známe z rozsiahleho územia Rímskej ríše. Napriek množstvu teórií a dodnes objavených exemplárov, ktorých počet neustále stúpa, zostáva jeho primárna funkcia a význam stále zahalený tajomstvom, bez vysvetlenia zo starovekých písomných či ikonografických prameňov. Príspevok zahŕňa aktuálne najdôležitejšie teórie a možné vysvetlenia týkajúce sa funkcie dvanáststeny. Hlavným cieľom štúdie je predstavenie troch fragmentov z jedného alebo viacerých dodekahedronov objavených v priestore barbarika, v okolí významných germánskych sídlisk lokalizovaných v dnešnom Chotíne a Hurbanove na juhozápade Slovenska. Vďaka jedinečnému nálezovému kontextu majú tieto fragmenty osobitný význam. Na rozdiel od väčšiny známych dvanáststenov, ktoré boli objavené na území Rímskej ríše, musíme uvažovať o tom ako, kedy a prečo sa tieto fragmenty do prostredia mimo hraníc Impéria dostali. Nové nálezy zlomkov dodekahedronov poskytujú príležitosť na zhrnutie a posúdenie existujúcich hypotéz a formulovanie nových teórií napomáhajúcich k pochopeniu účelu dvanáststeny. Unikátny nálezový kontext taktiež poskytuje možnosť hľadať odpoveď na význam ich výskytu v prostredí germánskych kmeňov.

Obr. 1. Mapa rozšírenia rímskych dodekahedronov. Lokality Chotín a Hurbanovo sú vyznačené sivým štvorcikom (zdroj *Grüll 2016*, 149, úprava P. Dragonidesová).

Obr. 2. Rímsky dvanáststen nájdený v Brigetiu, dnes Szöny (zdroj *Kolník 1979*, obr. 59).

Obr. 3. Korálky v tvare dvanáststenov vyrobené zo zlatého drôtu a granuliek z Hepu necropolis (zdroj *Zhaoming 2014*, fig. 9).

Obr. 4. Nákrsky fragmentov dodekahedronov. 1, 2 – Hurbanovo; 3 – Chotín (kresba J. Marettová, úprava P. Dragonidesová).

Mgr. Petra Dragonidesová, PhD.
Archeologický ústav AV ČR, Brno, v. v. i.
Čechyňská 363/19
CZ – 602 00 Brno
dragonidesova@arub.cz
dragonidesovapetra@gmail.com
<https://orcid.org/0000-0002-6131-5167>