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Cover: Selected artefacts of the Bauer collection (see Péntek, 2024). Compiled by Attila Péntek.

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RESEARCH ARTICLE

Lithic projectile points from Mexico of the collection at the Museum of Ethnography in Budapest

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Abstract. The America Collection of the Museum of Ethnography in Budapest houses two smaller lithic assemblages. These assemblages, in addition to various chipped stone tools mostly made of obsidian, also contain bifacially manufactured projectile points. According to the available data, the smaller assemblage originates from San Juan Teotihuacan (Mexico State, Central Mexico). The exact origin of the larger assemblage is unknown, but indirect evidence suggests that it comes partly from the area of Teotihuacan and partly the Oaxaca Valley (Oaxaca State, Southern Mexico). This paper reviews the projectile points that can be analysed with sufficient certainty based on the typology lists available to the author.

Keywords: Mesoamerica, Mexico, Teotihuacan, projectile points, obsidian, Museum of Ethnography in Budapest

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1. Characterisation of the projectile points

This paper reviews projectile points of two small assemblages in the America Collection of the Museum of Ethnography in Budapest, that could be analyzed with sufficient certainty based on several available typology lists. To infer the probable age of the projectile points, it was necessary to take some measurements on the artefacts and then to carry out an elementary mathematical statistical analysis of the measured data.

For the measurement of the basic artefact dimensions, the "box method" was used (Debénath & Dibble, 1994, p. 19). The maximum length is the distance from the point of percussion to the distal end perpendicular to the striking platform width, following the axis of percussion (the debitage axis *sensu* Inizan *et al.*, 1999, p. 138). Maximum width is taken at the widest point perpendicular to the length axis, and maximum thickness is recorded at the thickest point along the third dimension. Hereinafter, the measured maximum dimensions will be referred to in short form, only as length, width, and thickness.

Since most of the studied projectile points are stemmed, geometric morphometric measurements after Okumura & Araujo (2014) was applied to record the varibable morphology of the stems. In this paper, five Type-2 landmarks (Bookstein, 1990b) were located manually to analyze the shape of the projectile points (Okumura & Araujo, 2014, p. 62, Fig. 3): (A) the apex of the body in the longitudinal line (distal end), also defined as the junction of the two lateral edges, (B) the most extreme point of the stem in the longitudinal line that divides the tool into two symmetrical halves, (E) the most extreme point in the shoulder curve, (G) the meeting of the lateral and the basal parts of the stem, and (H) the point where the neck meets the body (notch). Traditional morphometrics was used to complement information retrieved by geometric morphometrics. The following seven linear measurements were taken with a steel calliper accurate to 0.1 mm: body length (AB), stem length (BC), body width (DE), stem width (FG), neck width (HI), neck thickness (measured at C) and body thickness (letters refer to Okumura & Araujo, 2014, p. 62, Fig. 3). Whenever it was possible, the attribute nomenclature proposed by Mentz Ribeiro & Hentchke (1976) was used (Okumura & Araujo 2014, p. 64, Fig. 5). Okumura & Araujo assumed that the stem-related attributes tend to be less related to point performance (Lipo *et al.*, 2010). On the other hand, attributes such as edge and shoulder shape, weight, length, width, and thickness can be considered much more relevant in the ballistic aspects of the points. The range, mean, standard deviation, and coefficient of variance of all measurements were calculated. Standard deviation is a good measure of the relative homogeneity in the measured attributes. The coefficient of variance, which is defined as the ratio of the standard deviation to the mean, shows the extent of variability in relation to the mean of the population.

2. Functional classification of projectile points

2.1. The use of dart-thrower in Mesoamerica

In Mesoamerica, dart-thrower (*atlatl*) use is inferred since the Palaeoindian period. Unambiguous proof of atlatl used by Archaic-period hunters *ca.* 5,400–7,000 years ago (in the El Riego phase in the Tehuacán Valley chronological sequence) comes in the form of a rare, preserved wooden atlatl recovered during excavations of the Cueva del Coxcatlán rock shelter in the Tehuacan Valley (eastern Central Mexico) (MacNeish *et al.*, 1967, pp. 150–151). During the excavations, some finely chipped, contracting-stemmed, concave-based projectile points and atlatl weights were also unearthed.

Recently, Garduño Arzave (2008) dealt with the issue of offensive weapons in Mesoamerica. In his detailed study, he made an archaeological, historical, symbolic and technical analysis of some weapons of war represented in Mesoamerican art.

The two greenstone effigy atlatls in the collection of Dumbarton Oaks, although lacking secure archaeological context, have been attributed to the Olmec horizon based on the quality of both the stone and its workmanship (Finegold, 2017, p. 224). Taube (2004, pp. 150–151) suggested that these objects were not intended as functional weapons but rather as ceremonial markers of status.

Slater (2011, pp. 373 *ff*) considered it possible that the use of the dart-thrower was a component of the ceremonial material culture of the Olmec horizon. Likely, the earliest depiction appears to be the unprovenanced Humboldt Celt, which has been attributed to the Middle Formative period (Justeson, 1986, pp. 442–443, Figure 3.d). Depicted objects, which cannot be unquestionably interpreted as dart-throwers are known from the Formative period at Chalcatzingo in the Valley of Morelos, in the Central Highlands of Mexico (Grove, 1968, p. 488, Fig. 3) and Tlatilco in the Valley of Mexico (Field, 1967, p. 28, Figure 25, p. 29, Figure 29). An early greenstone figurine from Oaxaca in the Peabody Museum of Archaeology and Ethnology at Harvard might depict the earliest reasonably-dated representation of a dart-thrower. The figurine is incised with an image of a person dressed as a monkey who carries a pair of darts in one hand, and a dart-thrower is grasped through two finger holes in the other hand. Both the figurine's structural appearance and its incised decoration are consistent with securely dated objects from the end of the Middle Formative to the beginning of the Late Formative periods (approximately 400 BC). A dart-thrower might also appear on Stele D of the epi-Olmec period at the site of Tres Zapotes, which depicts three figures. The right-hand figure can be seen carrying an object in his left hand. The object, which may be an atlatl, consists of dangling elements and a possible finger loop.

Slater (2011, p. 375) mentioned numerous examples representing spiritual entities and/or impersonators wielding dart-throwers at Teotihuacan (Headrick, 2007, pp. 126–127, Figure 7.2; Taube, 2000, p. 274). Warfare was a significant component of Teotihuacan ideology, and "*One of the most visible and diagnostic traits of a warrior was a bundle of darts and an accompanying atlatl* …" (Headrick, 2007, p. 72).

Gazzola (2014, p. 233) wrote that no bow is represented in Teotihuacan art. For this reason, most researchers believe that the bow was not used at Teotihuacan and that it is a later invention attributed to Epiclassic groups. Ciofalo (2012) refers to suggestions regarding the overlapping histories of atlatl and bow in the Maya region

(Aoyama, 2005). Aoyama (2005, pp. 299–300, Fig. 4c) described a corner-notched prismatic blade point made of green obsidian from Copan, from the Early Classic period. Such prismatic blade points made of Pachuca green obsidian from the volcanic centre Sierra Las Navajas (Hidalgo State, Central Mexico) were present in the Oaxaca Valley at the beginning of the Middle Formative period (Parry, 1987, pp. 42–43). The presence of a stem from Copan indicates that the point was attached to the end of a shaft, consequently, the point may have been used as an arrowhead. Aoyama concluded that the bow and arrow would have existed in the Maya Lowlands earlier than has been previously suggested (AD 450–620). It has been suggested that since the atlatl was considered a symbol of power, the Maya iconography highlighted the atlatl more than the bow-and-arrow (Ciofalo, 2012; Freidel, 1986; Kaneko, 2009; Slater, 2011).

2.2. Arrowhead versus dart point

Different techniques have been developed to classify projectile points as either darts or arrowheads.

According to Shott (1993, p. 425), the distinction is important because "*the economic and broader cultural consequences of the presumed shift* [from atlatl to bow] *are thought to be profound*". The developed technique to distinguish the projectile points can be divided into two groups.

The first group of techniques (Ames *et al.*, 2010; Bradbury, 1997; Shott, 1997) uses functions derived from discriminant function analyses on either ethnographic or archaeological specimens whose propulsion system was known. The discriminant functions were revisions of Thomas's (1978), which was applied to a large sample of projectile points. The second group of techniques (Hildebrandt & King, 2012), on the other hand, considers a threshold value of a given linear measurement to distinguish arrowheads from dart points.

Fenenga (1953) and Hughes (1998) set a threshold value of 3 g, points weighing 3 g or more would be considered as darts and those weighing less than 3 g would be classified as arrows. As VanPool (2006, p. 437) discusses, such limit value was based on the physics of projectile flight.

According to the criteria of Rivera *et al.*, (1989, cited by Gazzola, 2014, p. 232, Footnote 6), an arrowhead would be between 1.0 cm and 4.5 cm long and up to 4.5 g in weight; from 4.5 cm to 6.0 cm and from 4.5 g to 8.0 g, the object would be a dart point, while the spear point would have a length between 7.0–20.0 cm, and a weight of 8.0–17.0 g.

Following the work of Delacorte (1997), Hildebrandt & King (2012) proposed a simple dart-arrow index. They found that the most accurate approach was to add neck width to the maximum thickness and to use this single index value to make the distinction, with a threshold value of 11.8 mm. The dart-arrow index tends to increase with the overall size of the tool, and provides a good proxy for the original size and weight of fragmentary projectile points, as both attributes are usually preserved if the item is complete enough for a typological assignment. Artefact reworking can significantly alter the morphology of projectile points. As the experiments of Flenniken & Raymond (1986) showed, neck width and maximum thickness were minimally altered by rejuvenation when compared to other attributes, especially weight, perimeter, and those used to generate tip area. Charlin & González-José (2012, p. 233) concluded that the reduction affects mainly the shape of the point tip, while regions such as the neck and stem would be less affected. The dart-arrow index was applied to a large collection of projectile points from the northwestern Great Basin (USA), and it successfully distinguished between the two technologies.

Okumura (2015) used the technique proposed by Shott (1997) on projectile points associated with the Umbu Tradition in southern and southeastern Brazil. The results of the analysis were not unequivocal enough. The projectile points were analyzed also by Okumura & Araujo (2015). Several techniques were applied to differentiate between them. Although the results using the threshold by Hildebrandt & King (2012) are very similar to the ones obtained using the functions by Bradbury (1997), the results as a whole was contradictory. According to the authors, the results possibly referred to a very specific dart technology whose points were smaller than expected. Another possibility would be the independent invention of archery technology during the Pleistocene–Holocene transition in eastern South America (*c.f.* Owen, 1998). And it should be also taken into account the possible coexistence of the two technologies in many places in America after the introduction of the bow and arrow over a long period (Chatters *et al.,* 1995; Fawcett, 1998; Kennett *et al.,* 2013; Massey, 1961; Nassaney & Pyle, 1999; Railey, 2010; Shott, 1997; VanPool, 2006; Walde, 2013).

The technique suggested by Hildebrandt & King (2012) has been criticized by some scholars (Walde, 2013), and it is necessary to draw attention to the statement of Erlandson *et al.,* (2014, p. 168), that "*archaeologists should continue to be cautious in interpreting the specific function of projectile points based on size or morphology alone, especially in coastal or other aquatic settings.*", particularly when there is no detailed data on cultural contexts, faunal remains, use-wear, among others.

3. Typological remarks on the characteristics of Central Mexican stemmed projectile point

Chipped stone tools from different areas of Mexico representing different archaeological ages have a significant amount of literature (Parry, 1987; 1990; 2014; Darras, 2008; 2012; Vázquez, 2009; Castillo Bernal, 2014; Pérez & Moreno, 2017**).** In Fig. 1, some of the archaeological sites mentioned in the text and the main obsidian sources can be seen.

The pressure-flaked projectile points are likely the most characteristic Native American chipped stone artefacts. According to John C. Whittaker, the manufacturing sequence of making complex flaked stone tools, such as several bifacials, usually proceeds through the same sequence of hard-hammer, soft-hammer, and pressure work. Pressure flaking is a controlled form of flaking by the use of pressure *via* a pressure tool to fracture raw material and remove a flake from a core. It involves a different form of force application; the pressure is applied with the fine-pointed end of a tool made of wood, antler, or bone. With the pressure flaking technique, a more detailed shaping of lithic tools and making sharper tools can be achieved (Crabtree, 1972, pp. 14 *ff*; Whittaker, 1994, pp. 127 *ff*).

Knight (2019) dealt with the political, economic, or ideological role or impact of Cantona in the Mexican highlands during the Early Classic period. Cantona is located at a distance of about 150 km to the east of Teotihuacan, in the Cuenca Oriental of eastern Puebla at the edge of the central Mexican highlands. The economic basis of the city was the control over the extraction and initial reduction of obsidian, followed by the long-distance exchange of obsidian polyhedral cores and prismatic blades (García Cook & Merino Carrión, 1998, p. 210). The obsidian source area thought to have been controlled is the Zaragoza-Oyameles area, located 13 km to the north. From 2012 to 2014 intensive field survey and surface collection has been carried out that resulted in the collection of many obsidian projectile points. Among the collected projectile points, some were similar in outline to the Early Classic, central Mexican points identified at Teotihuacan as Stemmed-A and Stemmed-B by Spence (1996, Fig. 2b, 2a), corresponding to Tolstoy's (1971, Fig. 2, x, y; z) Shumla B and Shumla A types. Tolstoy identified the Stemmed-B (Shumla A) style as most common in the Teotihuacan II period (*ca.* AD 1–350). According to García Cook (1967, p. 64, Lám. 11, 5–6; p. 137, CUADRO N° 30), the Stemmed-B (Shumla A) point style was most common in the Basin of Mexico throughout the Classic period ("*Período II*"; AD 350–1,100). In the point typology of Sarabia (1996; referenced in Gazzola, 2014, p. 227, Fig. 9), these point styles are classified within the Family C.

According to numerous scholars (Carballo, 2011, pp. 133–145, pp. 159–163; Parry, 2014, p. 292; Sugiyama, 1989) at Teotihuacan, the Stemmed-A and Stemmed-B style projectile points are closely associated with the military and elite. Carballo (2011, pp. 87 *ff*), stated that the collection of blank and preform fragments is particularly well suited to establishing a sequence model of the dart point reduction sequence (for example, Bradley, 1975). Partly following Spence (1981), Carballo described in detail the production process of dart points. Based on this model, "*during the late preform stage, the point was finished through pressure flaking a stem and overlapping fine transverse-parallel flakes along the edges and faces (Figures 5.20-5.22). … the pressure scars running from the lower left to lower right margin across the point face. …*". The obsidian offerings proceed from the two burials (Burial 190 and Burial 203), dedicated to the *Old Temple of Quetzalcoatl* at Teotihuacan consisted of numerous "angular notch" points according to the classification of García Cook (1967). The points differed only slightly concerning tip, shoulder, and notch form; the manufacture and retouching techniques were practically the same (Sugiyama,

Fig. 1. Some archaeological sites and obsidian sources in Central Mexico. Compiled by the author.

1989, pp. 93–97, Fig. 10). Parry (2014, pp. 292–293, Fig. 10.4) represented a set of extremely finely flaked projectile points from the Burial 3 of the *Moon Pyramid* in Teotihuacan (Terminal Formative period).

Less finely made versions of these points styles have also been found in the domestic context at Teotihuacan. Hernández (1993, p. 404, p. 409, Fig. 292a, b, c) represented some specimens made of opaque grey obsidian recovered in the Oztoyahualco compound. According to Hernández, at Teotihuacan, the most popular offensive weapons were the throwing weapons (dart thrower), with Shumla- and Gary-type projectile points. At Cantona, a single Stemmed-A point made from green obsidian was recovered during site excavations (Knight, 2019, p. 248).

Spence (1996) and Knight (2019, pp. 247–248) listed several Mayan centres, at which finely made points of these styles, made of central Mexican obsidian have been recovered from burials and caches. At Mirador (Chiapas State, southern Mexico), Spence mentioned the presence of nine bifacially worked, stemmed points of green obsidian (Spence, 1996, p. 23, 25, Fig. 2a; referring to Agrinier, 1970, Fig. 52, no. 9–13). Based on the raw material, the form, and the workmanship, they were manufactured at Teotihuacan. These specimens correspond to the Stemmed-B type. The other three specimens were of the related Stemmed-A type (Spence, 1996, p. 23, 25, Fig. 2b; referring to Agrinier, 1970, Fig. 52, no. 14, Fig. 86, no. 18). The Stemmed-A type, the most common type at Teotihuacan, is quite variable in size and proportions. The much less common Stemmed-B type is more uniform. At Tikal (Guatemala), Moholy-Nagy *et al.* (1984) identified several specimens in terms of Tolstoy's (1971) typology; four Stemmed-A points are among those illustrated (Moholy-Nagy *et al.*, 1984, p. 112, Fig. 3b, g–i). The analysis of the lithic artefacts suggested that most of the grey obsidian points or knives found at Tikal were Central Mexican products. At Altún Ha (Belize), an extensive array of green obsidian artefacts were from a Teotihuacan-related source, but possibly not from the centre itself (Pendergast, 2003, pp. 238–240, Fig. 9.1–9.2). Most of the thirteen bifacially worked projectile points were of the Stemmed-A type (Pendergast, 1990, Fig. 121f, h, j; 2003, p. 240, Fig. 9.2). Chase & Chase (2011, pp. 10–11, Fig. 5) reported the presence of six projectile points made of green obsidian in a special deposit from Caracol (Belize). It was suspected that these spear points were still attached to their shafts and were used to poke or stir burning fire during cremation. This accounts for the deformed tips and warped and discoloured bodies. Braswell (2013, p. 164) mentioned the presence at Uxul (Campeche State, Mexico) of several green Pachuca obsidian artefacts from the central Mexican source. Two bifaces have been assigned to the Otumba source, and one of them had patterned flake scaring diagnostic of central Mexican manufacture. These two artefacts came to Uxul from the Teotihuacan region during the late Early Classic period. In Calakmul (Campeche State, Mexico), one of the fragmentary small bifaces made of Pachuca obsidian exhibits the patterned flaking typical of bifaces produced in the Mexican highlands. The Mexican-source bifaces might have been brought to Calakmul as finished artefacts, and as they broke, they were reworked and curated by local artisans. The prismatic blade point, made of green Pachuca obsidian, has a small stem, and artefacts of this type were almost certainly projectile points (Braswell & Glascock, 2011, pp. 126–127, Fig. 10.8). At Balberta (Pacific coast of Guatemala), Bove & Medrano Busto (2003, p. 50) reported a large number of green Pachuca obsidian. Ten green obsidian projectile points were made in Teotihuacan style. Five were recovered from the ritual area of Balberta and the remainder from either residential or other ritual contexts within the site core. Spence (1996, p. 26, after Kidder *et al.*, 1946, p. 138, Fig. 157c, 168e) referred to seven finely worked Stemmed-B points from Tomb A-V at Kaminaljuyú, (Guatemala) similar to those from Mirador. Eight complete and one partial stemmed points of green obsidian were found in Tomb B-I (Kidder *et al.*, 1946, p. 31, 138), but they were neither illustrated nor described. It can be determined from the report that they were stemmed, from green obsidian, relatively uniform, and not as finely worked as the Tomb A-V specimens.

The characteristics of finely flaked projectile points are bifacial symmetry, thinness, and pressure flaking of both faces. The vast majority of central Mexican fine points exhibit diagonal pressure flaking from the lower left to the upper right on each face (Knight, 2019, p. 250, Fig. 8.5b). The pattern seems to be typical of the Early Classic period projectile points at Teotihuacan, recovered from the *Moon Pyramid* (Carballo, 2011, p. 107, Fig. 5.20, p. 159, 7.1) and the *Feathered Serpent Pyramid* burials (Sugiyama, 1989, p. 97, Fig. 10). At the Classic period Maya site of Caracol, all illustrated green obsidian points from elite caches have the lower-left-to-upper-right pattern (Chase & Chase, 2011, pp. 10–11, Fig. 5). In the examples recovered from Zaragoza-Oyameles, all Stemmed-A and Stemmed-B style points exhibit the attribute of fine flaking, but they are marked by an upper-left-to-the-lower-right diagonal flaking pattern (Knight, 2019, p. 250, Figure 8.5a).

Finally, a brief reference should be made to Hester's publication (1986). Concerning the projectile points, Hester drew attention to the misinterpretation of the "Texas typology" (Suhm & Krieger, 1954; Suhm & Jelks, 1962) in different areas of Mesoamerica. At the same time, Hester noted that certain useful efforts to define point types with regional significance in Mesoamerica and its peripheries had also been made by some scholars (for example, Spence, 1971). Hester criticized particularly sharply the publication of Moholy-Nagy *et al.* (1984), where Texas-type names (Gary, Shumla, Livermore-like, Kent) had been applied to obsidian points of various Maya periods. Kelly (1993), who wrote on preceramic projectile-point typology in Belize, concluded that the Belize Archaic Archaeological Reconnaissance (BAAR) projectile-point typology was so badly flawed that the hypothetical chronology was without merit. The comparison of the preceramic points with Preclassic through Early Postclassic Maya points shows a sharp discontinuity between preceramic and Maya point types. There were no shared morphological attributes.

Muñoz Espinosa & Castañeda Reyes (2002; 2017) analysed and described surface-collected projectile points from several sites of the Sierra Gorda (Querétaro State, northern Mexico). During the analysis, the authors applied the classical typology lists of Suhm & Krieger (1954) and Turner & Hester (1993). The reason for this choice was mainly that possible contact between Mesoamerica and cultural areas of North America, especially with the hunter-gatherer groups that inhabited the current territory of Texas, had been pointed out by scholars (MacNeish, 1947, p. 11). This projectile point-making tradition could have reached the Sierra Gorda through the Sierra Madre Oriental (northeastern Mexico) and the Gulf Coastal Plain. The authors reported the presence of several Palmillas-type points. García Cook (1967, pp. 62–64, Lám. X, no. 21–22) placed these points in his "Family V: Muescas angulares". According to Turner & Hester (1993, p. 167), these are small, lanceolate-shaped points with "shoulders", with well-marked barbs achieved by notching. The expanded stem and the convex base give the piece a bulbous appearance. Among these points reported by Rodríguez-Loubet (1983, p. 130), there are points which were referred to as so-called G1c types (points with straight stems). Another identification of these types of points is for example Shumla points from Texas cited by Suhm & Krieger (1954, p. 480). From a morphological point of view, the same or similar specimen has been represented from the Middle Pecos Valley, New Mexico (Jelínek, 1967, Pl. XVI, j). These points were called Tecolote I, Hidalgo by García Cook (1982, p. 67, Lám. XII, no. 7–8). These Shumla points were located by García Moll (1973, p. 35, p. 94) in the Cueva de Texcal in Puebla, assigning them a temporality of 4,000 to 500 BC

4. The Prokop collection

Numerous reliable information is available on the collector and the origin of the collection (Procopp, 1891a; 1891b; 1892; Daday, 1893, p. 2; 1894; Bánó, 1906, pp. 99–100, 311). The collector, Dr Jenő Prokop (Procopp), a Hungarian physician, pharmacist, and naturalist who visited Mexico twice. In 1891, Prokop collected cacti, other succulents and several insects around Oaxaca in southwestern Mexico. At the end of the detailed report on this journey (Procopp, 1892, p. 638), he referred to the antiquities of San Juan Teotihuacan and specifically stated that he collected obsidian artefacts there and brought them to Hungary. In 1892, he donated his entomological specimens, mostly *Myriapoda* species (Sp. *Spirostreptus fraternus*, Saussure, Sp. *Spirobolus aztecus*, Saussure) collected in Mexico to the Hungarian National Museum. Instead of the exact location, only Mexico was listed as the origin of the pieces in the museum's zoological collection. On May 5, 1892, Prokop donated an archaeological collection of 27 objects to the Hungarian Ethnographic Museum. The small collection included several clay objects (mostly small anthropomorphic clay heads made in portrait sculpture style) and various obsidian artefacts. For the clay objects, as the place of the collection, San Juan Teotihuacan was given.

5. The Wilhelm Bauer collection

Dr Wilhelm (Guillermo) Bauer-Thoma was a German collector living in Mexico. In Mexico City, he came into contact with Guillermo Heredia, a prominent architect. Heredia was an exuberant collector of fine arts and also had an interest in archaeological objects. Heredia paid middlemen to assemble collections. One of his middlemen was Bauer, a self-made expert in antiquities, who procured objects for the architect and was also charged with the task of cataloguing and documenting them. Bauer Thoma's images of objects that ended up in Guillermo Heredia's collection show a large number of Oaxacan objects, mostly Zapotec effigies and other elaborate vessels (Sellen, 2015).

Bauer was recommended to the Head of the Department of Ethnography of the Hungarian National Museum by Jenő Bánó as a person who would certainly collect ethnographical and archaeological objects in Mexico. Jenő Bánó was born in 1855 in Roskovány (Sáros County). He graduated from the Maritime Academy in Fiume and served as a sailor. He settled in Mexico at the end of September 1892, and he bought a coffee plant in the Oaxaca Valley, near Pluma Hidalgo. Pluma Hidalgo is a small mountain community located northeast of Chacalapa, Oaxaca, in a coffee-growing region. At the turn of the 20th century, the coffee plant was destroyed by a cyclone. In 1903 he became Consul General of the Republic of Mexico in Hungary. He died on August 2, 1927, at the age of 72 in Malaga, Spain (Gyarmati *et al.*, 1997, p. 113; Szente-Varga, 2004; Siposné Kecskeméthy, 2014; Csikós, 2018).

The background to the contact with the Hungarian National Museum, established through Jenő Bánó's recommendation, was illuminated by one of Bauer's letters accompanying an assemblage sent to Berlin and the provenance of two objects in the collection. He acquired the two objects in the Mazatec territory, more precisely in the Rio Tonto region, on the Finca Hungaria in the Teotitlán district of Oaxaca. Bauer and Bánó probably became acquainted during one of Bauer's collection trips, perhaps when he visited Bánó's plantation or during one of Bánó's visits to Mexico City.

The Bauer collection, containing 804 objects was purchased by the Hungarian National Museum in 1903 (Gyarmati *et al.*, 1997; Gyarmati, 2004). In the Bauer collection, among others, there are several chipped stone artefacts of uncertain origin as well.

6. Technical evaluation of the collections

During the processing of the collections, the author has been guided primarily by the typology list of Tolstoy (1971), which was based on the scheme of Suhm & Krieger (1954) elaborated for Texas but extended with some necessary amendments. Tolstoy elaborated his typology based on the observations made on about 5,400 artefacts from central Mexico. Some 3,000 had originated from the excavations of Vaillant (1930; 1931; 1935) carried out in the 1930s in the Valley of Mexico.

Moreover, a continuous comparison with the typological system previously developed by García Cook (1967) proved to be necessary. This typology was also based on the "Texas typology" and included many additionally defined point types. In some cases, the thesis of García Moll (1973) on the archaeological material of the Cueva del Texcal cave (Puebla State, eastern Central Mexico), and the publication of MacNeish *et al.* (1967) on the Non-Ceramic artefacts of the Tehuacan Valley were useful. Before evaluating each collection, the formal point groups defined by Tolstoy should be briefly described.

A whole series of points were classified under the group "C. Stemless Points" (Tolstoy, 1971, pp. 277–278). Here only the point types will be mentioned that are of interest for the collections studied. Those are the Catan points (Suhm & Krieger, 1954, p. 410, Pl. 84; Tolstoy, 1971, Fig. 2, f; Vaillant, 1930b, pl. 42, middle, 4, 6, 7; 1931, pl. 86, top, I, 5; MacNeish *et al.*, 1967, p. 69, Fig. 53), not exceeding 4 cm in length, and the Abasolo types (Suhm & Krieger, 1954, pp. 400, 410, 474, Pl. 117, 84, 79; Tolstoy, 1971, Fig. 2, g). According to Suhm & Krieger, the Catan point is the same as the Abasolo point but smaller, and García Cook (1967, p. 58) also noted that the Catan point is just a variant of the Abasolo point. With a reference to the publication of MacNeish (1958, p. 64, Fig. 23, 8–14; Tolstoy, 1971, Fig. 2, h) Tolstoy mentioned also the Nogales points (MacNeish *et al.*, 1967, p. 60, Fig. 41). The Tortugas points (García Cook, 1967, p. 58, Lám. VII, 9–11) belong also to this group. According to MacNeish *et al.*, (1967, p.60, Fig. 41) this type has a straight or slightly concave base. These points have also been found in the Valley of Mexico, and appear earliest about 4,000 BC. Tortugas points lasted into historic times, but in southern Mexico, they disappeared by 500 BC.

The group "D. Expanding-stem points" (Tolstoy, 1971, p. 278) shows a consistent distribution in time, and its component types grade into one another morphologically. The various types of points range from the Palmillas points (Suhm & Krieger, 1954, p. 462, Pl. 110; Tolstoy, 1971, Fig. 2, k, with further references to Vaillant, 1930 and 1931), through the Ellis points (Suhm & Krieger,1954, p. 420, Pl. 89; Tolstoy, 1971, Fig. 2, l, with further references to Vaillant, 1930 and 1931) to the Ensor points (Suhm & Krieger, 1954, p. 422, Pl. 90; Tolstoy, 1971, Fig. 2, m, with further references to Vaillant, 1930 and 1931). On the Palmillas end of the continuum, some points with a large size and stem fall closer to the Ellis points, they have been classified by Tolstoy as Williams points (Suhm & Krieger, 1954, p. 490, Pl. 124; Tolstoy, 1971, Fig. 2, o, with further references to Vaillant, 1931). Points with well-defined corner notches have been classified as Marcos points (Suhm & Krieger, 1954, p. 442, Pl. 100; Tolstoy, 1971, Fig. 2, p, with further references to Vaillant, 1931), and points with neatly outlined concave bases have been classified as Edgewood points (Suhm & Krieger, 1954, p. 418, Pl. 88; Tolstoy, 1971, Fig. 2, q, with further references to Vaillant, 1931).

According to Tolstoy, the Late Preclassic chronological position of this group of points in the Valley of Mexico (Central Mexico) presents a clear parallel to Tamaulipas State (northeastern Mexico), where Palmillas Corner-notched and Ensor Side-notched points appear in the first millennium BC (MacNeish, 1958, pp. 66–68, Fig. 24, 24–27, 14–17). Both García Cook (1967) and García Moll (1977) classified the Ensor points in "*Familia III. – Muescas laterals*" (side-notches), while the Ellis points were listed under the "*Familia V. – Muescas angulares*" (angular notches).

The group "E. Contracting- and thin-stem points" (Tolstoy, 1971, pp. 278–279) includes above all the Gary-type points. Their formal description was given by Suhm & Krieger (1954, p. 430, Pl. 94). The Gary-type points are triangular blades with edges usually straight to convex but sometimes concave or recurved; the shoulders may be small but usually flare out widely almost at right angles; the barbs, if present at all, are short, and the stems usually contract to a pointed or somewhat rounded base but may at times approach being parallel-sided. Tolstoy adopted the subdivision of the Gary-type points of Ford & Webb (1956, pp. 52–54). According to the typology of García Cook (1967, pp. 60–62, Lám. IX, 15), Gary-points belong to the „*Familia IV: Muescas que eliminan esquinas*" (notches that eliminate corners). On the other hand, in his classification of the material from the Cueva del Texcal in Valsequillo, Puebla, García Moll (1977, p. 35, 93) classifies them in the "*Familia V. Muescas angulares*" (angular notches), dated in the Texcal II phase, roughly 2,000 BC – AD 1,000.

Tolstoy defined a new Gary-like point type, the San Martin point, which in dimensions and proportions resembles the Gary Typical of Ford & Webb (1956, p. 53, Fig. 17, a–e), but has an untapered, parallel-sided stem, with a rounded end, and occasionally small and long examples occur.

Some points, diverging formally from the Gary-type points, were classified by Tolstoy as Shumla points (Suhm & Krieger, 1954, p. 480, Pl. 119; Tolstoy, 1971, Fig. 2, x–z). The stems may be tapering or parallel, rounded or sectioned off, and the barbs sometimes reach as far as the stem base. In the typology of García Cook (1967, pp. 62–64, Lám. XI, 5–6), the Shumla A and Shumla B point variants belong to the "*Familia V. Muescas angulares*" (Angular notches). Shumla points were located by García Moll (1973, p. 35, 94) in the Cueva del Texcal from the Coxcatlán phase (MacNeish *et al.*, 1967, pp. 67–69), assigning them a temporality of 4,500–500 BC.

As regards the group "F. Side-notched points", Tolstoy (1971, p. 279) called most of the studied points Texcoco points (Tolstoy, 1971, Fig. 3, p), and noted that all of Vaillant's specimens were of Late Aztec date. Texcoco points resemble the Harrell points of Texas (Suhm & Krieger, 1954, p. 500, Pl. 129), but Tolstoy represented only one point that is small enough to fit the type (Suhm & Krieger, 1954, Fig. 3, o).

García Cook (1967, p. 58), based on the shape of the base (straight or concave), distinguished two subvariants, the Texcoco A and Texcoco B points. According to Tolstoy, the Texcoco point is a local derivative of the Harrell point, diffused to Mexico in early Aztec times from the north. Pastrana & Carballo (2016, p. 338) stated that the projectile points within the ceremonial precincts of Tenochtitlan and Tlatelolco stylistically grade into Texcoco types.

Based on the studied assemblages, the group "G. Broad-stem points" in Tolstoy's typology (Tolstoy, 1971, p. 281) contains a whole series of points. As Tolstoy noted, a dearth of comparative data prevents us from recognizing the chronological position of these points. Some may be deviants, others may have been imported.

The following is only a brief, summarizing description from a typological point of view of the collections. The inventory numbers (inv. no.) of the artefacts are in brackets.

6.1. The Prokop collection

The collection contains 11 appreciable and classifiable projectile points, a distal fragment of a non-classifiable projectile point (inv. no. 5025), and an artefact whose identification is problematic (inv. no. 5028).

One specimen (inv. no. 5021, Fig. 2.1) belongs to the group "D. Expanding-stem points" of Tolstoy's typology. The point is a borderline case between the Williams point and the Marcos point. These types are characterized by pronounced shoulders and are usually well-barbed. The stem is formed by corner notches and is always expanded. The base is straight to convex. According to the typology of García Cook, the point (inv. no. 5021) belongs to the „*Familia V: Muescas angulares*" (angular notches) and can be classified as a subtype of the Marcos point (García Cook, 1967, p. 62, Lám. X, 1–4). As regards the dimensions, (inv. no. 5021) resembles more the Marcos Tepeapulco subtype, but is not so finely worked.

The group "E. Contracting- and thin-stem points" contains most specimens in the collection.

The Gary-type points are represented by two specimens (inv. no. 5017, and 5027). The point (inv. no. 5017) has the greatest morphological resemblance either to the Gary Large point (Tolstoy, 1971, Fig. 2, u) or the Gary-like San Martin point (Tolstoy, 1971, Fig. 3, c). According to the typology of García Cook, the point can be classified either as a Gary B point (García Cook, 1967, p. 64, Lám. XI, 4) or as a Tlatilco point (García Cook, 1967, p. 60, Lám. IX, 13). This latter point belongs to the „*Familia IV: Muescas que eliminan esquinas*" of García Cook and was described for the first time by Lorenzo (1951, pp. 29 *ff*, Fotó 1; Lorenzo, 1965). Because of the unequivocal classification, the chronological position of the (inv. no. 5017) is uncertain. The Gary Large points are characteristic mainly for the Teotihuacan III period, while the San Martin points are somewhat older, and were present in the Teotihuacan I and II periods.

The other Gary-type point (inv. no. 5027) is a Tlatilco point in García Cook's typology (1967, p. 60, Lám. IX, 13).

The Gary-like San Martin points are represented with three examples (inv. no. 5020, Fig. 2.4; inv. no. 5024, and 5029, Fig. 3.1**)**. From a morphological point of view, in García Cook's typology, all three specimens can be classified as Perdiz points. Due to their dimensions, two of them (inv. no. 5020 and 5029) resemble the represented long and narrow variant (García Cook, 1967, Lám. X, 17); the (inv. no. 5024) point resembles the represented somewhat shorter and wider variant (García Cook, 1967, Lám. X, 17). Unfortunately, García Cook gave no details on the Perdiz points. In Tolstoy's typology (1971, p. 277, Fig. 2, b), the Perdiz points are listed in the group "A. Small Points of the Middle Preclassic". In the original description of Suhm & Krieger (1954, p. 504, Pl. 131), the dimensions of the Perdiz points vary in a rather wide range. In Texas, these points are late and interpreted as arrow points.

The Shumla points are represented with four specimens (inv. no. 5014, Fig. 2.3, inv. no. 5022, inv. no. 5023, Fig. 2.2, and inv. no. 5026, Fig. 3.2). In three cases (inv. no. 5014, 5022, and 5026), the corresponding analogue in the typology of García Cook is the Hayes Grande point („*Familia V: Muescas angulares*" (angular notches); García Cook, 1967, p. 64, Lám. XI, 11–12; *cf*. Tolstoy, 1971, Fig. 3, a–b). According to Tolstoy, from a chronological point of view, this form of Shumla points belongs to the Teotihuacan III or IV phases. In the case of the point inv. no. 5023, the classification as a Gary-like San Martin point is also possible (Tolstoy, 1971, Fig. 3, c). In García Cook's work, besides the Hayes Grande classification, the point can be classified also as a Palmillas point („*Familia V: Muescas angulares*" (angular notches); García

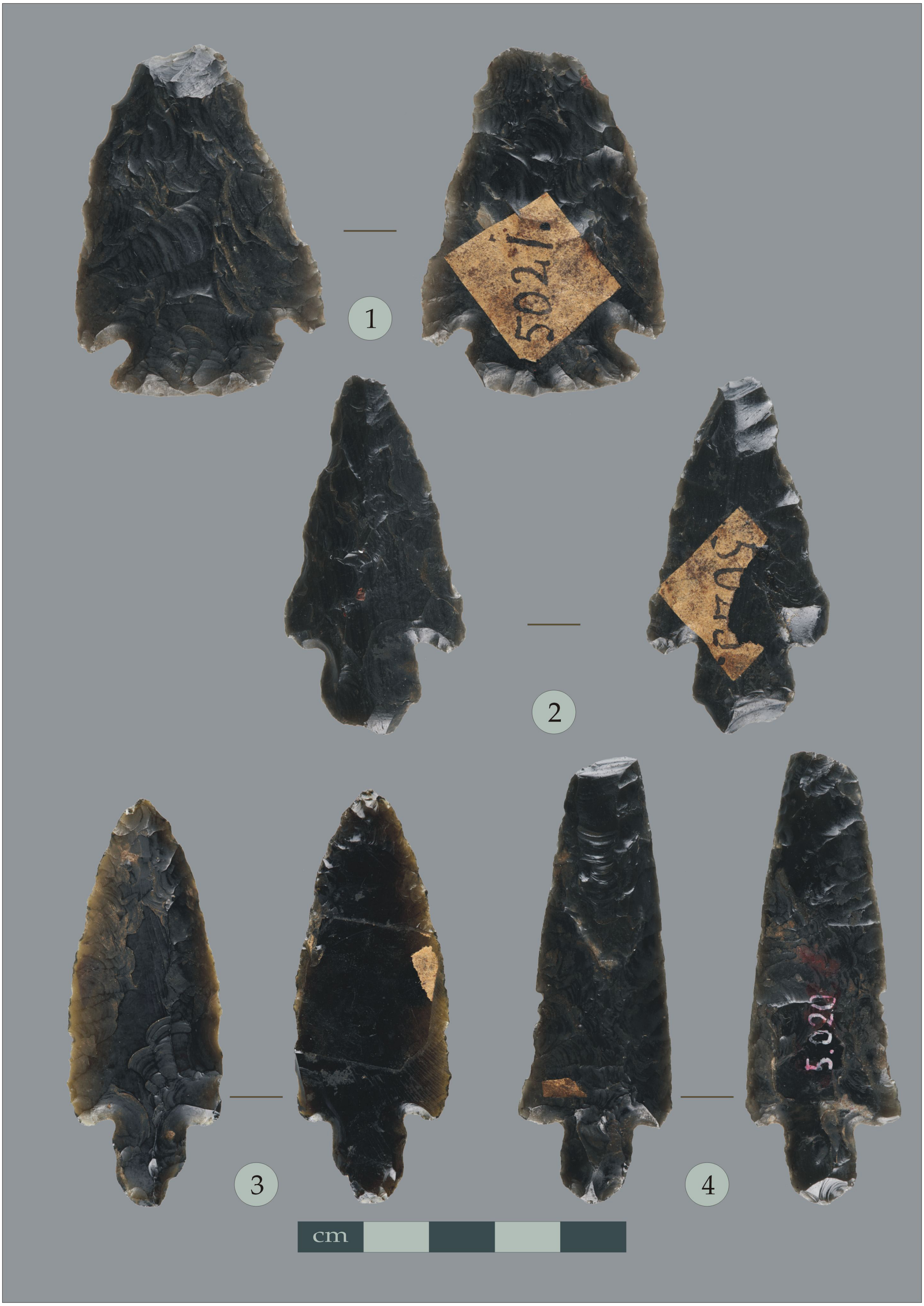

Fig. 2. Selected artefacts of the Prokop collection. Compiled by the author.

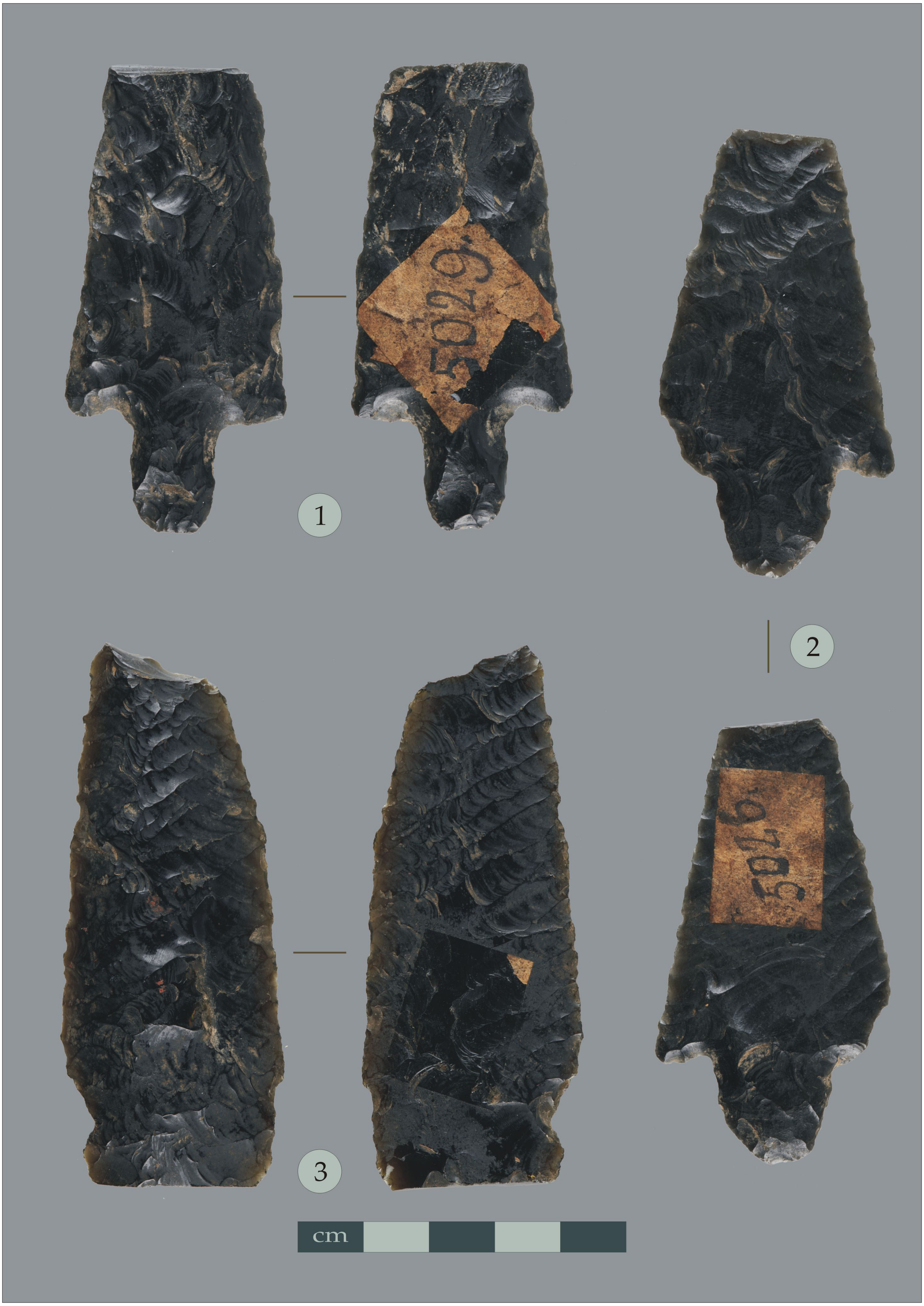

Fig. 3. Selected artefacts of the Prokop collection. Compiled by the author.

Cook, 1967, pp. 62–63, Lám. X, 8, 21–22). On the other hand, in the typology of Tolstoy (1971, p. 278), the Palmillas points have expanding stems.

There is one side-notched specimen (inv. no. 5031) in the collection. It has a morphological resemblance to the Castroville points (Suhm & Krieger, 1954, p. 408, Pl. 83), exemplified by one specimen by Tolstoy (1971, Fig. 3, l). In García Cook's typology, the point inv. no. 5031 can be classified as an Ensor point (García Cook, 1967, p. 58, Lám. VIII, 18; *cf*. Tolstoy, 1971, Fig. 2, m), and in García Moll's typology, it is rather a Texcoco point (García Moll, 1973, Lám. 15).

In the collection, there is an artefact (inv. no. 5028, Fig. 3.3) that could not be determined unambiguously as a projectile point. It is a large mesial fragment, both the proximal and the distal end have been broken long ago. The left lateral edge is straight, the right edge is convex. Both the cross-section (transverse section) and the side profile (longitudinal section are plano-convex. The lateral edges are retouched bifacially. There is intensive covering retouch over the entire surface of both faces. The regular diagonal pressure-flaking pattern from the lower left to the upper right on each face (Knight, 2019, p. 250, Fig. 8.5b; Fig. 9) is particularly pronounced on the right side of both faces. The object may have been a leaf-shaped spear point or a bi-pointed bifacial knife. The raw material is green obsidian. The dimensions are (83.1) × 33.3 × 9.9 mm. The weight is 29.8 g. The reproduced length is *ca*. 125–130 mm.

As regards the somewhat confusing terminology, according to Slater (2011, p. 372), the term "dart-thrower" is preferable to "spear-thrower". Spears are inferred to be rigid and designed for thrusting or hand-propulsion. Stiff projectiles are ineffective when used with a dart-thrower (Whittaker, 2010, p. 15). There is much data on the existence of hand-thrust or hand–thrown spear and bifacial knives in Mesoamerica (Sugiyama, 2005, pp. 131 *ff*.; Sugiyama & Luján, 2007). Tolstoy (1971, p. 283) uses the term "knife" regarding a class of large lens-shaped bifaces, which might equally well be considered large points or "ceremonial blades". Their greatest proportional occurrence is in Classic deposits. These blades are often carefully trimmed by parallel flaking. According to Linné, the size of the blades varies considerably, but the form is constant. "*They are symmetrical, leaf-shaped or lanceolate, with both sides equal, and of acutely oval section, while both ends are pointed and the edges carefully chipped.*"(Linné, 1934, pp. 146–47, Fig. 293–297).

Although among the projectile points there are some rather atypical specimens, from a typological point of view they have a homogeneous character and fit well into the Middle Preclassic period (Middle Formative period; 900 BC–AD 250) and Classic period (AD 250–900), which includes the Teotihuacan I to Teotihuacan IV periods (200 BC–AD 750).

All artefacts from San Juan Teotihuacan in the Prokop collection were made of obsidian. Macroscopically, three variants were distinguished: 1) an opaque dark grey (almost black) obsidian (six artefacts), 2) a translucent grey obsidian (four artefacts), and 3) a green obsidian (one artefact). Based on several studies on obsidian utilization during the Teotihuacan periods and provenance analysis of the obsidian (Gazzola, 2009; Hirth *et al.*, 2019; Kwoka & Shackley, 2019, Ponomarenko, 2004, with further references), all grey obsidian variants can be attributed to the Otumba source area, some 12 km to the east of Teotihuacan. The source of the black variant is Barranca de Los Ixtetes (Hernández, 1993, p. 391), at a distance of about 80 km to the northeast of Teotihuacan. The geological source area of the green obsidian is likely the Pachuca obsidian source near the volcanic centre Sierra Las Navajas in Hidalgo, Mexico, at a distance of about 50 km to the north of Teotihuacan.

6.2. The Wilhelm Bauer collection

The collection contains 47 appreciable and classifiable projectile points and two distal fragments of non-classifiable projectile points (inv. no. 48029, 48030, and 48049).

There are five stemless points (inv. no. 48008, 48029, 48044, 48048, and 48052) in Tolstoy's group "C. Stemless Points" (Tolstoy, 1971, pp. 277–278). One point (inv. no. 48008), with its length of 46.1 mm, is rather a borderline case between the Catan or Abasolo point (Tolstoy, 1971, p. 277, Fig. 2, f, g). In the typology list of García Cook (1967, p. 56, Lám. VII, 4) the point is an Abasolo point. The point inv. no. 48029 is a Pandora point (García Cook, 1967, p. 56, Lám. VII, 4; García Moll, 1973, Lám. 12; Suhm & Krieger, 1954, p. 466, Pl. 112). Three points (inv. no. 48044, 48048, and 48052)

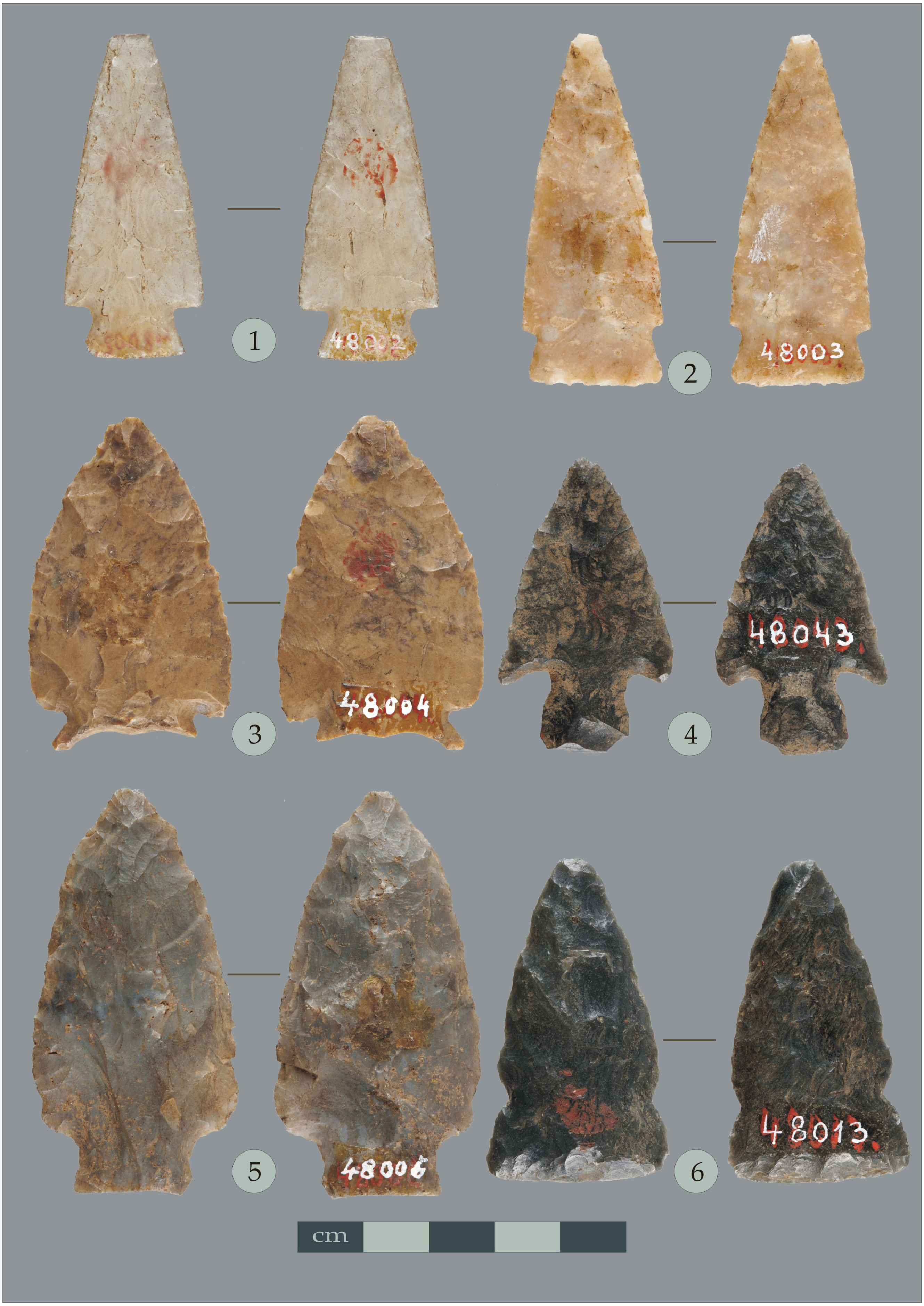

Fig. 4. Selected artefacts of the Bauer collection. Compiled by the author.

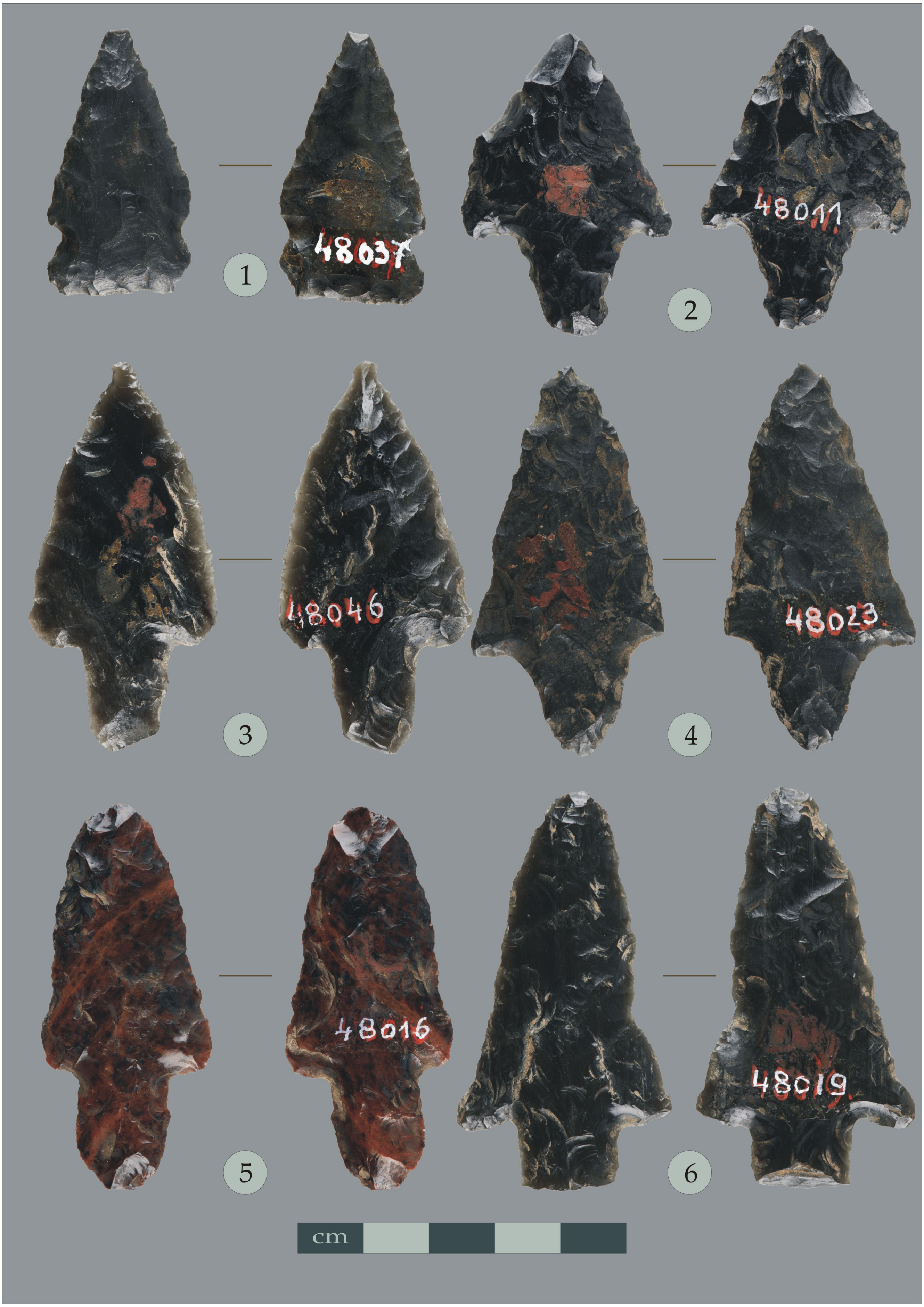

Fig. 5. Selected artefacts of the Bauer collection. Compiled by the author.

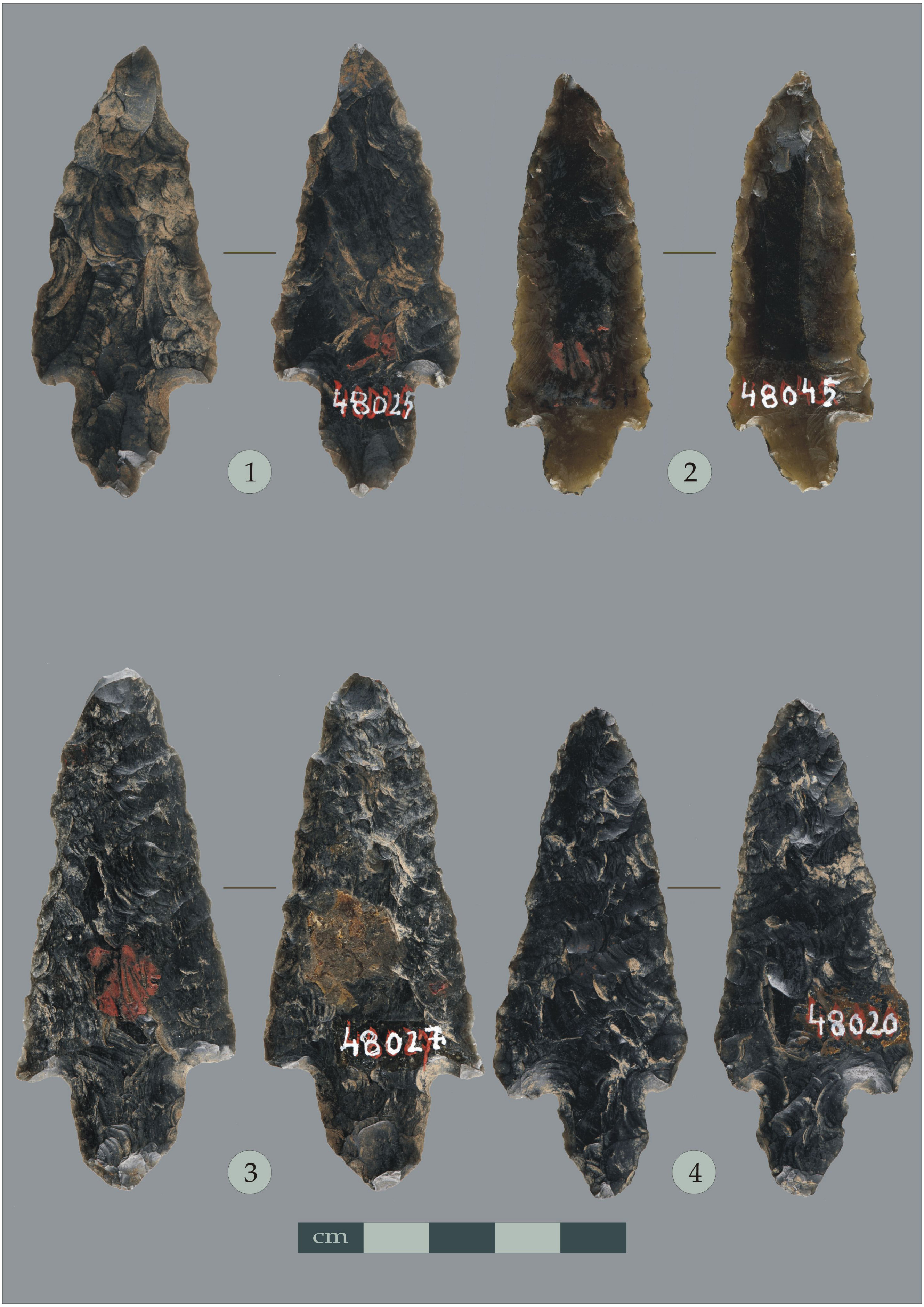

Fig. 6. Selected artefacts of the Bauer collection. Compiled by the author.

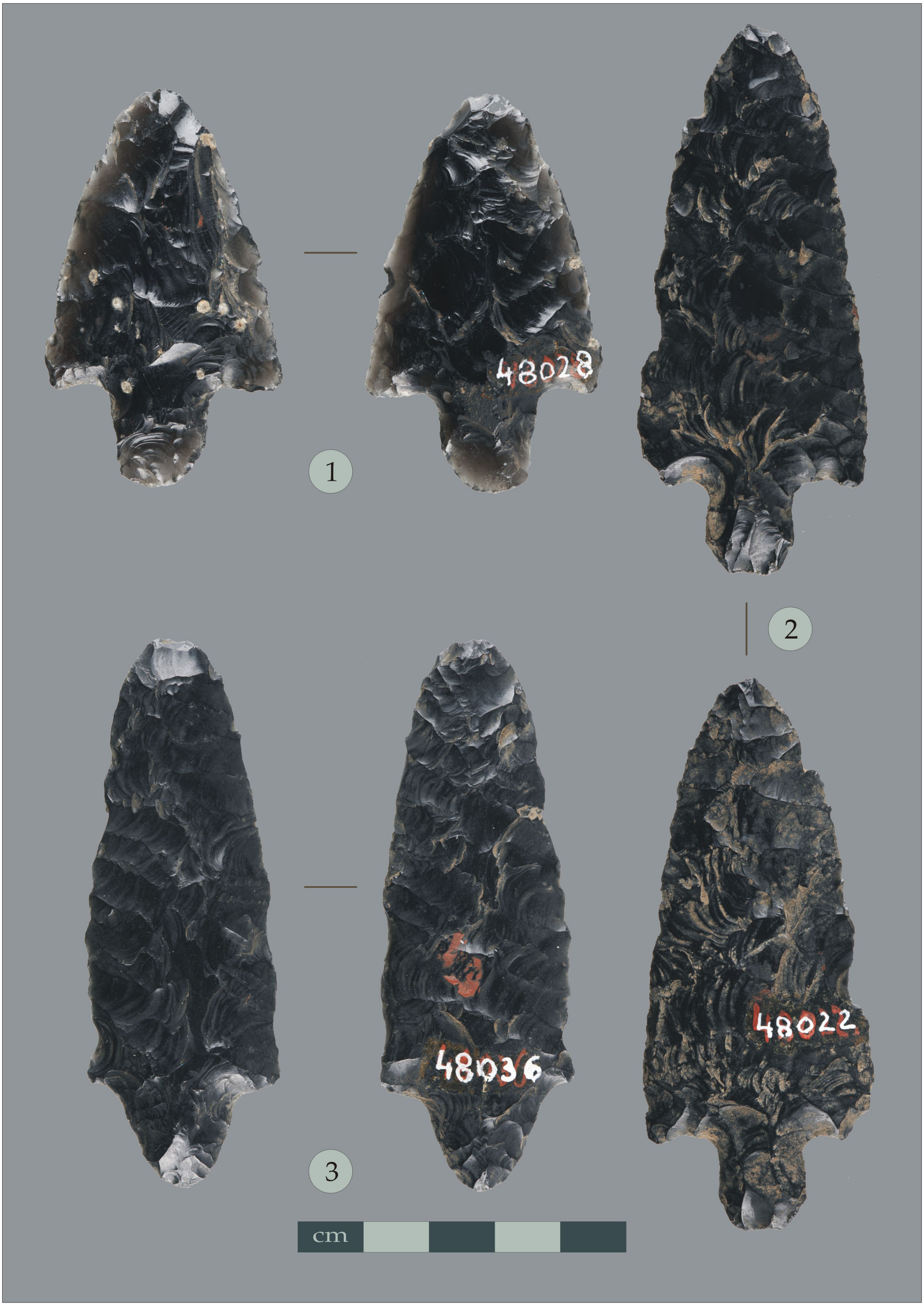

Fig. 7. Selected artefacts of the Bauer collection. Compiled by the author.

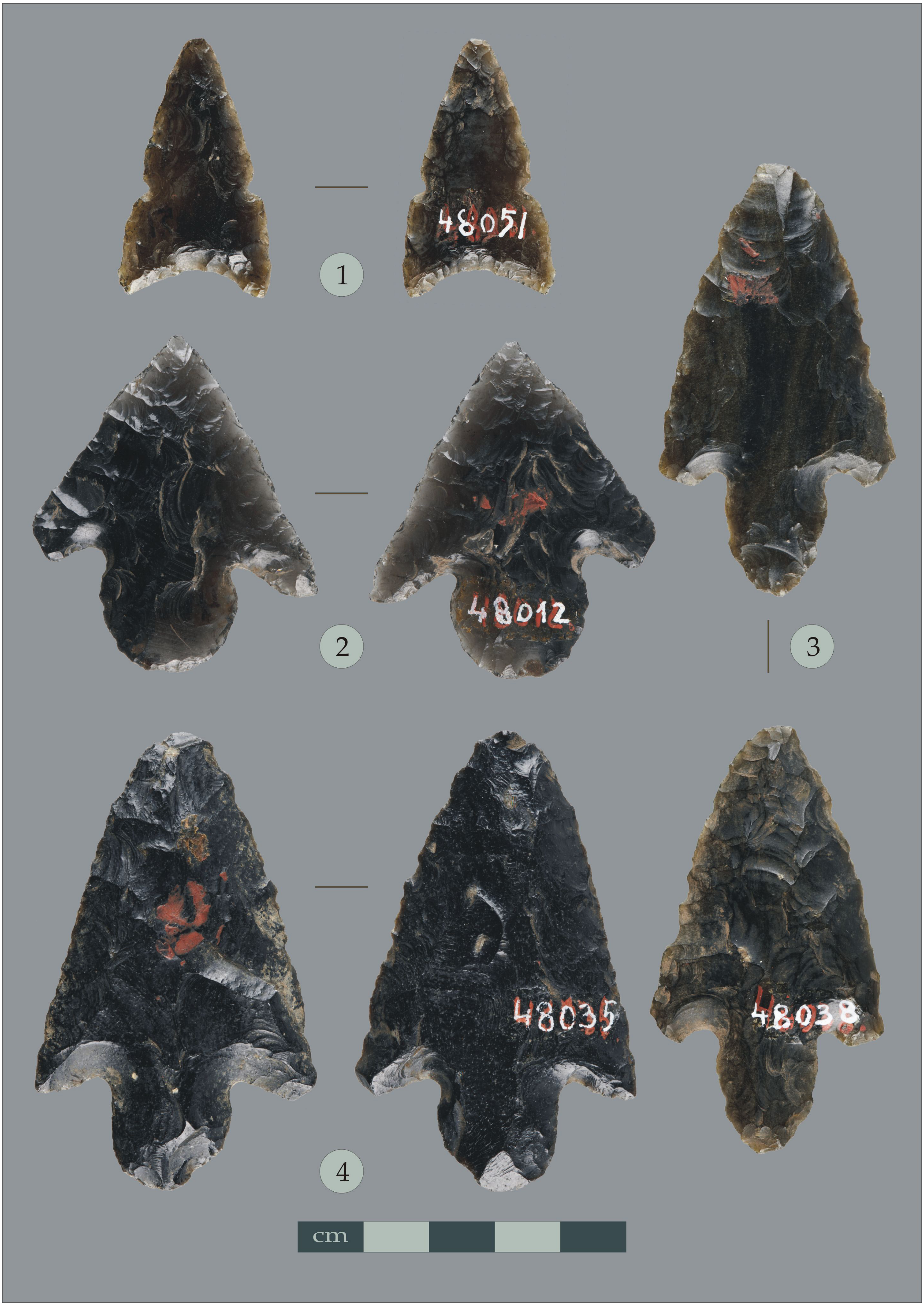

Fig. 8. Selected artefacts of the Bauer collection. Compiled by the author.

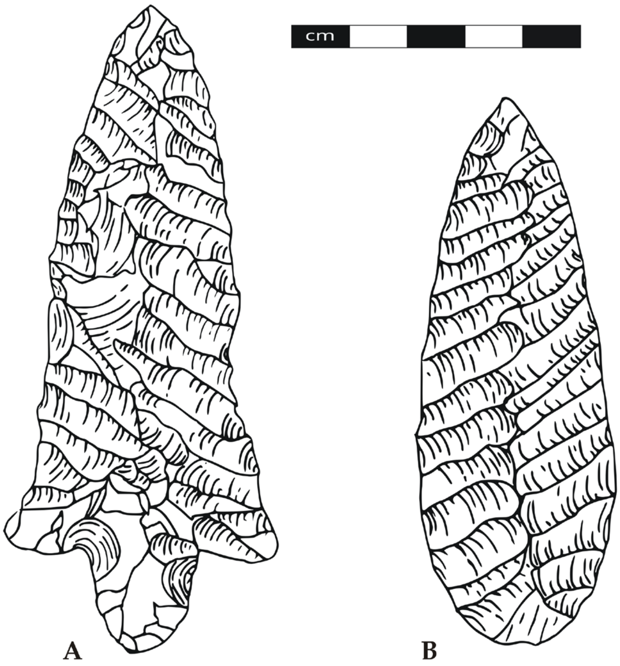

Fig. 9. (A) Zaragoza-Oyameles stemmed-A style point exhibiting upper-left-to-lower-right, diagonal flaking pattern; (B) ovate point exhibiting lower-left-to-upper-right, diagonal flaking pattern (redrawn by N. Faragó after Hirth *et al*. 2003, Fig. 10.4).

are Tortugas points (García Cook, 1967, p. 56, Lám. VII, 11) with a straight base. The latter point (inv. no. 48052) has a certain resemblance to the slightly convex-based Nogales point represented by Tolstoy (1971, p. 277, Fig. 2, h).

Six specimens (inv. no. 48002, Fig. 4.1, inv. no. 48003, Fig. 4.2, inv. no. 48005, inv. no. 48037, Fig. 5.1, inv. no. 48041, and inv. no. 48051, Fig. 8.1) belong to the group "D. Expanding-stem points" of Tolstoy's typology (1971, p. 278).

The three points (inv. no. 48002, 48003, and 48005) are borderline cases between the Williams point (Tolstoy, 1971, Fig. 2, o), the Marcos point (Tolstoy, 1971, Fig. 2, p) and the Edgewood points (Tolstoy, 1971, Fig. 2, q). The examples, represented by Tolstoy have slightly convex bases. According to Suhm & Krieger (1954, p. 442), the Marcos points have a straight to convex base, which sometimes are slightly concave, and generally not as wide as barbs. Due to their rather straight base, the two former points are closer to the Marcos points. In the typology of García Cook, both points can be classified as either Tlanalapa A points (García Cook, 1967, p. 58, Lám. VIII, 15; similar to the Ensor points) or Xihuingo points (García Cook, 1967, p. 64, Lám. X, 10; similar to Marcos points). The point inv. no. 48005, with its slightly concave base, has a greater similarity to Edgewood points. In the García Cook typology, its likely best analogy is the Texcoco A point (*cf.* Tolstoy, 1971, Fig. 3, p), which resembles Harrell points (Suhm & Krieger, 1954, p. 500, pl. 129) and may be of Early Aztec date.

Three points (inv. no. 48037, 48041, and 48051) are either Ensor points (Tolstoy, 1971, Fig. 2, m; García Cook, 1967, p. 58, Lám. VIII, 18) or Texcoco A point (Tolstoy, 1971, Fig. 3, p; García Cook, 1967, p. 58, Lám. VIII, 21–22).

The vast majority of the points, 30 specimens, can be classified in Tolstoy's group "E. Contracting- and thin-stem points" (Tolstoy, 1971, p. 278).

The Gary points are represented with six specimens (inv. no. 48011, Fig. 5.2, inv. no. 48023, Fig. 5.4, inv. no. 48032, inv. no. 48036, Fig. 7.3, inv. no. 48040, and 70.70.37).

Based on morphological considerations and taking into account their dimensions, four specimens (inv. no. 48011, 48023, 48032, and 48040) can be classified as Gary Typical (Tolstoy, 1971, Fig. 2, r). In the typology of García Cook, except for the point inv. no. 48011, which has a slight resemblance to the Axolotl points (García Cook, 1967, p. 66, Lám. XI, 14), the other three points are either Tlatilco points (García Cook, 1967, p. 60, Lám. IX, 12–13) or Gary points (García Cook, 1967, p. 61, Lám. IX, 15).

The Gary-like San Martin points (Tolstoy, 1971, Fig. 3, c) are represented with four specimens (inv. no. 48010, 48024, 48026, and 48028, Fig. 7.1). All cases are relatively unambiguous. All of them have obvious analogies in García Cook's typology, the Gary point (García Cook, 1967, p. 61, Lám. XI, 3–4) or Hayes Grande points (García Cook, 1967, p. 64, Lám. IX, 11–12).

Two points (inv. no. 48046), Fig. 5.3, and inv. no. 48050) seem to exhibit morphological similarities to Palmillas points (Tolstoy, 1971, Fig. 2, k), San Martin points (Tolstoy, 1971, Fig. 3, c), and Kent points (Suhm & Krieger, 1954, p. 432, pl. 95; Tolstoy, 1971, Fig. 3, k). Both points have similar dimensions, which does not facilitate more accurate identification. Accordingly, they have several analogies in García Cook's typology. The four potential candidates are the Langtry point (García Cook, 1967, p. 61, Lám. IX, 8), the Kent point (García Cook, 1967, p. 61, Lám. IX, 10), the Gary B point (García Cook, 1967, p. 61, Lám. XI, 3–4), and the Palmillas B point (García Cook, 1967, pp. 62–63, Lám. X, 21–22).

The Shumla points are represented by 19 specimens.

The point inv. no. 48012, Fig. 8.2 is a Shumla point (Tolstoy, 1971, Fig. 2, y). Its first analogy in García Cooks' typology is the Ellis point (García Cook, 1967, p. 62, Lám. X, 19; *cf.* Tolstoy 1971, Fig. 2, l). The second analogy is the Trinidad point (García Cook, 1967, p. 64, Lám. XI, 1–2; MacNeish *et al.*, 1967, pp. 61–62, Fig. 43).

There is a short and wide, atypical point (inv. no. 48053), with the dimensions of 34.5 × 29.9 mm. A somewhat longer point with a damaged tip may have been refurbished. With its recent chunky form, the point can be identified as either a Shumla point (Tolstoy, 1971, Fig. 2, y) or a Kent point (Tolstoy, 1971, Fig. 3, k). In García Cook's typology, the closest morphological analogy is likely the Carrollton point (García Cook, 1967, p. 62, Lám. X, 11–12; Suhm & Krieger, 1954, p. 406, pl. 82, A–F).

All other points (inv. no. 48016, Fig. 5.5, inv. no. 48017, and 48018, inv. no. 48019, Fig. 5.6, inv. no. 48020, Fig. 6.4, inv. no. 48021, inv. no. 48022, Fig. 7.2, inv. no. 48025, Fig. 6.1, inv. no. 48027, Fig. 6.3, inv. no. 48033, inv. no. 48035, Fig. 8.4, inv. no. 48038, Fig. 8.3, inv. no. 48039, inv. no. 48043, Fig. 4.4, inv. no. 48045, Fig. 6.2, inv. no. 48047, and 48105) can be identified as *sensu lato* Shumla points in Tolstoy's typology (Tolstoy, 1971, Fig. 2, y). The closest morphological analogies in García Cook's typology are the Gary B points (García Cook, 1967, p. 61, Lám. XI, 3–4) and/or Hayes Grande points (García Cook, 1967, p. 64, Lám. XI, 11–12).

In Tolstoy's group, "G. Broad-stem points" (Tolstoy, 1971, p. 281), there are three points.

The points inv. no. 48004, Fig. 4.3 and inv. no. 48013, Fig. 4.6 are Castroville points (Suhm & Krieger, 1954, p. 408, Pl. 83; Tolstoy, 1971, Fig. 3, l). In García Cook, they are Tlanalapa A (García Cook, 1967, p. 58, Lám. VIII, 16) and Texcoco A (García Cook, 1967, p. 58, Lám. VIII, 21) points respectively. The point inv. no. 48006, Fig. 4.5 is a Lange point (Suhm & Krieger, 1954, p. 408, Pl. 83; Tolstoy, 1971, Fig. 3, j). In García Cook's typology, it is either a Lange A point (García Cook, 1967, p. 60, Lám. IX, 3; *cf.* MacNeish *et al.*, 1967, pp. 72–73, Fig. 59, Tehuacan point) or a Palmillas Tepeapulco point (García Cook, 1967, p. 60, Lám. IX, 7–8).

One point (inv. no. 48015) in the collection is likely a Desmuke point (Suhm & Krieger, 1954, p. 416, pl. 87; Tolstoy, 1971, Fig. 2,w). Tolstoy (1971, p. 279) noted that in the Valley of Mexico, all Desmuke points seem essentially to be Gary Small forms with attenuated shoulders (Vaillant, 1931, pl. 86: top, 4,8,15). On the other hand, according to Suhm & Krieger, the Desmuke points are probably related to both Abasolo and Catan points.

There is one point (inv. no. 48014) in the Bauer collection without having an analogy neither in Tolstoy's nor García Cook's typology. In plan view, the point has an asymmetric pentagonal form. The lateral edges and the oblique base are bifacially retouched. Its dimensions are 40.6 × 21.0 mm. MacNeish *et al.*, (1967, p. 79, Fig. 68,5) represented a somewhat smaller (3.8 × 2.5 cm), but morphologically similar specimen as an "aberrant pentagonal point".

From a typological point of view, the collection has a rather heterogeneous character. This diversity is likely since the artefacts come from multiple sites of uncertain locations.

In the case of the dominant group ("E. Contracting- and thin-stem points", Tolstoy, 1971, p. 278), it is likely that the points were collected around Teotihuacan or at least in the Valley of Mexico. This group, containing Gary-like and Shumla points, typologically fit well into the Middle Preclassic period (Middle Formative period; 900 BC–AD 250) and Classic period (AD 250–900), which includes the Teotihuacan I to Teotihuacan IV periods (200 BC–AD 750). Based on circumstantial evidence (the personal contact of Bauer with Jenő Bánó; see above), at least a part of the collection may have come from the Oaxaca Valley.

The raw material spectrum of the Bauer collection is diverse. Almost half of the artefacts (27 specimens) were made of translucent grey obsidian. The opaque dark grey (almost black) obsidian (12 artefacts), 2) and the green obsidian (five artefacts) are also present. There is a single artefact made of relatively rare mahogany ("*meca*") obsidian (Glascock *et al.*, 1994). This obsidian variant can also be found in the Otumba obsidian source area. Five artefacts were made of "chert" of unknown origin, of this hard, fine-grained sedimentary rock composed of microcrystalline or cryptocrystalline quartz. Two of them are translucent, two of them have a yellowish-brown colour and one is grey.

7. Statistical results

In the following, the used abbreviations for the quantitive attributes of the studied objects are as follows: AB = Body length, BC = Stem length, DE = Body width, FG = Maximal stem width, HI = Stem neck width, ST = Stem thickness, BT = Body thickness, WT = Weight. All measured data are in millimetres, the weight is in grams. Two derived data were calculated, one is the ratio of the Body length to the Stem length (AB/BC), and the other is the ratio of the Body length to the Body width (AB/DE).

The Prokop collection, consisting of nine projectile points, is a too small sample to be suitable for more detailed statistical analysis. On the larger Bauer collection, consisting of 37 artefacts, normality tests were performed. Normality tests are tests of whether a set of data is drawn from a normal population, that is, distributed in a way that is consistent with a normal probability distribution. The statistical data below were calculated with the PAST (PAleontological STatistics) Version 4.13 freeware software program (Hammer *et al.*, 2001).

7.1. The Prokop collection

The descriptive statistical data for the Prokop collection can be found in Table 1. The analysed sample contains only nine artefacts (inv. no. 5014, 5017, 5020, 5021, 5023, 5024, 5026, 5027, and 5029), and does not contain the non-classifiable distal fragment (inv. no. 5025) and the problematic artefact of inv. no. 5028. The rather small lithic assemblage, containing also proximal fragments, is not suitable for further statistical analyses. Although the basic dimensions (AB (reconstructed), DE, BT) vary in wide ranges, the standard deviations and the coefficient of variations are relatively low. Among the measurements of the artefacts, there are no outlier values. The means and the medians have very similar values. The kurtosis and the skewness values are near zero, indicating symmetric distributions. All these facts suggest a kind of "standardization" in the manufacturing of the points, which corresponds to the fact of assumed relative typological homogeneity of the assemblage. The AB/DE values vary between 1.71 and 4.03 with a mean of 2.66. Except for artefact inv. no. 5021, all points were made on blade blanks, i.e., on flakes that are at least twice as long as wide.

7.2. The Wilhelm Bauer collection

The descriptive statistical data for the 37 stemmed points of the Bauer collection can be found in Table 2. The basic dimensions (AB, DE, BT) vary in wide ranges, the standard deviations and the coefficient of variations are relatively low. Among the measurements of the artefacts, there are no outlier values. The means and the medians have very similar values. The kurtosis and the skewness values are near zero, indicating symmetric distributions. Even though the exact origin of the artefact assemblage is uncertain, the descriptive data suggest relative homogeneity, i.e., a kind of standardization. Possible explanations for this fact is that the objects from the Oaxaca Valley were originally made in Teotihuacan and imported from there, or that Teotihuacan point-making traditions were followed in the Oaxaca Valley. AB/DE varies between 1.15 and 2.96 and has a mean value of 2.06. Nineteen points were made on "blades", the remaining eighteen points were made on flakes.

On these 37 stemmed points several normality tests (Shapiro-Wilk (Shapiro & Wilk, 1965; Royston, 1995), Anderson-Darling (Stephens, 1986), Lilliefors (Lilliefors, 1967; Molin & Abdi, 1998; Abdi & Molin, 2007),) and Jarque-Bera (Jarque & Bera, 1987), with 10,000 Monte Carlo permutation were carried out (Table 3). Based on the normality tests, taking into account the calculated probability values (p (normal) and p (Monte Carlo)), the basic dimensions (AB, DE, BT) and also the weight (WT) strongly suggest a normally distributed population. The normal distribution of weight (more appropriately, the mass) is a sequel, probably because except for four artefacts (inv. no. 48002, 48003, 48004, and 48006) made of some sort of "chert", their raw material is obsidian. However, the specific weight of "chert" is approximately 2.5–2.8 g/cc, while that of obsidian is 2.35–2.60 g/cc, which are very similar to each other.

8. Discussion and conclusions

Table 1. Statistics of the Prokop collection.

	AB	BC	DE	FG	HI	ST	BT	WT	AB/BC	AB/DE
N (Sample size)	9	9	9	9	9	9	9	9	9	9
Minimum	62,00	6,80	21,50	0,00	10,20	4,10	5,80	6,70	4,00	1,71
Maximum	115,00	17,60	36,80	15,40	21,70	8,00	10,20	22,90	11,62	4,03
Range	53,00	10,80	15,30	15,40	11,50	3,90	4,40	16,20	7,62	2,32
Mean	77,91	13,17	29,87	7,86	14,31	6,14	7,63	13,33	6,29	2,66
Stand. Deviation	18,75	3,47	5,19	4,43	3,80	1,14	1,49	5,31	2,26	0,72
Coeff. of variation (%)	24,07	26,34	17,37	56,40	26,54	18,63	19,46	39,83	36,00	26,94
Median	70,00	13,40	31,20	7,30	13,80	6,20	6,90	11,40	6,24	2,53
Lower quartile	62,60	10,40	24,95	5,65	10,85	5,40	6,50	9,40	4,58	2,13
Upper quartile	93,00	16,20	33,90	11,10	16,90	7,00	8,95	17,70	6,81	3,15
Interquartile range	30,40	5,80	8,95	5,45	6,05	1,60	2,45	8,30	2,23	1,02
Skewness	1,06	-0,57	-0,48	0,06	0,90	-0,22	0,54	0,73	1,79	0,76
Kurtosis	0,23	-0,16	-0,95	0,78	0,31	0,38	-0,91	-0,28	4,14	0,31

Table 2. Statistics of the Wilhelm Bauer collection.

	AB	BC	DE	FG	HI	ST	BT	WT	AB/BC	AB/DE
N (Sample size)	9	9	9	9	9	9	9	9	9	9
Minimum	62,00	6,80	21,50	0,00	10,20	4,10	5,80	6,70	4,00	1,71
Maximum	115,00	17,60	36,80	15,40	21,70	8,00	10,20	22,90	11,62	4,03
Range	53,00	10,80	15,30	15,40	11,50	3,90	4,40	16,20	7,62	2,32
Mean	77,91	13,17	29,87	7,86	14,31	6,14	7,63	13,33	6,29	2,66
Stand. Deviation	18,75	3,47	5,19	4,43	3,80	1,14	1,49	5,31	2,26	0,72
Coeff. of variation (%)	24,07	26,34	17,37	56,40	26,54	18,63	19,46	39,83	36,00	26,94
Median	70,00	13,40	31,20	7,30	13,80	6,20	6,90	11,40	6,24	2,53
Lower quartile	62,60	10,40	24,95	5,65	10,85	5,40	6,50	9,40	4,58	2,13
Upper quartile	93,00	16,20	33,90	11,10	16,90	7,00	8,95	17,70	6,81	3,15
Interquartile range	30,40	5,80	8,95	5,45	6,05	1,60	2,45	8,30	2,23	1,02
Skewness	1,06	-0,57	-0,48	0,06	0,90	-0,22	0,54	0,73	1,79	0,76
Kurtosis	0,23	-0,16	-0,95	0,78	0,31	0,38	-0,91	-0,28	4,14	0,31

Due to uncertainty regarding the exact place(s) of origin of the objects, the article lacks a detailed discussion. However, certain statistical conclusions can be drawn regarding the Bauer collection.

Even though the exact origin of the artefact assemblage is uncertain, the descriptive data suggest relative homogeneity, that is, a kind of standardization. Possible explanations for this fact is that the objects from the Oaxaca Valley were originally made in Teotihuacan and imported from there, or that Teotihuacan point-making traditions were followed in the Oaxaca Valley.

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Statements

Data availability statement. The author confirms that the data supporting the findings of this study are available within the article.

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Table 3. Normality test results on the Wilhelm Bauer collection

	AB	BC	DE	FG	HI	ST	BT	WT	AB/BC	AB/DE
N	37	37	37	37	37	37	37	37	37	37
Shapiro-Wilk W	0,981	0,929	0,982	0,915	0,962	0,952	0,992	0,987	0,882	0,972
p(normal)	0,777	0,020	0,799	0,008	0,238	0,115	0,995	0,931	0,001	0,452
Anderson-Darling A	0,192	0,830	0,227	1,137	0,436	0,619	0,129	0,208	1,107	0,360
p(normal)	0,890	0,029	0,802	0,005	0,282	0,099	0,981	0,855	0,006	0,431
p(Monte Carlo)	0,904	0,030	0,804	0,005	0,288	0,097	0,992	0,853	0,006	0,429
Lilliefors L	0,081	0,130	0,080	0,153	0,111	0,161	0,069	0,076	0,185	0,094
p(normal)	0,768	0,114	0,785	0,028	0,293	0,017	0,944	0,850	0,001	0,550
p(Monte Carlo)	0,777	0,115	0,779	0,030	0,296	0,017	0,929	0,843	0,002	0,546
Jarque-Bera JB	0,475	4,735	0,408	4,946	1,855	1,508	0,303	0,805	23,710	0,535
p(normal)	0,789	0,094	0,815	0,084	0,396	0,471	0,859	0,669	0,000	0,765
p(Monte Carlo)	0,754	0,050	0,791	0,044	0,217	0,300	0,846	0,585	0,003	0,723

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REVIEW ARTICLE

The Lower Palaeolithic in Korolevo I (Transcarpathia, Ukraine, East-Central Europe): the earliest in Europe?

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Abstract. A recently published article in "Nature" (Garba et al., 2024) claims that lithic finds in the lowermost artefact-bearing sediments of lithological unit 26 at the Korolevo I site (Transcarpathia, Ukraine) are the oldest in Europe, dated to *ca*. 1.42 Ma with cosmogenic nuclides of gravel pebbles. These surprisingly old dates were then used to build hypotheses on the geochronology and routes of the initial Homo erectus colonization of Europe from the east. The present author reviews all published and unpublished Lower Palaeolithic (LP) data of the Korolevo I site, the field investigations of which he also participated in the 1980s, and came to the following negative results. The dated pebbles in Korolevo I unit 26 are of "intrusive" character, they do not date unit 26 and its lithic finds. Also, the proposed Early Pleistocene interglacial MIS 47, 45 and 43 periods for the LP colonization of Europe either via Asia Minor and the Danube River valley or the Caucasus and the southern part of Eastern Europe do not correspond to the known palaeogeographic and archaeological data from Western Eurasia. Besides, our review of LP contexts in Korolevo I suggests that the so-called lowermost LP lithic artefacts found in situ in archaeological horizon VII within lithological unit 26 in Korolevo I in 1984–1986 are distributed randomly horizontally and vertically. Moreover, they are mostly unworked hyalodacite and siliceous sandstone pieces together with several artefacts redeposited from the sediments above. Accordingly, the only certainly LP material in Korolevo I we know so far is situated in archaeological horizon VI, which is geochronologically associated with the Middle Pleistocene inter-Mindel period or MIS 14, dated to *ca*. 550 ka BP. However, the Korolevo I site still appears to represent the oldest LP human occupation in both Eastern Central Europe and Ukraine.

Keywords: Ukraine, Transcarpathia, Early Pleistocene, Lower Palaeolithic, Korolevo site complex

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The present paper is dedicated to the fiftieth anniversary (September 1974) of the discovery of the Korolevo Palaeolithic site complex by the outstanding researcher of the Palaeolithic of Ukraine, V.N. Gladilin (1935–2015)

"*Evidence of human presence and activity in Europe around or before 1 million years ago is still limited and controversial. At most of the sites, the uncertainties concern either stratigraphy and dating or the artefactual character of the objects. In fact, we never may be certain until we discover and document living surfaces with full contextual data about the past human behaviors.*" (Svoboda *et al.*, 1998, p. 203)

1. Introduction

The Korolevo I site was discovered by Vladislav N. Gladilin (Demidenko, 2017) 50 years ago in September of 1974, in the Transcarpathian region of Ukraine which is the only Central European region of the geographically Eastern European

Fig. 1. Map of the Levant and Southern Europe with the location of Korolevo.

country (Fig. 1). Gladilin and his team from the Archaeological Museum of the Institute of Zoology, Ukrainian Academy of Sciences in Kyiv conducted large-scale archaeological investigations at the site every year between 1975 and 1991. Since then, Korolevo became widely known as a multi-period Palaeolithic site complex (e.g., Gladilin, 1989) with several *in situ* archaeological horizons in Quaternary sedimentary deposits up to a 12 m thickness, containing artefacts from the Lower Palaeolithic (LP) (e.g., Gladilin & Sitliviy, 1990) through the Middle Palaeolithic (MP) (e.g., Koulakovska, 1989) to the Early Upper Palaeolithic (UP) (e.g., Gladilin & Demidenko, 1989).

After the collapse of the Soviet Union, in the second half of the 1990s, L.V. Kulakovska and V.I. Usik[1] started regular Palaeolithic fieldwork in Transcarpathia. In contrast to Gladilin's approach who conducted intensive and systematic regional Palaeolithic studies in the context of the Central European Palaeolithic, these researchers mainly concentrated on Korolevo and a few other sites' stratigraphy and geochronology (e.g., Haesaerts & Koulakovska, 2006). They also investigated the integrity and characteristics of their lithic artefacts, mostly the Korolevo material excavated in the 1970s and 1980s (e.g., Koulakovskaya, 2004; Usik, 2003; 2008; Koulakovska & Usik, 2010). Reviewing the literature from the late 1990s to the 2010s, the Transcarpathian Palaeolithic can be seen as isolated and disconnected from contemporary sites and industries in neighbouring Central European regions. In the past 25 years, no papers were published in detail about any of the revised assemblages from Korolevo, or the newly excavated material from Beherove I, only strictly regional accounts (e.g., Koulakovska & Usik, 2011a; 2015; Usik *et al.*, 2004). One exception is the small assemblage of

1 For the sake of clarity, name varieties mentioned in the list of references as "Soldatenko, Koulakovska, Koulakovskaya" are all refer to L.V. Kulakovska, and "Usyk" to V.I. Usik.

33 lithics from Korolevo I horizon VII, the subject of the present paper. According to the published preliminary data from the 1980s and early 1990s, as well as more detailed papers from this century, the combined Palaeolithic industrial-geochronological sequence from Korolevo I and II spans from *ca.* 950 ka BP to *ca.* 40 ka BP. The sequence encompasses lithic industries from the LP to the Early UP, with the MP being the richest and best-represented among the archaeological horizons. Regarding the dating of the LP in Korolevo, the Korolevo I site was considered one of the oldest sites in both Central Europe and the entire European continent, dated to the "Günz" and "Günz-Mindel" periods, *ca.* 1.0–0.7 Ma (e.g., Gladilin & Sitliviy, 1990, pp. 128–129, 140–141).

The current Palaeolithic "island-like situation" in Transcarpathia was strengthened by the new dates of the lowermost LP artefact-bearing sediments in Korolevo I, *ca.* 1.42 Ma (Garba *et al.*, 2024). The newly received dates and their archaeological interpretation allowed our colleagues to conclude that "*Korolevo represents, to our knowledge, the earliest securely dated hominin presence in Europe*" (Garba *et al.*, 2024, p. 1). Accordingly, Korolevo is proposed to be the "first LP human island" in Europe, being an exceptional site. According to our present knowledge, Central European LP sites postdate the Early Pleistocene, so this is a strikingly early date. The known LP sites are almost two and a half times younger, not earlier than 0.6 Ma, and even that is still debated in the case of two presumably *in situ* Central European LP sites, based on their archaeological context, Přezletice and Stránská skála I in the Czech Republic (Valoch, 1995, pp. 69–70, 73–75; 2011, p. 12; Roebroeks & Kolfschoten, 1995, p. 304). Here we do not consider a few suggested LP loci with the presence of single lithic artefacts, e.g., the famous Quaternary sediment sequence at Červený kopec (Red Hill) in Brno (southern Moravia, Czech Republic) where allegedly "*a polyhedron was discovered in fossil soil PK X below the Matuyama/Brunhes palaeomagnetic boundary, i.e. approximately 0.8 m.y. old, and even older soil yielded a simple chopper (?)*" (Valoch, 2011, p. 22; see also Svoboda *et al.*, 1998). Such single finds without an industrial affinity cannot testify to an "LP site" status.

Considering this significantly increased age proposed to the Korolevo I LP (Garba *et al.*, 2024), the present article aims to analyze all the data concerning the new chronometric results, their lithological and archaeological context, and to gain more insight into the LP record of Korolevo I.

2. The newly proposed absolute dates for the Lower Palaeolithic of Korolevo I and the associated data: Pro and Contra arguments

2.1. The absolute dating method

This is, in fact, a novel approach for Palaeolithic artefact-bearing sediments aiming "*dating with cosmogenic nuclides, beryllium-10 and aluminium-26*" of gravel pebbles "*using P-PINI (particle-pathway inversion of nuclide inventories) and isochron burial-dating methods*" because it considers how long the pebbles "*were exposed at the surface for sufficient time to accumulate a large inventory of ^{10}Be and ^{26}Al before their lengthy burial*" (Garba *et al.*, 2024, pp. 1–2). The authors also note the most known and successful previous application of a "*P-PINI model to 10Be–26Al data*" (Garba *et al.*, 2024, p. 3), was conducted on a quartz piece found in the Early Pleistocene sediments of level TE9 in the Sima del Elefante cave site (Sierra de Atapuerca, northern Spain), resulting in a 1.22 ± 0.16 Ma date (Carbonell *et al.*, 2008, pp. 466–467). Importantly, this latter example concerns unquestionably LP lithic artefacts, paleomagnetic dates and faunal evidence.

Cosmogenic nuclide dating is more and more popular in Palaeolithic archaeology, as it can reach beyond the limits of radiocarbon dating. However, the 2024 Korolevo case was the first cosmogenic dating attempt of the international team organized and headed by R. Garba. It would be fortunate for the Czech–Ukrainian scientific collaboration for Transcarpathian research, to test the method at younger sites in the region where the archaeological material is undoubtedly *in situ*, and the the raw materials of the on-site worked lithic artefacts were mainly siliceous sandstone pebbles, similar to the ones dated in Korolevo I (Garba *et al.*, 2024, Supplementary Information, Table S2). Such a site is Ruban, with an MP Quina-type Mousterian material dated to MIS 4, which is located in sandy clayey alluvium right at a fossil river, containing numerous sandstone pebbles with a potential to date both the unworked pebbles and the MP artefacts.

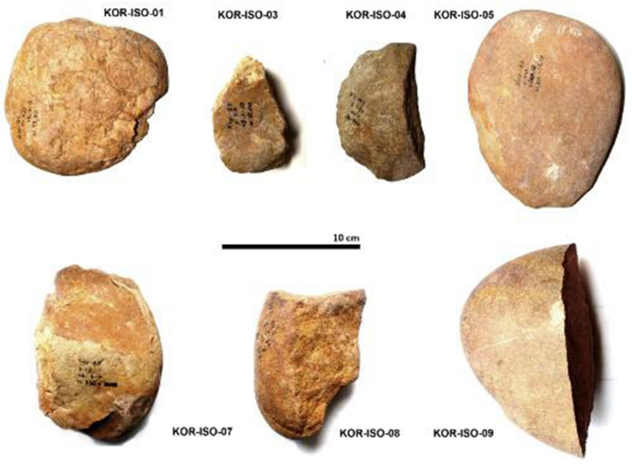

Fig. 2. Seven gravel pebbles from lithological unit 26, 1985 excavation block XIII, Gostryi Verkh, Korolevo I, dated with cosmogenic nuclides (after Garba et al., 2024, Supplementary Information – Fig. S4)

Another potential site is the Early UP Sokirnitsa 1-A, level 3 dated to MIS 3, *ca.* 20 km from the next sandstone occurrence (Demidenko & Racz, 2024, p. 241). However, the dating program aimed at the oldest recognized archaeological material in the region should be taken with caution. Such caution was warranted by G. Muttoni (Milano, Italy), a specialist in magnetostratigraphy and palaeomagnetism and one of the Garba *et al.*, 2024 article reviewers, noting that "*there is too much uncertainty around dates from the cosmological dating method to draw any conclusion about when the site was occupied*" (Johnson, 2024).

2.2. The sampling and dating procedures at Korolevo

For the Korolevo cosmogenic study, "*seven cobble-sized samples (Fig. S4) of different lithology (vein quartz, quartzite, fine-grained sandstone), weathering and mass from the lowermost cultural layer (level VII) were taken from the collection of the 1985 Transcarpathian Palaeolithic Expedition housed at the Archaeological Museum of the Institute of Archaeology in Kyiv*" (Fig. 2). These seven samples showed consistently "*high and relatively uniform 10Be concentrations (1.0–1.7 × 106 at g–1) and low* ^{26}*Al/*^{10}*Be ratios of 3.0 to 3.5.*" allowing the authors to suggest "*a single burial age*" for all the analyzed samples "*with little or no reworking*" (Garba *et al.*, 2024, Supplementary Information, pp. 10–11, 15). However, in connection with the isochron burial datning results of 1.42 ± 0.28 Ma (±1σ), the authors admitted "*an unexpectedly high (18%) uncertainty given the low degree of scatter among the samples*", namely, 280 000 years (Garba *et al.*, 2024, Supplementary Information, pp. 15–16). This is why the P-PINI burial dating calculations was additionally used for "*the same 10Be–26Al data*". The P-PINI dating results with additional calculations (see *contra* below), "*yields a burial age for level VII of 1.42 ± 0.10 Ma (±1σ), which includes 2% uncertainty on the decay constants and a surface* ^{26}*Al/*^{10}*Be production ratio that varies from 6.75 to 7.15*" (Garba *et al.*, 2024, Supplementary Information, p. 18). In other words, we can see the same basic date of 1.42 Ma with the uncertainty changed from 18% to *ca.* 7% using both isochron and P-PINI dating results. As a result, the paper concludes that the most reliable date is provided by the P-PINI model which also "*yields a well-constrained burial age that is relatively insensitive to both the average accumulation rate (Fig. S8) and the imposed initial depth*" (Garba *et al.*, 2024, Supplementary Information, p. 18).

However, the dated samples from level VII, and the dating results with "*a single burial age*" and "*little or no reworking of the samples*", still raise some serious doubts.

1) The results pertain to the seven pebbles used for dating, one third or 35% of the 20 pebbles "*embedded in the same cultural level VII (n = 20; depth 10.03–12.05 m)*" that "*were recorded, collected and stored with the artefacts as part of the museum collection*" (Garba *et al.*, 2024, Supplementary Information, p. 7). Moreover, Garba and Usik initially selected nine pebbles but then two "*fine sandstone*" clasts were excluded from the dating procedure due to the following two reasons (Garba *et al.*, 2024, Supplementary Information, p. 10, Table S2). One "*sample KOR-ISO-06 was excluded from further chemical processing due to its different origin (cf. Table S2)*". This clast, which was the heaviest piece with 2059 g, was found at the uppermost position of the 20 pebbles at a 10.03 m depth.[2] Another excluded pebble, sample KOR-ISO-02 weighing 462 g and found at a depth of 11.65 m, had "*low quartz content*". The remaining 11 pebbles were not described in the paper.

2) The uncertainty levels of 18% (280 000 years) for the isochron burial dating and *ca.* 7% (100 000

2 All depth measurements in excavation block XIII was taken from the present surface, at the highest corner of the block.

years) for the P-PINI burial dating are rather discouraging, although the authors propose to consider the more precise P-PINI model's results.

"*In the P-PINI model setup, the source zone is the contributing drainage area characterized by a set of model parameters that govern the pre-burial cosmogenic-nuclide inventory of the detrital particles (i.e., $^{10}Be/^{26}Al$ production rates, elevation range above sea level, bedrock density, periods of glacial cover, and erosion history). Each of these parameters is allowed to vary within a given range based on the field setting and together they define a range of plausible landscape histories experienced by the samples. The sink zone is defined as the site of permanent burial where samples are collected with the aim of determining their burial age*" (Garba *et al.*, 2024, Supplementary Information, p. 17).

Accordingly, it cannot be excluded that each of the parameters was set in such a way that they "artificially" lowered uncertainty from 280 000 to 100 000 years, although even the latter "narrow" interval provides a considerable interval to deal with. Certainly, previous testing of the cosmogenic nuclide methods in Transcarpathia would contribute to a more firm approach in setting the model parameters.

3) It is worth taking a closer look at the seven dated pebbles (Garba *et al.*, 2024, Supplementary Information, pp. 10–11, Table S2, Fig. S4). Even excluding the above-mentioned heaviest sample KOR-ISO-02 found at the highest position of 10.03 m, the seven dated pebble samples (Fig. 2) still do vary in depth (11.10–12.05 m), weight (196–1105 g), and size (the smallest fragmentary specimen is under 10 cm, the others are larger than 10 cm). Moreover, the samples are recovered from only three excavation squares (2×2 m each) in excavation block XIII. The excavation grid of this block has 32 squares in 128 m², which was excavated down to the lowermost stratigraphic unit 27 in 1983–1986. These factors cast doubt on the sedimentary homogeneous character without redeposition, thus the claimed simultaneous depositional age of these unworked (!) pebbles. Moreover, the published photos show (Garba *et al.*, 2024, Supplementary Information, Fig. S24) (Fig. 2), that four pebbles out of seven are heavily fragmented with worn surfaces, which strongly suggest transport or reworking. Concerning depth data, level VII containing the 33 lithic artefacts was measured between 9.40–12.00 m (2.60 m thickness). The interval is also considerable if we take the depth measurements of the artefacts into account, which are, according to Kulakovska and Usik, scatter between 8.98 and 12.05 m (3.07 m thickness, see Koulakovska, Usik & Haesaerts, 2010, p. 126; Kulakovska & Usik, 2015, p. 11). Accordingly, in level VII, there is no total overlap between the depth of the dated pebble samples (11.10–12.05 m) and the depth of the artefacts they are supposed to date (11.10–12.05 m and 8.98–12.05 m). It seems that the seven fragmented and worn pebbles date the lower-lying portion of the artefacts in level VII and not the entire unit in which the artefacts were distributed. It should be emphasized that 24 of the 33 artefacts in level VII were found at a depth between 8.98/9.40–11.00 m, that is, 72.7% of the artefacts were recovered above the dated pebbles (re-calculated from Kulakovska & Usik, 2015, pp. 14–17).

2.3. The dated pebbles and their stratigraphic position within the Korolevo I sediment sequence

The dated pebbles and artefacts of archaeological level VII stratigraphically belong to lithological unit 26: "*...light-grey sands of floodplain facies (unit 26), with multiple yellow and bright-red spots. The latter indicates enrichment in iron oxides that can be typical for sediments formed under a warm interglacial climate. According to the pollen data, this bed, with cultural layer VII, also was formed in an interglacial.*" Unit 26 was deposited above the lowermost Pleistocene unit 27 at the site: "*The lowermost (27) is represented by a basal bed consisting of pebbles cemented by red-coloured clays*" (Garba *et al.*, 2024, Supplementary Information, p. 5). In the main text where the short stratigraphy for Korolevo is illustrated (Garba *et al.*, 2024, Fig. 2, p. 3), unit 26 is characterized as "*Alluvial, silt/sand*" and unit 27 below as "*Alluvial gravel, clay matrix*" constituting two different alluvial sediment facies.

This stratigraphical description of unit 26 containing the lowermost artefact-bearing level VII mentions only sandy/silty sediment without a gravel component. Thus, the presence of 20 pebble- and cobble-sized clasts in unit 26, excavation block XIII of 1985, needs an explanation. Here it should be emphasized again that the pebbles in question are all "natural" and lack any evidence of treatment by Palaeolithic

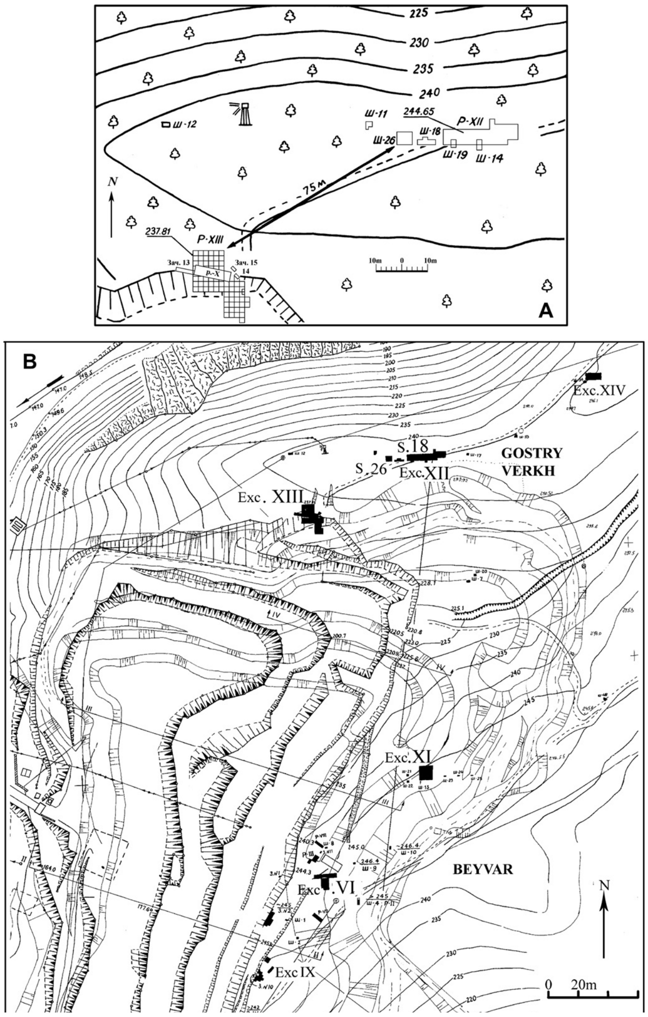

Fig. 3. A: excavation blocks in the Gostryi Verkh area in Korolevo, up to 1986 (after Adamenko et al., 1989, Fig. 3); B: relief map of the Gostryi Verkh area Beyvar areas in Korolevo I, with the excavation blocks up to 1988 (after Koulakovska *et al.*, 2010, Fig. 2B)

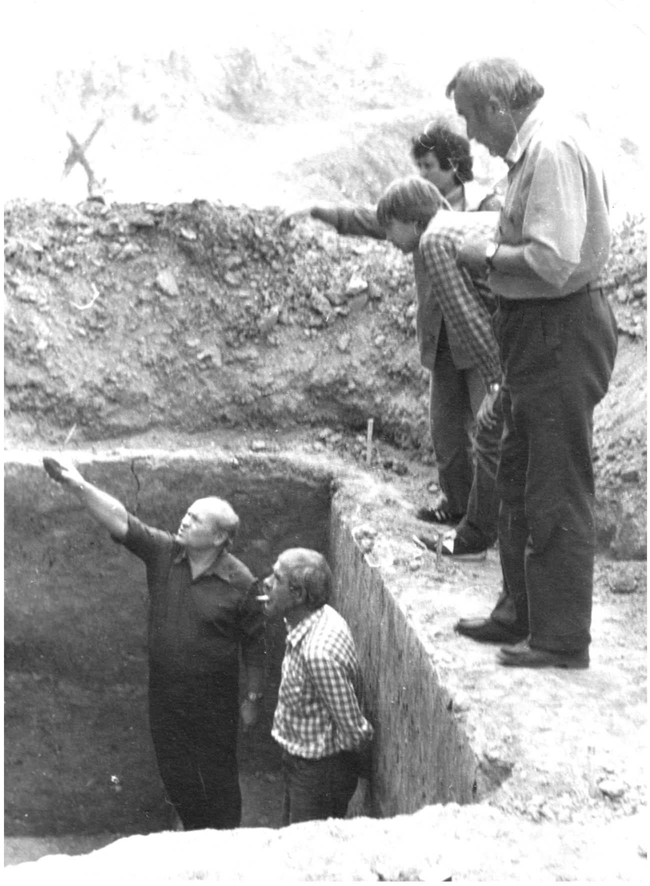

Fig. 4. Profile studies in 1985, along squares и-к-л – 10 in excavation block XIII, Gostryi Verkh area. From left to right: O.M. Adamenko, V.I. Tkachenko, G.A. Pospelova, Yu.E. Demidenko, V.N. Gladilin (photo by Yu.V. Kukharchuk)

humans, suggesting that they were not brought to their place of recovery by humans. Consequently, we have to find other ways to confirm or abandon the co-occurrence of these pebbles and LP lithic artefacts in level VII.

The stratigraphic description of Korolevo I in the 2024 paper is based on secondary sources, not new fieldwork. The authors used previous lithological studies conducted in the 1980s (O.M. Adamenko and V.N. Gladilin), 1998 (P. Haesaerts) and 2006 (J. Nawrocki and M. Lanczont with Polish and Ukrainian colleagues), mainly the description of Haesaerts from 1998 about unit 26. "*Unites 25 et 26 (11,20 a 11,50 m). Sable limoneux a taches grises et ocre, passant vers le bas a un sable gris-jaune legerement stratifie, lequel repose au sommet du cailloutis de l'unite 27*" ["Units 25 and 26 (11.20 to 11.50 m). Silty sand with gray and ochre spots, passing downward to a slightly stratified gray-yellow sand, which rests on top of the pebble of Unit 27" (translated by the present author)] (Haesaerts & Koulakovska 2006, p. 25). The other descriptions and illustrations of the lower straighraphic units in Korolevo I present sondages 18 and 26 from the 1980s, profile cleanings in 1998 and 2006, located *ca.* 75 m to the east from block XIII of the 1983–1986 excavations (Fig. 3), as well as excavation block XIII itself (e.g., Adamenko & Gladilin, 1989, Fig. 2, Tab. 1; Adamenko *et al.*, 1989, pp. 6–16, Figs. 4 & 5; Gladilin, 1989, pp. 99–101, Fig. 4; Haesaerts & Koulakovska, 2006, pp. 25–27, Fig. 2; Koulakovska, Usik & Haesaerts, 2010, pp. 126–127, Fig. 3; Kulakovska & Usik, 2015, p. 7, Fig. 4; Nawrocki, *et al.* 2016, p. 77, Tab. 1, Fig. 10; Garba *et al.*, 2024, Fig. 2; Garba *et al.*, 2024, Supplementary Information, p. 5). None of them showed the presence of large- and medium-sized gravel pebbles above the basal unit 27, the

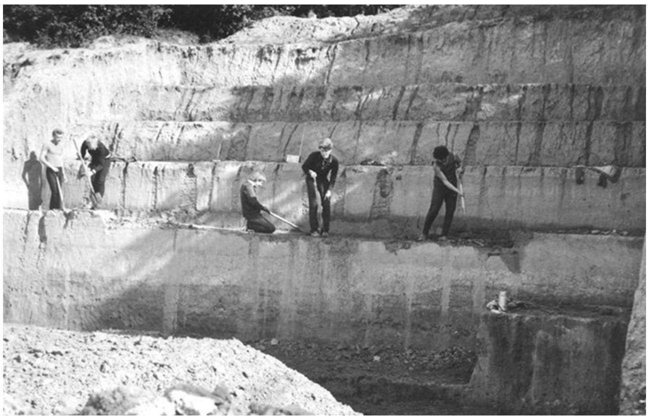

Fig. 5. Excavation in excavation block XIII, Gostryi Verkh area in 1984 (photo by Yu.V. Kukharchuk)

only proper gravel alluvium with pebbles in the site's sedimentary sequence. Here it is also worth mentioning that geologist O.M. Adamenko, who studied the sedimentary units in the field in the 1970s–1980s, used the basic stratigraphic and lithological data observed in sondage 18 both before and after (!) the excavations of block XIII (e.g., Adamenko *et al.*, 1989, pp. 6–16) (Fig. 4).

Stratigraphical unit 26 in Korolevo I is sometimes shortly described as "*small pebble alluvium*" (e.g., Koulakovska, Usik & Haesaerts, 2010, p. 126). With this name, Haesaerts followed the stratigraphy of Korolevo as described by Adamenko and Gladilin in the 1980s. They noted the presence of "*small pebbles (up to 5 cm)*" in unit 26, while unit 27 below was characterized "*with big pebbles*" (e.g., Gladilin, 1989, p. 97).[3] However, such small pebbles usually occur within alluvial sands (!) and they can not weight more than 50 g, while the dated cobbles are much heavier (196–1105 g) and larger (>10 cm). Thus, units 26 and 27 contain considerably different clasts and they cannot be confused. Therefore, the dated large- and medium-sized pebbles look absolutely "lithologically exogenous" in unit 26.

2.4. Concluding remarks

The presented arguments showed that the middle- and large-sized pebbles used for the dating of the LP in Korolevo I have worn surfaces indicating reworking, they occurred together only with a small portion of the lithic artefacts in level VII, in the lower part of lithological unit 26. These arguments suggest that the dated pebbles are "intrusive" in unit 26 and cannot be associated with the LP archaeological material. Taking into consideration that such large- and medium-sized gravels are known only from unit 27 in the lower sediment sequence of Korolevo I, the most plausible scenario is that these pebbles in unit 26 originate from the underlying unit 27. Thus, these pebbles proposed to be dated to *ca.* 1.42 Ma might represent the age of unit 27, the archaeologically sterile gravel alluvium at Korolevo I.

3. Unit 26 in the Korolevo I site stratigraphy: some possible explanations of the presence of large- and medium-sized pebbles

Considering the "intrusive, not genuine" origin of these pebbles within unit 26, we propose several factors to explain their occurrence in silty/sandy deposits, that all contributed to the complicated lithology of unit 26.

1) The most straightforward explanation for their presence that comes to mind to the present author, who personally participated in the excavation of block XIII in 1983 and 1985–1986, is fieldwork methodology. Having no fauna and other organic remains in the artefact-bearing sediments, Gladilin used a 2×2-metre grid instead of 1×1, as usual for Palaeolithic sites, without internal subdivision of the 4 m^2. As Gladilin presumed, find density did not increase, so block XIII was excavated with spades and without sieving, in 20 cm thick spits with arbitrary horizontal levels (Fig. 5), despite the previously known significant southeastern inclination of the sediment sequence (see below). Taken together, it was a rather unsophisticated excavation technique targeting to acquire *in situ* LP artefacts in block XIII.

Here, the present author draws special attention to the use of the term archaeological "*level/layer*" in Garba *et al.* 2024. These terms were applied only for artefacts found *in situ* by Kulakovska and Usik (e.g., Kulakovskaya, 2009, p. 92). However, in their Korolevo revision, several assemblages were composed of *in situ* finds, artefacts from excavated but redeposited sediments, and also

3 The stratigraphic studies of V.N. Gladilin and O.M. Adamenko in Korolevo are often cited from the English publication by Gladilin in 1989, to avoid mistakes in geological terminology. For the present paper, the author used and translated their other articles published in Russian in the 1980s.

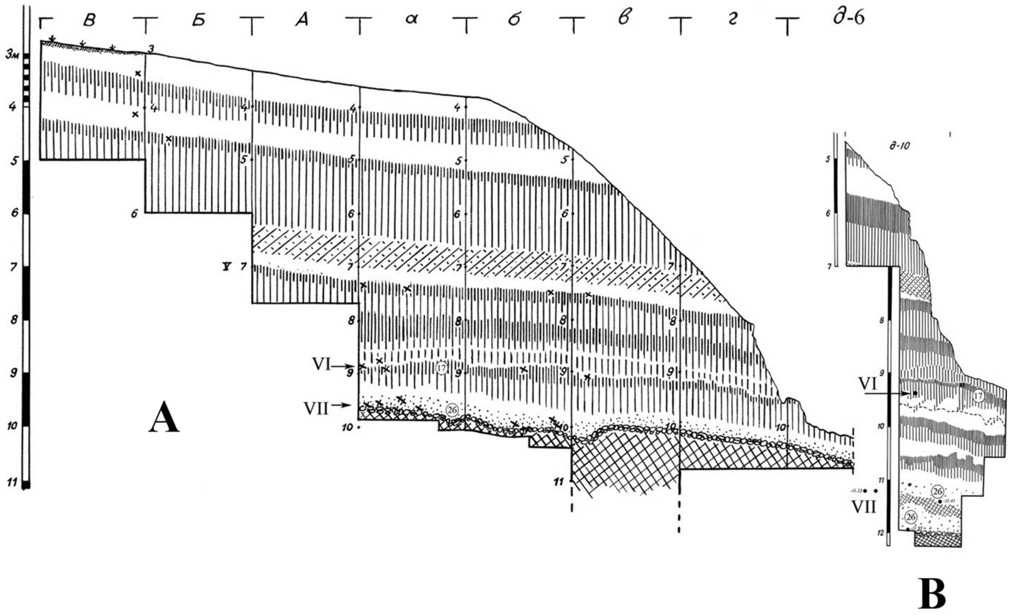

Fig. 6. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). A: part of the eastern stratigraphic profile; B: the eastern stratigraphic profile for square д-10 (modified after Koulakovska *et al.*, 2010, Fig. 10)

finds collected from the surface. Such mixed assemblages were named "*cultural-chronological complexes*" by Gladilin (e.g., Gladilin, 1989, p. 93). He also (!) used the term "*cultural horizons/ horizons*" (e.g., Gladilin, 1989, p. 102) for *in situ* excavated artefacts at the site where a real find horizon was visible during fieldwork. The opinion of the present author is that Gladilin used his "*horizon*" term correctly for these occurrences, again, due to the mentioned absence of organic remains and the rarity of archaeological features. Apart from weakly-preserved fireplace remains in a few instances, the only archaeological phenomena in the excavated *in situ* beds were lithic artefacts. This is why the term "*horizon*" perfectly fits here, and not the term "*layer/level*". Accordingly, the term "*horizon*" will be used in this meaning in the remainder of this article.

In excavation block XIII, both lithological units and archaeological horizons inclined to the southeast more than three meters along the 22 m trench, including horizon VII with the artefacts measured between 8.98–12.05 m in depth (e.g., Koulakovska, Usik & Haesaerts, 2010, Fig. 9–10; Kulakovska & Usik, 2015, Fig. 5–6) (Fig. 6A). This inclination hindered the stratigraphic control of find positions during the excavations. It was especially true for squares а-б – 1-4, в-г – 4, far from the main longitudinal profile in the east (Fig. 7). Here, occasional mixing of finds from different lithological units have probably taken place. Therefore, the presence of pebbles from unit 27 in the lower part of unit 26 is not surprising with such excavation circumstances.

2) The lower part of the stratigraphic sequence of Korolevo I has some "deposition problems".

There are "*three erosional hiatuses between the Matuyama–Brunhes boundary and level VII (Fig. 2)*" (Garba *et al.*, 2024, p. 2), that is, a *ca.* 1.5 m thick sediment package constitutes units 23–25 between lithological units 22 (*ca.* 0.77 Ma) and 26 (see Gladilin, 1989, pp. 98–100). Although Adamenko and Gladilin distinguished lithological units 25 and 26 (e.g., Gladilin, 1989, p. 97), and Haesaerts combined them (Koulakovska, Usik & Haesaerts, 2010, p. 126), it is still worth noting that "*in Korolevo excavation XIII, an erosional break* [underlined by the present author] *is observed between the alluvial units 26 and 25*" (Garba *et al.*, 2024, Supplementary Information, p. 5). Moreover, the silty/sandy deposits of Haesaerts' unit 26 were not lithologically homogeneous in its entire 0.8 m thickness. The mentioned "*erosional break*" refers to this phenomenon observed by Haesaerts: "*In square д-10, lithological layer 26 is divided by a horizon of diluvium* [underlined by the present author], *suggesting a localized episode of disturbance within the stratigraphic sequence (Fig. 10). Above horizon 3, level VII artefacts were found (Fig. 10). Beneath this horizon, one flake and two chunks were found. There was no diluvium observed either above or below*" (Koulakovska, Usik & Haesaerts, 2010, pp. 126–127) (Fig. 6B). Probably, lithological unit 24 in the stratigraphy of Adamenko and Gladilin

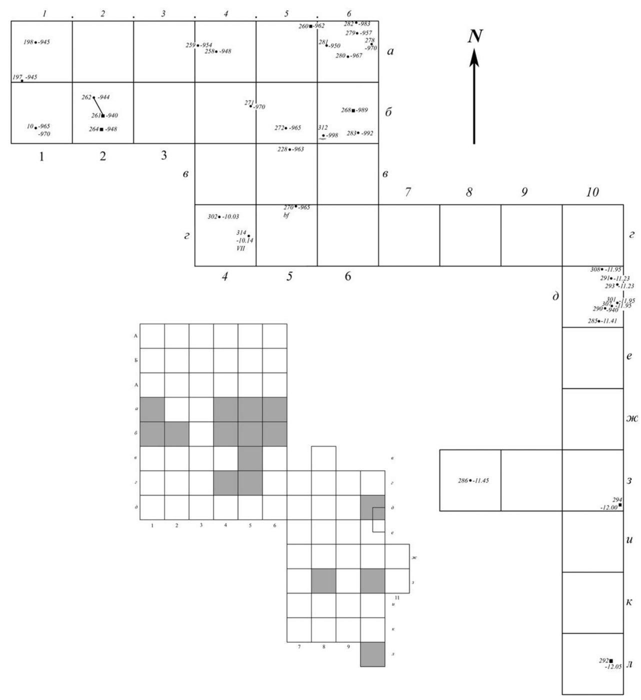

Fig. 7. Plans of excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Spatial distribution of horizon VII lithic artefacts recognized by Kulakovska and Usik (modified after Koulakovska *et al.*, 2010, Fig. 9)

for sondage 18 and 26 (e.g., Gladilin, 1989, p. 96) is also a similar diluvium up to 0.10 m thick.

Thus, it is highly likely, that a series of identified and probably not identified (!) diluvium episodes and erosional breaks influenced the site's stratigraphy at its most complicated lower part, and this is the reason why some large- and medium-sized pebbles appeared in unit 26.

3) The topography of excavation block XIII, where the artefacts of horizon VII were found *in situ* in 1984–1986, is worth a special discussion (Fig. 3B). Usik, one of the key archaeological contributors to Garba *et al.*, 2024, analyzed the stratigraphic position of horizon V, the uppermost LP "*Acheulian*" horizon of Gladilin (e.g., Gladilin & Sitliviy, 1990, pp. 55–65; Tab. XXIV–XXIX), which is now considered Early MP (Usik, 2009). He mentions:

"*Excavation block XIII. The excavation block is located approximately 75 m southwest of sondage 26 [Adamenko et al., 1989, p. 7, fig. 4]. The current state of the quarry shows that the excavation block was cut into the western edge of a huge ravine* [underlined by the present author], *the bottom of which is located approximately in line of sondages 18 and 26. The cultural layer, which corresponds to layer V and can be analyzed, comes from the part excavated in 1983–84. In an area of more than 100 m², less than 100 artefacts have been found (Fig. 2). According to the description of the eastern wall (sq. A, a-6), loess-like loam corresponding to horizon 9 lay at a depth of 7.00 m to 7.30 m (Fig. 2, I). Along the border of squares A-a 1-6, a drop of loam in the western direction to a depth of 7.40 m to 7.70 m was noted (Fig. 2, I (A/a)). The northern projection of the artefact scatter from squares A-6/a-6 shows a significant vertical dispersion (Fig. 2, I). These observations are confirmed by a few refitted artefacts. A similar situation is seen when projecting the position of artefacts along line 6 onto the eastern wall of the excavation. In general, we can conclude that in the studied part of excavation XIII, artefacts of layer V were deposited in the lower part of horizon 8, in the loam of horizon 9 and the upper part of horizon 10, corresponding to the horizons of the main stratigraphic sections of Korolevo (Fig. 3). Apparently, the cultural layer was influenced by the activity of the ravine and the ancient relief* [underlined by the present author and translated by the present author]." (Usik, 2009, p. 104).

Having such a complicated stratigraphy for archaeological horizon V with its lithic artefacts dispersing in three (!) lithological units, due to ravine processes, it would be logical to assume a similar situation for the finds of horizon VII. Indeed, looking at the northern, transversal profile a/A – 1 – 6 of excavation block XIII (Koulakovska, Usik & Haesaerts, 2010, Fig. 9a-b) (Fig. 8A), a partly compressed stratigraphy is seen, in which lithological unit 26 is missing for more than half of the 12 m wide profile in its western part; besides, an inclination to the east suggests an active ravine context. It also means that a part of lithics assigned by Kulakovska and Usik to horizon VII, which comes from at least eight squares (a-б – 1-4, 32 m² in total, Fig. 8B), was most probably deposited in the gravel of lithological unit 27 that is well-represented there. It is also possible that units above this gravel, now unknown to us, contained these artefacts. Thus, the lithic assemblage of archaeological horizon VII was composed by Kulakovska and Usik from artefacts originating from at least three lithological units: units 26 and 27, and probably some now-unknown unit(s) above.

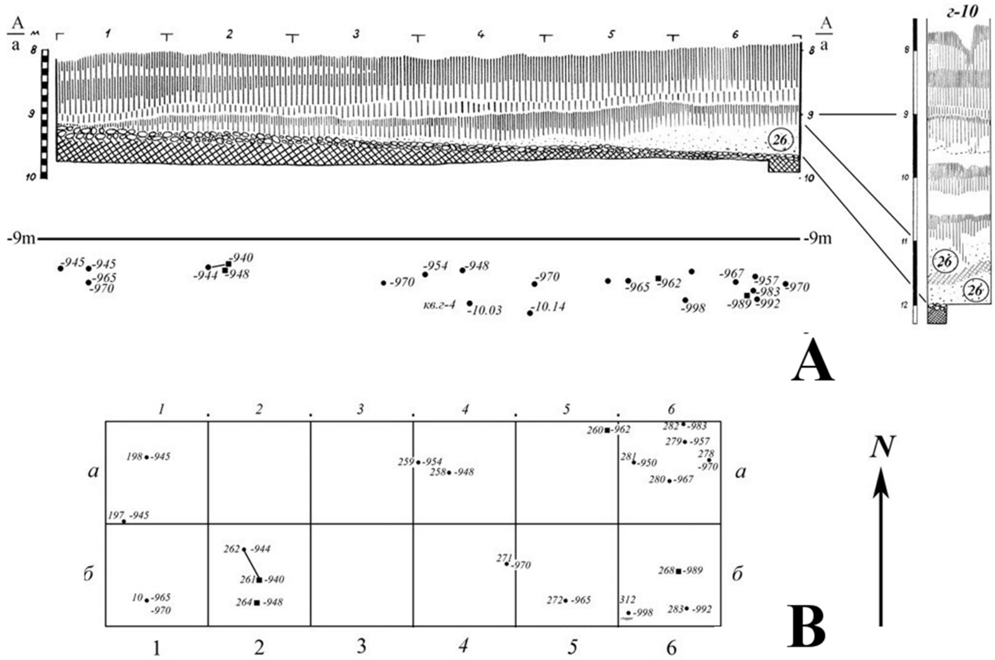

Fig. 8. Excavation block XIII, Gostryi Verkh area, Korolevo I (1984–1986). A: northern stratigraphic profiles and the vertical positions of horizon VII lithic artefacts, as recognized by Kulakovska and Usik; B: horizontal distribution plan of horizon VII lithic artefacts, as recognized by Kulakovska and Usik (modified after Koulakovska *et al.*, 2010, Fig. 9)

Usik's description of the lithics from horizon V in excavation block XIII is also worth citing here: "*The artefact assemblage composition: the virtual absence of lithic concentrations and formal tools, and the presence of clearly random items that are primarily the result of separate, unrelated flaking processes, indicate a peripheral nature of the excavated area*" [translated by the present author] (Usik, 2009, p. 106). Combining Usik's description of the stratigraphy and lithics of horizon V, one can get the impression that this lithic assemblage consists of randomly redeposited pieces due to sedimentation processes affected by the ravine. The same could also happen with the lithic artefacts and pebbles of horizon VII in excavation block XIII (see the lithic artefact analysis of horizons VII and VIII below).

Thus, sediments below the Matuyama-Brunhes boundary at Korolevo ("*passing between the VIIIth and IXth fossil soils*" – Gladilin, 1989, p. 100, that is, between lithological units 21 and 22), particularly in the huge ravine area of excavation block XIII had no easy stratigraphy and depositional history. Accordingly, stratigraphic and artefact disturbance must be expected, especially in the lower sediments, where depth measurements of horizon VII lithic artefacts scatter between 8.98/9.40 and 12.00/12.05 metres, along the 307 cm long slope of the ravine.

4) The lowermost Korolevo lithological unit 27 also deserves a more thorough look. Adamenko and Gladilin, and then Haesaerts emphasize its gravelly characteristics. "*The same loam* [Yu.D. – like the ones of units 25 and 26] *with marked ochre-red hue and with big pebbles; alluvium; thickness up to 0.30 m*", and this unit 27 is underlined by unit 28: "*the weathering crust of the dacite*" (Gladilin, 1989, p. 97).

"*Cailloutis hétérogène comprenant une majorité de galets, cimenté par un sable argileux bigarré. Ces cailloutis et les alluvions limono-sableuses susjacentes … appartiennent à la terrasse de la Tisza*" ["Heterogeneous gravel comprising mainly pebbles, cemented by a variegated clayey sand. These pebbles and the overlying silty-sandy alluvium belong to the Tisza terrace" (translated by the present author)] (Haesaerts & Koulakovska, 2006, p. 25).

The 2006 study of the lowermost sediments at Korolevo, corresponding to lithological unit 27, provided more details: "*Bw horizon (?) red-orange, weakly developed, faint. Scattered river gravels occurring in its lower part were redeposited from the hypsometrically higher alluvial horizon (Fig. 1C). It is possible that this red-orange horizon is a soil developed directly on weathering crust of volcanic rocks (it may be evidenced by a high content of clay fraction, enrichment with resistant minerals). This soil is characterised by high content of iron* *compounds up to 6.5%. It is partially redeposited and contains kaolinized blocks/debris of volcanites so it looks like breccia. Sharp erosion-denudation boundary separates this soil from the weathering crust developed on andesitic basement*" (Nawrocki *et al.*, 2016, p. 77). Regarding the pebbles in unit 26, it is the most important information here is the redeposition of pebbles from a higher alluvial level. In the case of redeposition, the presence of pebbles in the silty-sandy alluvium of unit 26 is not surprising, especially when we consider the "ravine factor" effect on the sediments in excavation block XIII.

Summarizing the four mentioned factors: the unsophisticated excavation methods, various diluvium episodes and erosional breaks, the location of excavation block XIII within a huge ravine affecting sedimentation, including redeposition of gravels from topographically higher alluvial sediments; the "intrusive" presence of large- and medium-sized pebbles in unit 26 is highly probable. Thus, the cosmogenic nuclide dating of unit 26 pebbles to 1.42 Ma, and the inferred result that Korolevo I provides "*the earliest securely dated hominin presence in Europe*" (Garba *et al.*, 2024, p. 1) does not correspond to the lithological situation of unit 26 in excavation block XIII and should be rejected.

4. The 1.42 Ma date for Korolevo I and the newly proposed hypotheses on the geochronology and the earliest Early Pleistocene, LP human dispersal routes into Europe

Besides the absolute dating program of the lowermost artefact-bearing sediments in Korolevo, Garba and his associates also propose the geochronology of LP human occupation at Korolevo and the initial occupation of high-latitude Europe (Garba *et al.*, 2024, Fig. 1). Their hypotheses are cited below.

"*Our findings at Korolevo provide the first primary evidence advancing the hypothesis that Europe was colonized from the east. A plausible dispersal scenario is that the Korolevo hominins stem from the Levant via Asia Minor, the Danube corridor and the Pannonian Basin (Fig. 1). Alternatively, a route from the Caucasus and to the north of the Black Sea remains a possibility*" (Garba *et al.*, 2024, p. 4).

"*H. erectus occupied Korolevo at a time* [...which] *(1.42±0.10 Ma) coincides with three interglacial warm periods* [...] *MIS 47, 45 and 43* [...] *These interglacials apparently offered some of the most favourable conditions for* H. erectus *during the half million years before the Middle Pleistocene Transition.* [...] *This supports the idea that early hominins exploited warm interglacial periods to disperse into higher latitudes*" (Garba *et al.*, 2024, pp. 4–5).

The present author proposes that these ideas do not correspond to the widely known paleogeographic and archaeological evidence of the Palaeolithic in Western Eurasia.

First, considering interglacials as periods for the first human dispersals to Europe from the East Mediterranean Levant during the Early Pleistocene. Global average sea levels during interglacials were significantly higher than today, in the Mediterranean Basin as well. Early Pleistocene *Homo erectus* groups without seafaring vessels and knowledge would not be able to cross open waters between Asia Minor and the Balkans. The route via the Caucasus, considered due to the Dmanisi Early Pleistocene site in the region, would be even more complicated for any LP human groups because there were two natural barriers between the South Caucasus and the southern part of Eastern Europe. The first barrier was the Main Caucasian Range which did not allow any LP and MP human groups, neither *Homo erectus* nor Neanderthals to travel through. This is why, for example, MP Micoquian sites are well-known in the North Caucasus and entire Eastern Europe but they are completely unknown in Transcaucasia. On the other hand, MP Zagros Mousterian sites frequently occur in the South Caucasus and are absent in the North Caucasus and Eastern Europe. Similar examples can be found in the LP, the South Caucasus is rich in Acheulean sites but there is not even one Acheulean site in entire Eastern Europe. Only Early UP *Homo sapiens* groups with various lithic traditions penetrated the North Caucasus and the southern parts of Eastern Europe from Transcaucasia because they followed the eastern shore of the Black Sea, exploiting aquatic resources for their subsistence. LP and MP humans did not exploit marine and river food resources systematically, consequently, they were unable to follow sea shorelines (see Demidenko, 2014; 2020). The high mountains certainly posited a similar obstacle to their dispersion.

The second natural barrier was the Manych Strait (Fig. 9) that connected the Caspian Sea and

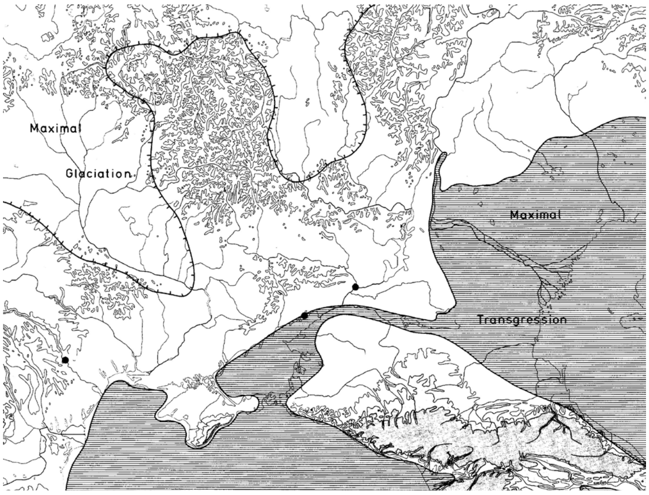

Fig. 9. Map of the southern part of Eastern Europe showing maximum glaciation and the maximum transgression of the Manych strait (modified after Praslov, 1995, Fig. 2)

the Sea of Azov during interglacials and even interstadials of the Pleistocene (see, e.g., Kaplin & Selivanov, 1999, pp. 169–239; Yanina, 2009). This sea-like water barrier would be again impossible to cross for LP *Homo erectus* groups without seafaring vessels and knowledge. The Pleistocene Manych Strait obstacle was also considered by Gladilin (1976, pp. 141–142), who believed that the peopling of Eastern Europe during various periods of the LP and the MP happened from the west, from Europe and not from the south, via the Caucasus. That was one of the reasons he moved to Transcarpathia in his search of LP sites (Gladilin, 1976, pp. 137, 148; Demidenko 2017, pp. 165–166). Finally, there is one more data set that contradicts an Early Pleistocene LP "Caucasian migration route". LP "*early hominin sites*" in the Taman peninsula of the Black Sea and the northern Caucasus are briefly mentioned (Garba *et al.*, 2024, p. 4), as indicators of LP human migrations from the South to the North Caucasus and further to the south of Eastern Europe. Some Russian colleagues working in the northern Caucasus for the last 40 years have reasonably considered these sites to be "*related to shallow water marine and marine shore sediments, which correspond to typical conditions for the formation of eolithic or geofact assemblages. The shallow water marine and marine shore environments are also unique to these sites and have no analogs among verified Early Pleistocene archeological assemblages in either Europe and West Asia or Africa. Two lines of evidence combining archaeological and geoarchaeological indicators strongly suggest that the "Oldowan" assemblages from Dagestan and Taman most likely represent collections of naturally broken stones that were selected by researchers among fragments of the same rock that is present naturally in the area*" (Doronichev & Golovanova, 2022, p. 18). Based on their views, there are no LP archaeological "bridge sites" between Dmanisi in the South Caucasus and the south of Eastern Europe as it was suggested by Garba and his associates.

In conclusion, the present author argues that the newly proposed dating of the lowermost artefact-bearing sediments in Korolevo, the suggested geochronology and Early Pleistocene, LP human migration routes to Europe are incorrect in the Garba *et al.* 2024 article.

5. Lower Palaeolithic stratigraphy and artefacts in Korolevo: previous and newly proposed hypotheses

5.1. Stratigraphy

After the discovery of Korolevo I in September 1974, Gladilin conducted large-scale annual fieldwork at the site, excavating *in situ* archaeological horizons. Gladilin also understood that the rock most frequently used for on-site artefact production in Korolevo, andesite (hyalodacite, see for the most recent update in Demidenko & Rácz, 2024), is characterized by varying degrees of surface weathering, less for the younger and more for the older pieces. It has led him to group finds from *in situ* excavated contexts, redeposited sediments, and also from surface collections together, according to their degree of weathering (e.g., Gladilin, 1989, p. 95). As a result, he and then we, as his team, started to use the term "cultural-chronological complex" for these assemblages, instead of horizon. Nevertheless, some artefact assemblages originate only from *in situ* horizons in Korolevo I, such as the Early UP Ia horizon, and the MP IIb and II horizons, that do not contain lithics from redeposited sediments or the surface. Then, in the 2000s, Kulakovskaya and Usik started to concentrate on analyses of only *in situ* finds for each horizon excluding finds from other contexts. Their revision led to the distinction of a "pure" industrial component in "mixed" assemblages, which also changed the characteristics of the industries in some cases (e.g., Koulakovska & Usik, 2017).

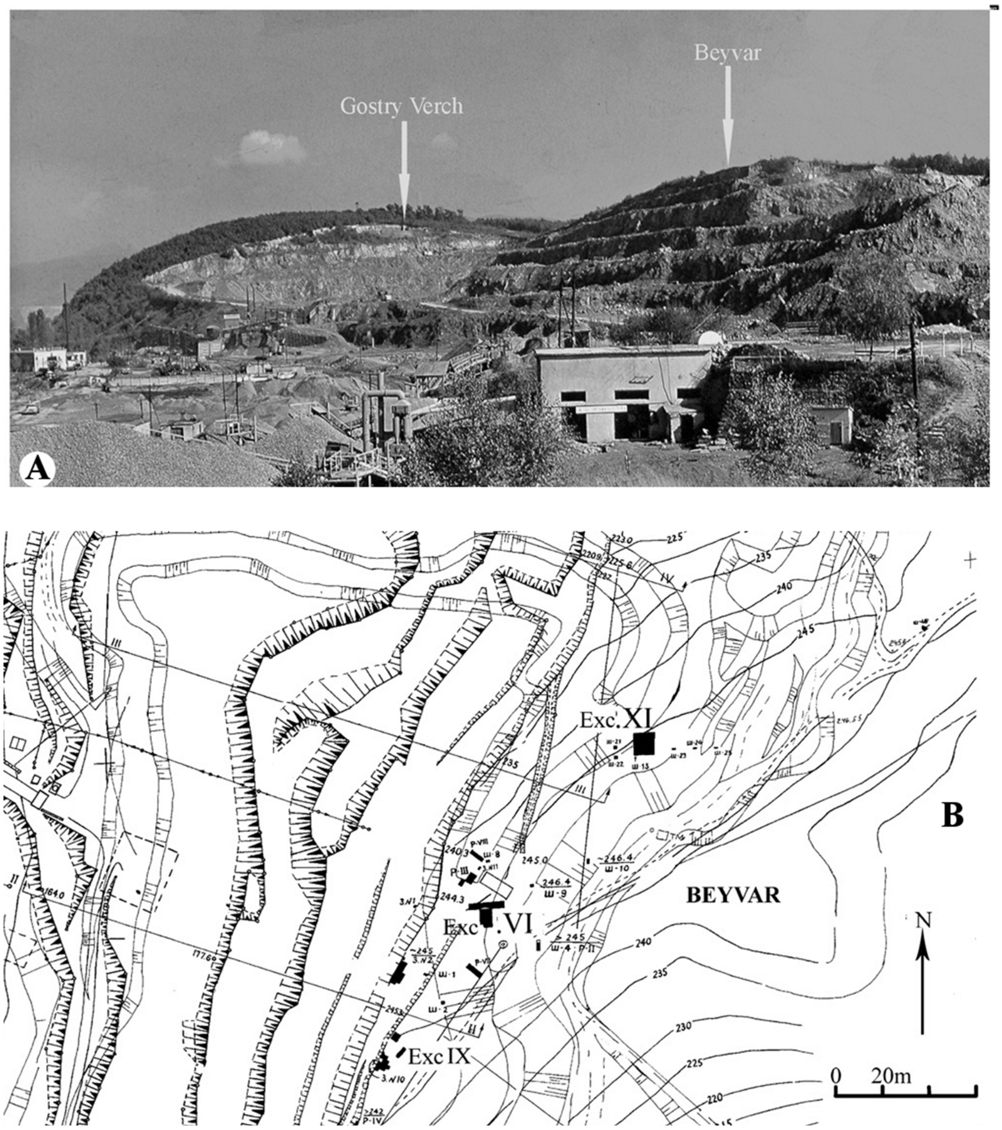

Fig. 10. A: a general overview of Korolevo I with the Gostryi Verkh and Beyvar hills/peaks (after Koulakovska et al., 2010, Fig. 1B); B: topographic plan with all excavation blocks at the Beyvar site in Korolevo I up to 1988 (modified after Koulakovska et al., 2010, Fig. 2B)

However, in the 1970s and 1980s, Gladilin was still added non-*in situ* hyalodacite finds to respective *in situ* horizon finds in Korolevo. Before the 1984 excavation of block XIII and units 26 and 27 in it, he defined the presumably lowermost and most archaic find complexes (VII and VIII) based on redeposited and surface hyalodacite finds.

The Korolevo I site (or more correctly, the Korolevo Palaeolithic site complex including the nearby Korolevo II, see Demidenko & Rácz, 2024), (Fig. 10A) is composed of two hills, Gostry Verkh and Beyvar. Beyvar (Fig. 10B) is the archaeologically richer location where most of the MP horizons (II, IIa, III and V) and the LP horizon VI were found *in situ*, providing a large number of lithic artefacts. At Gostry Verkh (Fig. 3A), all archaeological horizons are poorly represented, except the Early UP horizon Ia (sondages of 1979 and 1986, excavation block XII), and the MP horizon IIb with pointed Levallois-Mousterian (excavation block XIV). On the other hand, Gostry Verkh has a longer, more complete stratigraphic sequence compared to Beyvar. The lowermost find complexes (VII and VIII) were defined based on redeposited and surface artefacts in Beyvar, and the only chance to find them *in situ* was in Gostry Verkh.

Respectively, sondages 18 and 26 at Gostry Verkh, excavated in the late 1970s and early 1980s, were opened to provide the longest stratigraphic profiles in Korolevo I (up to 12 thick Pleistocene sequences) and to find *in situ* LP archaeological material, first of all, horizons VII and VIII. The two sondages lacked such horizon VII and VIII finds *in situ*, having only horizon VI material as their lowermost archaeological finds. Horizon VI was already well-known from Beyvar excavation block IX, at the top of paleosoil VII in lithological unit 17, from the inter-Mindel or MIS-14 (e.g., Haesaerts & Koulakovska, 2006, pp. 24, 28, Fig. 2; Koulakovska, Usik & Haesaerts, 2010, p. 120, Fig. 3). However, these two sondages provided the most complete stratigraphic sequences for Korolevo I, described by geologist Adamenko with Gladilin in the 1980s. Following excavation, they used these profiles for the publication of the combined Korolevo sequence, even after the excavation of block XIII (e.g., Adamenko *et al.*, 1989, pp. 6, 9–16; Gladilin, 1989, pp. 96–97; Gladilin & Sitliviy, 1990, pp. 28–30). In these complete sequences, large- and medium-sized pebbles were only recognized in unit 27 with alluvial gravels and not in unit 26 with silty-sandy alluvium. Further stratigraphic data of these early periods came from the 1998 and 2006 profile cleanings *ca.* 75 m from excavation block XIII dug in 1983–1986, the latter of which finally provided *in situ* lithic artefacts belonging to horizons VII and VIII.

5.2. LP lithic artefacts

For the analysis of the lowermost lithic artefacts at the Korolevo site complex, it is needed to take a closer look at such hyalodacite pieces. At first, even an experienced Palaeolithic archaeologist might not recognize hyalodacite objects as human products. This is especially true for pieces with significant chemical destruction, like the ones from horizon III, where MP Levallois-Mousterian with Levallois centripetal flake technology have been excavated *in situ* at "*the top of paleosoil K-IV (sub-unit 8a)*" (Haesaerts & Koulakovska, 2006, pp. 28, 33–37). This horizon probably has an MIS 5a age, *ca.* 80 ka BP (see also Koulakovska & Usik, 2011a, p. 133) on geochronological grounds. Similar altered pieces are also known through the archaeological sequence in the lower MP and LP horizons, even reaching the LP archaeological horizon VI, with an MIS 14 with age, *ca.* 550 kyr BP. Seeing in their original contexts, these hyalodacite artefacts became recognizable with time. However, the situation is different with the non-*in situ* hyalodacite pieces, found in the first half of the 1980s, which Gladilin added to the suggested lowermost cultural-chronological complexes VII and VIII. The personal experience of the present author with these latter finds, who often helped V.I. Sitlivyi in the field to catalogue LP artefacts, is that these are *not* man-made artefacts. Other members of our team, including Usik and Kulakovskaya (who quit fieldwork after she defended her PhD on the Mousterian in Korolevo in 1982), had a similar opinion about these objects, so I wonder why Gladilin and Sitlivyi recognized those as artefacts. However, Gladilin divided the team according to periods, and the LP belonged exclusively to Gladilin and Sitlivyi, while other team members were working on various MP and UP materials from Korolevo and other Transcarpathian sites. Anyway, as the present author clearly remembers, hyalodacite artefacts from Korolev I non-*in situ* complexes VII and VIII were not well understood and recognized by us as artefacts in the first half of the 1980s, being of rather dubious character.

Later, in 1984–1986, artefacts belonging to complexes VII and VIII were found *in situ* at excavation block XIII in Korolevo I: 26 pieces belonging to complex VIII and 33 pieces belonging to complex VII (Koulakovska & Usik, 2015, pp. 13, 19). In addition, we still have to note the following non-*in situ* finds of these two lowermost LP complexes at Korolevo: *ca.* 400 pieces in complex VIII and *ca.* 1500 pieces in complex VII (Gladilin & Sitliviy, 1990, pp. 37–41, Tab. I–VI).

5.2.1. Horizon VIII finds in excavation block XIII (1983–1986)

The reviewed 2024 article presents horizon VII lithic artefacts as the lowermost *in situ* archaeological finds in Korolevo I without mentioning complex VIII (Garba *et al.*, 2024). The reason for this may be that Kulakovska and Usik, during their previous study of the stratigraphy and artefacts belonging to complexes VII and VIII, concluded that horizon VII is the only "archaeological representative" for the lowermost artefacts at Korolevo I.

"[...] *the stratigraphic-depositional conditions of artefacts in layers VIII and VII are identical following the scheme of O. Adamenko – P. Haesaerts (fig. 4). The state of destruction of the surface of andesite finds from layer VII and the so-called layer VIII are absolutely the same. Some differences that are traced in a few cases are connected with the chemical structure of andesite pieces. Artefacts from "both" layers have the same morphology, and several pieces of the so-called layer VIII do not have traces of real primary flaking and secondary treatment (Koulakovska, Usik & Haesaerts, 2010; Koulakovska & Usik, 2011b). Thus, a part of the finds from excavation block XIII are not real artefacts, while other finds belong to layer VII. This allows us to conclude the absence of layer VIII in the Korolevo site*" [translated by the present author] (Koulakovska & Usik, 2015, p. 19).

Here, it is worth citing more details on horizon VIII artefacts from excavation block XIII: "*The final reports of the 1984–1986 excavation seasons describe only a small collection* [...] *The same report mentions a large number of andesite chunks and "dozens of cracked pebbles of sandstones and quartzite, but it is difficult to tell about the artificial origin of it" [Gladilin et al., 1985 final report ., 1985, pp. 5–6]. After further analysis, it was determined that the andesite chunks are natural, not artificial. [Gladilin, Field Diary 1986, 10 July record]. On pebbles "with the traces of the reduction" made on sandstone, quartz and quartzite, there is no evidence of artificial human production – these are not artefacts*" (Koulakovska, Usik & Haesaerts, 2010, p. 129).

Although the rejection of an LP layer VIII at Korolevo I quickly became accepted among colleagues working on the LP in Central Europe (e.g., Valoch, 2011, p. 10), the topic needs further comments.

First, the statement of Kulakovska and Usik on stratigraphy that there were the same "*deposition conditions for artefacts of layers VIII and VII*" within "*alluvial deposits of Tisza terrace*" (Koulakovska & Usik, 2015, p. 19) is surprising from a geological point of view. The alluvial deposits were divided by Adamenko into three lithological units, 25, 26 and 27. Then Haesaerts combined Adamenko's units 25 and 26 into one unit, 25–26 and retained unit 27. Lithologically, as it was already shown above, these units are all different. Moreover, in the stratigraphic description of sondage 18, among others (Adamenko *et al.*, 1989, pp. 15–16), the sediment package of units 25–27 has a considerable thickness: 0.35 m for unit 25, 0.80 m for unit 26 and 0.30–1.50 m for unit 27, that is, only the upper part of unit 27 has no less than 1.3 m thickness. In excavation block XIII, where lithics of horizons VII and VIII were discovered, sediment units 25–27 reach an almost 1-metre thickness in profile а-д – 6, and more than 1 metre in profile д-10 (Koulakovska, Usik & Haesaerts, 2010, Fig. 10). Nevertheless, it was recently proposed not only to reject the existence of horizon VIII in Korolevo but to accept that the few lithic artefacts (the 33 proposed pieces) were actually (!) distributed all along this lithologically variable and thick sediment package at an excavated area of 128 m² – "*objective data indicate that layer VII in situ is distributed within the boundaries of the terrace alluvium horizon, and not only in its upper part*" (Koulakovska & Usik, 2011b, p. 15).

Second, the presence of "*a large number of andesite chunks"* and *"dozens of cracked pebbles of sandstones and quartzite*" among horizon VIII finds in excavation block XIII (Koulakovska, Usik & Haesaerts, 2010, p. 129) shows that Gladilin and Sitliviy rendered natural hyalodacite and non-hyalodacite pieces from the pebble alluvium unit 27 to horizon VIII in the middle of 1980s. However, while rejecting the existence of horizon VIII in excavation block XIII, Kulakovska and Usik never published any data on their analysis of the 26 *in situ* lithics belonging to horizon VIII, to show the unworked stones and the artefacts apart, the latter of which had to be reclassified into horizon VII. Gladilin and Sitliviy published artefacts of complex VIII without distinction between the suggested *in situ* lithics from excavation block XIII, and non-*in situ* lithics from the Beyvar hill (Gladilin & Sitliviy, 1990, pp. 37–39; Tab. I–III, IV: 1, V: 1). Before finalizing their 1990 book, they note about complex VIII lithics (as mentioned, irrespective of their places of recovery): "*the collection in this layer consists of more than 400 artefacts, but is represented only by two inconclusive tools, the rest are flakes and fragments*" (Gladilin & Sitliviy, 1987, p. 203). Then, strangely, they write in their 1990 book that the complex VIII lithic assemblage consists of 11 cores, five pre-cores and 12 tools, including five choppers, four examples of two types of proto-handaxes, as well as a doubtful tool and two unidentifiable tools (Gladilin & Sitliviy, 1990, p. 38). Most likely, Gladilin and Sitlivyi tried to substantiate the complex VIII assemblage with more cores and tools in the final 1990 publication but from where they got some "extra" cores and tools, remains unknown.

In summary, hyalodacite and non-hyalodacite (siliceous sandstone and quartz) lithics of complex VIII indeed look like geofacts, pseudo-artefacts or eoliths. This conclusion pertains to the entire "cultural-chronological complex VIII", i.e., lithics found at Gostryi Verkh, excavation block XIII, as well as pre-Middle Pleistocene natural hyalodacite pieces from the surface and in redeposited contexts from the Beyvar area.

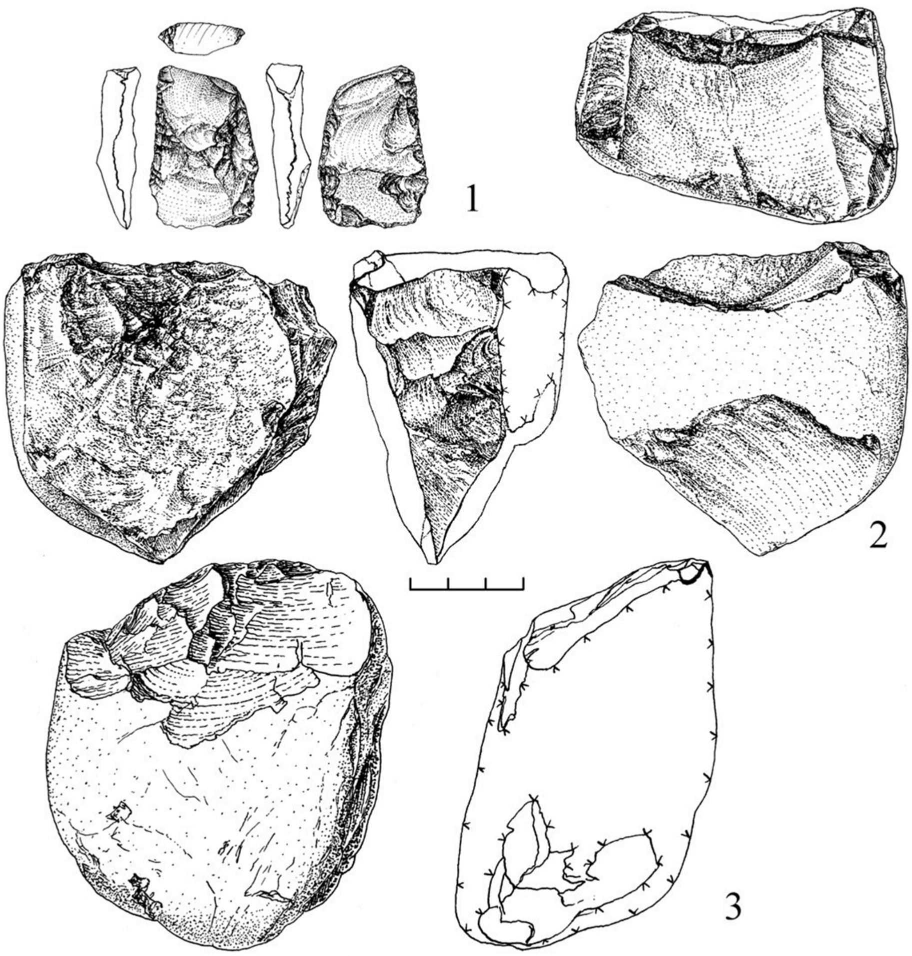

Fig. 11A. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Drawings of three non-hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1 – a “*bifacially formed tool made on a primary flake*” on siliceous sandstone; 2 – a “*multi-platform core*” on siliceous sandstone; 3 – a “*chopper/core-chopper*” on quartz (?) (after Koulakovska & Usik, 2015, Fig. 11 and 14)

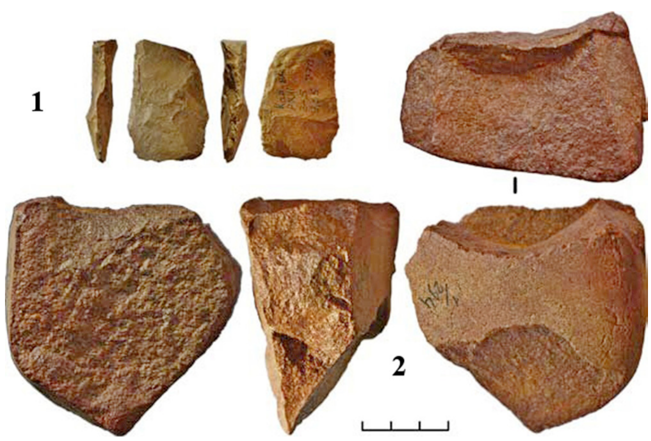

Fig. 11B. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Photos of two non-hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1 – a “*bifacially formed tool made on a primary flake*” on siliceous sandstone; 2 – a “*multi-platform core*” on siliceous sandstone (after Koulakovska & Usik, 2015, Fig. 12)

5.2.2. Horizon VII finds in excavation block XIII (1983–1986)

If the lithics of archaeological horizon VIII are most probably not modified by humans, the question should be asked, for the first time: is the small assemblage of horizon VII man-made? The most practical way to review this question about the proposed oldest *in situ* LP artefacts at Korolevo I is to cite the results published by Kulakovska and Usik, shortly summarized by Usik in Garba *et al.*, 2024.

"*All artefacts that were found in excavation area XIII during the 1984–1986 seasons were studied. In general, they consisted of isolated finds (from one to five) distributed throughout separate squares (Fig. 9c,d). Artefacts were noted at different depths (from - 9.40 to - 12.0 m), which can be explained by the substantial dip of the lithological layer towards the southeast (Figs. 9 and 10). In squares a/b-6, which are located near the represented profiles, the findings are distributed evenly from -9.5 to -9.92 m within the bounds of a single geological layer (Fig. 10). In square d-10, lithological layer 26 is divided by a horizon of diluvium, suggesting a localized episode of disturbance within the stratigraphic sequence (Fig. 10). Above horizon 3, level VII artefacts were found (Fig. 10). Beneath this horizon, one flake and two chunks were found. There was no diluvium observed either above or below. Level VII is located within the alluvium of the terrace, but not within the upper portion as marked by Gladilin (1989a, p.10). In sondages 18 and 26 and also in the 1998 season profile, which represents the main stratigraphic sequence of Korolevo, level VII artefacts are absent*" (Koulakovska, Usik & Haesaerts, 2010, pp. 126–127).

The following comments on these observations can be made. First, archaeological horizon VII's 33 artefacts were found as "*isolated finds*" in groups "*from one to five*" in a few 2×2 m squares (4 m² each). Looking at the grid of excavation block XIII excavated to the pebble alluvium (32 squares = 128 m²) (Koulakovska, Usik & Haesaerts, 2010, Fig. 9c–d; Koulakovska & Usik, 2015, Fig. 5), horizon VII artefacts were randomly found in just 16 squares or 50% of all squares (64 m²). Moreover, these artefacts do not show any concentration(s) or cluster(s) within the excavated area. Of the 16 squares with horizon VII artefacts, half of them (8 squares, 32 m²) contain a single find, again in a 4 m² area each. Accordingly, the word "random" fits the spatial distribution of horizon VII lithic artefacts within excavation block XIII. Second, all lithological units in the longitudinal profiles of excavation block XIII incline from north to south, which is especially well seen in the case of unit 26 with a diluvium level within it. Keeping in mind the transversal northern profile of excavation block XIII with a kind of compressed stratigraphy, Usik's observation (2009, p. 104) is indeed right on the location and influence of a "*ravine and the ancient relief*" on the vertical distribution of artefacts in horizon V. This observation seems especially true for the stratigraphically lowermost finds as well. Indeed, the small amount of randomly distributed artefacts of horizon VII "*within an alluvial channel deposit*" (Garba *et al.*, 2024, p. 2) certainly does not represent any kind of Palaeolithic living floor of an archaeological horizon. However, our close look at the characteristics of these 33 artefacts may offer a clue to the reason for their distribution.

Kulakovska and Usik published data on these 33 lithics two times (Koulakovska, Usik & Haesaerts, 2010, pp. 127–129; Koulakovska & Usik, 2015, pp. 11–18). The 2015 data set is more detailed, including the square number and elevation measurement of each find, as well as metrical parameters, drawings and even high-quality photos of the so-called best or most indicative pieces.

The 33 artefacts are grouped by us into the following five categories, in Kulakovska's and Usik's artefact terminology:

- True cores (5) and associated flakes (11);
- Core-like chunks (3) and associated chunk-flakes (4);
- Chunks (7);
- Chip (1) – a piece under 3 cm;
- Tools (2).

Of these items, 30 are hyalodacite and 3 are non-hyalodacite specimens. Our re-analysis logically starts with the non-hyalodacite items, which are easier to read than the hyalodacite ones: two quartzites (siliceous sandstones) and a quartz with a question mark. Following the published drawings, all three pieces initially look as they are defined: a "*multi-platform core*" (siliceous sandstone) (Fig. 11A: 2), a "*bifacially formed tool made on a primary flake*" (siliceous sandstone) (Fig. 11A: 1), a "*chopper/core-chopper*" (quartz?) (Fig. 11A: 3).

However, on the published high-quality photos, the "*multi-platform core*" (siliceous sandstone,

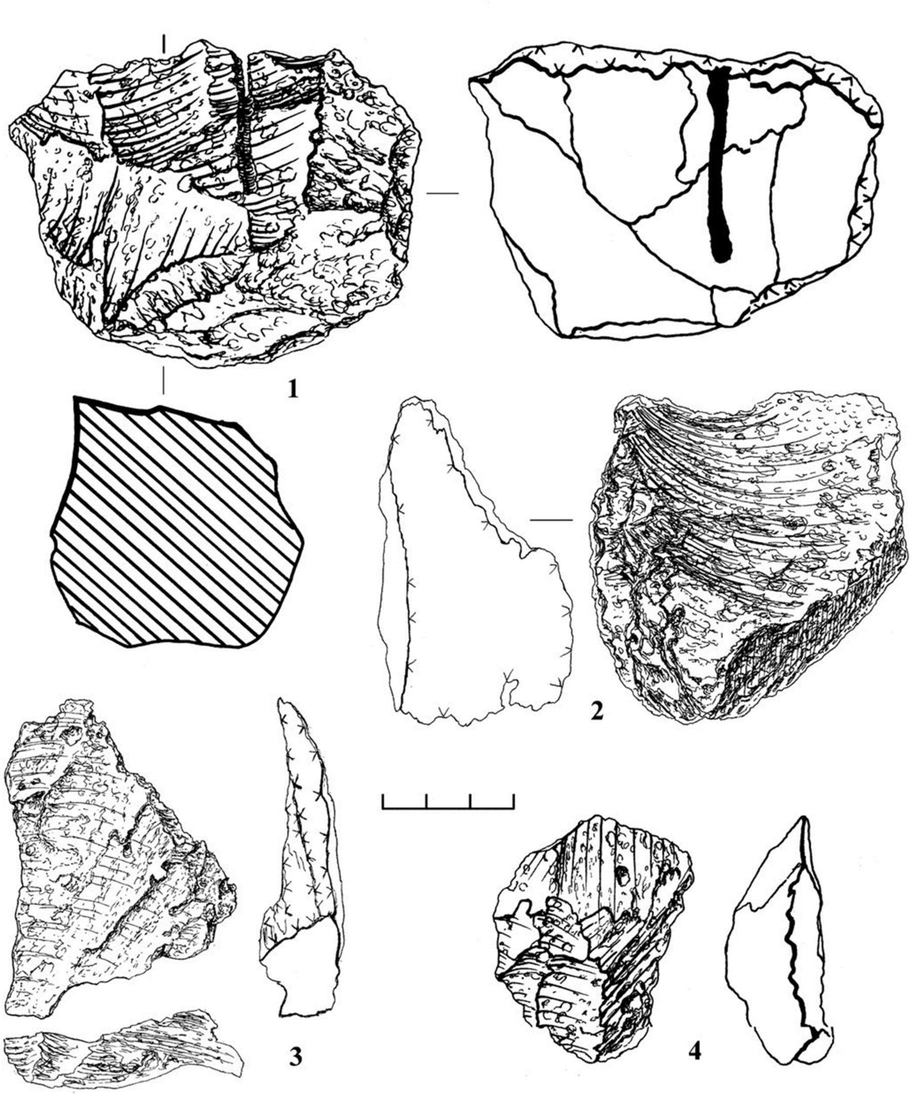

Fig. 12. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Drawings of four hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1–2 – so-called true cores; 3–4 – so-called flakes (after Koulakovska & Usik, 2015, Fig. 13)

83.74×84.15×53.69 mm) (Fig. 11B: 2) does not show any true debitage removal negatives on its surface, just natural-looking damage. This piece was found at the greatest depth among horizon VII artefacts, 12.00 metre, in square з-10 as a single piece in an area of 4 m², suggesting its origin from the gravel pebble alluvium unit 27. The "*bifacially formed tool made on a primary flake*" (siliceous sandstone, 42.28×27.83×9.12 mm) (Fig. 11B: 1) again does not show any true removal negatives on its surface having instead natural-looking damage. Moreover, edge damage on the piece indicates rolling in a hard (pebble?) matrix. Although all colleagues underlined that horizon VII lithic artefacts have no natural damage, this so-called bifacial tool seems to have it. Finally, this object comes as a single find from square г-5 at a depth of 9.65 m, from an area without well-controlled stratigraphy. The "*chopper/core-chopper*" (102.81×84.78×53.40 mm) (Fig. 11A: 3) was found in square б-6 at a depth of 9.98 m, which is the deepest measurement in the western part of excavation block XIII (Fig. 7). There was no good published photo of it in the 2015 article but a photo was eventually published in 2024 (Garba *et al.*, 2024, Fig. 3a). This third non-hyalodacite piece is also dubious, there are removal negatives only on one surface without any striking platform or another edge usually a chopping tool-like piece has. It also has an interesting "taphonomic feature". This "*chopper/core-chopper*" is illustrated as belonging to cultural-chronological complex VIII in the 1989 and 1990 publications (Adamenko *et al.*, 1989, Fig. 7, 3; Gladilin & Sitlivyi, 1990,

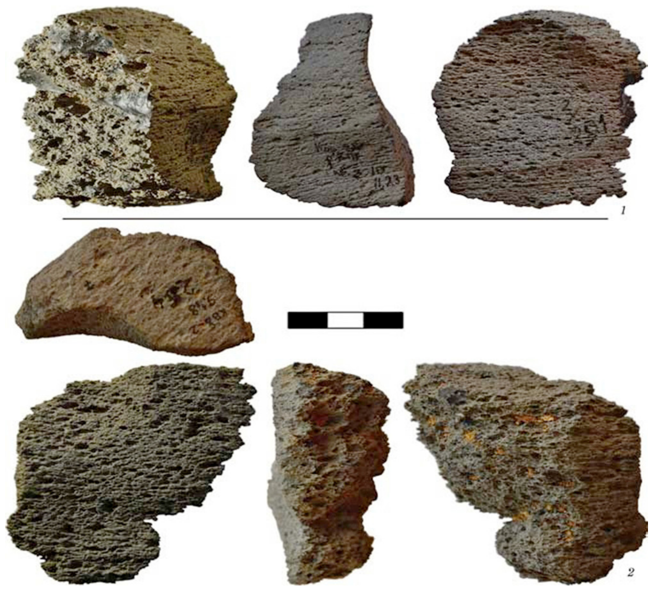

Fig. 13. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Photos of two hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1 – a so-called chunk-flake; 2 – a so-called core (after Koulakovska & Usik, 2015, Fig. 8)

Tab. III, 1). This drawing was published in 1989 and 1990 and then reproduced by Kulakovskaya and Usik in their 2015 article but as an artefact belonging to horizon VII, not VIII (Koulakovska & Usik, 2015, Fig. 14).

Thus, the second and third discussed non-hyalodacite pieces are items found in unit 27 and connected to horizon VIII by Gladilin and Sitlivyi. Then Kulakovska and Usik reclassified these as human-modified objects, and consequently, as not horizon VIII but horizon VII artefacts. Finally, the most promising "*chopper/core-chopper*" from horizon VII actually comes from the archaeologically sterile pebble alluvium unit 27 and looks-like a naturally damaged piece.

There is one more technological peculiarity in connection with the three non-hyalodacite specimens. By definition, the suggested primary and secondary treatment of these pieces surely had to produce flakes and chips. However, not one debitage-like non-hyalodacite piece was found in horizons VII and VIII in excavation block XIII. It leads to a conflicting situation, with the occurrence of three (!) objects at various stages of reduction and the absence of any other products linked to these reduction events. It is highly unlikely that early humans (*Homo erectus*) planned such a behaviour, and brought non-hyalodacite products knapped elsewhere to a hyalodacite outcrop. We suggest a more plausible interpretation. These three pieces most probably are naturally damaged sandstone and quartz pebbles from the pebble gravel unit 27, which have been classified into unit 26 and horizon VII. More than that, there is a common, obvious pebble alluvium feature, be it a fossil or a modern gravel bed: you can always find some "core-like and chopper-like pieces" there but you hardly find the detached flakes because they were carried away by fluvial processes. The present author observed this situation several times, with siliceous sandstone pebbles in the modern bed of the Tisza River in Transcarpathia, and with Lower Eocene flint cobbles in a fossil fluvial bed around the Hummal site in the El Kowm region of central Syria in 2010. Similar reasonable doubts on suggested LP loci in Bohemia were also expressed by K. Valoch (2013, p. 54):

"*It is known from indisputable European settlements from the early Lower Palaeolithic that, as long as they are in situ, they always also contain flakes and additional accompanying material. Grouping of only quartz and quartzite pebbles and fragments of siliceous schist probably indicate separation by running water*".

Thus, all three non-hyalodacite pieces in the collection of so-called *in situ* horizon VII lithics do not look like real artefacts, based on stratigraphy and spatial data, and archaeological characteristics.

The 30 hyalodacite pieces are reassessed as follows. Two object classes should be straightaway excluded from artefacts due to the absence of any visible traces of anthropogenic modification: seven chunks (square a-4, 9.48 m depth; square б-4, 9.70 m depth; square a-6, 9.57 m depth; square д-10, 11.95 m depth, below the above-noted diluvium horizon in that square, see Koulakovska, Usik & Haesaerts, 2010, p. 126; square б-5, 9.65 m depth; square a-4, 9.54 m depth; square a-1, 9.45 m depth), and a single chip (square д-10, 11.95 m depth, below the above-noted diluvium horizon in that square, described as a flake – Koulakovska, Usik & Haesaerts, 2010, p. 126), with no published data on their metrical dimensions. Two of these eight specimens were situated in the lower part of unit 26 in square д-10, below the diluvium horizon, where no modified artefacts were found. Six chunks were unearthed in the upper, northern squares of excavation block XIII. They have the uppermost depth measurements for horizon VII artefacts, between 9.45 and 9.70 m. One of them was in square a-1 and two of them were in square a-4. These squares did not have unit 26 sediments, which makes the number of chunks belonging to horizon VII from seven to four.

Two flakes, from the upper squares with high depth measurements again, also have to be excluded – a "*fragment of unidentifiable flake*" (square a-6, 9.80 m depth) and a "*dubious flake*" (square б-6, 8.98 m depth). The depth of the latter piece is less than 9 m, while Kulakovskaya and Usik state that horizon VII artefacts were found between 9.40–12.00 m (Koulakovska, Usik & Haesaerts, 2010, p. 126; Kulakovska & Usik, 2015, p. 11). Accordingly, this "*dubious flake*" either indicates even a more extended occurrence of horizon VII finds, enlarging its depth interval to more than 3 m, or it is a redeposited piece that was still included in the horizon VII assemblage. In sum, we are speaking about only 20 possible (!) artefacts in 128 m² of excavation block XIII, instead of 30.

Turning to the remaining four "true cores" and 10 associated flakes, three of the four cores are illustrated and not one is regarded by the present author as an artefact modified by humans.

Object #1 (Fig. 12: 2), square a-6, 10.00 m depth, 77.21×72.39×41.72 mm. It is a fragment of a hyalodacite "bomb" and its missing part was interpreted by Kulakovskaya and Usik as a flake removal negative. However, the object lacks a striking platform and the detached piece is also missing, it is just a fragmented "natural" piece. With its 10.00 m depth, this is the lowest-lying piece in the square (this depth is missing (!) from the excavation block XIII plan and profile at a-б, see Kulakovska & Usik, 2015, Fig. 5), compared to the other recorded items found between 9.50 and 9.83 m. Thus, this natural "bomb" probably either originated from lithological unit 27, or it was a redeposited piece like the above-discussed "*dubious flake*".

Object #4 (Fig. 12: 1), square б-6, 9.89 m depth, 59.33×83.24×59.18 mm. This piece looks similar to object #1, it is a fragment of a hyalodacite "bomb" and its fragmented part was probably assumed by Kulakovska and Usik as having two flake removal negatives. Again, the object lacks a striking platform and the detached pieces are also missing, it is just a fragmented "natural" piece. There is, however, one more specific feature of the object not mentioned by Kulakovska and Usik. Like the already discussed quartz "*chopper/core-chopper*", this so-called core is also illustrated in the 1989 and 1990 publications (Adamenko *et al.*, 1989, Fig. 7, 2; Gladilin & Sitlivyi, 1990, Tab. II, 3) as a "*chopper*" from cultural-chronological complex VIII. So, it is again a hyalodacite natural piece from the archaeologically sterile gravel pebble alluvium unit 27.

Object #2 (Fig. 15: 2), square б-2, 9.48 m depth, 68.53×73.87×42.29 mm. The photograph of the objects shows a more than 7 cm wide hyalodacite natural fragment in our opinion.

None of the three illustrated cores look like cores. Two of them are damaged hyalodacite bombs and one more piece is just a natural fragment of hyalodacite. Moreover, two of these pieces certainly come from the archaeologically sterile gravel pebble alluvium unit 27. The same attribution, unit 27, is possible for the fourth, not illustrated core #3 (10.21×70.06×51.40 mm, square л-10, 12.05 m depth), which is the single identified "artefact" for not only square л-10 but also for the two adjacent squares к-10 and и-10. Thus, there are no real cores in horizon VII.

Of the nine "*flakes*", four have published illustrations (Kulakovska & Usik, 2015). Two flakes were both drawn (Fig. 14A: 1–2) and photographed (Fig. 14B: 1–2), which certainly helps to discuss why they are not flake-looking pieces. They don't have flake traits such as removal negatives of previously detached flakes, a butt, point and/or bulb of percussion, fissures and ripples. In addition, their different degrees of weathering prevent us from classifying them into the same archaeological horizon. The object classified as a "*Kombewa flake*" (square a-6, 9.70 m depth, 113.94×111.44×26.81 mm, Fig. 14A: 1; Fig. 14B: 1) is significantly more weathered than the other flake (square д-10, 11.23 m depth, 142.53×120.79×29.33 mm, Fig. 14A: 2; Fig. 14B: 2). Moreover, the latter piece from square д-10 was found above the diluvium horizon so it cannot be securely linked to unit 26.

Two other illustrated flakes cannot be securely evaluated without photographic illustration. One of them (square д-10, 11.95 m depth, 71.63×58.52×9.05 mm, Fig. 12: 3) originates below the diluvium horizon and probably from unit 27. The other flake (square б-1, 9.65 m depth, 54.52×40.54×20.21 mm, Fig. 12: 4) comes from an area where no unit 26 sediment is known, and it is *ca.* 11 m from the eastern, well-controlled

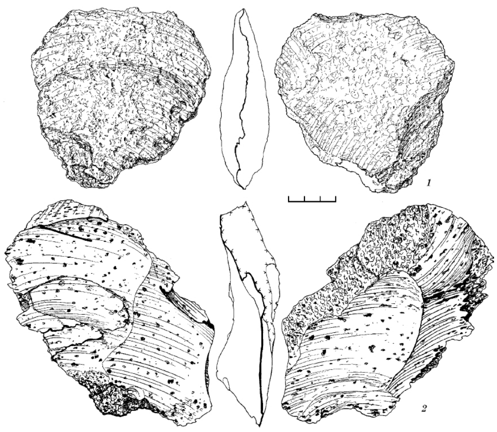

Fig. 14A. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Drawings of two hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1 – a so-called "*Kombewa flake*"; 2 – a so-called flake (after Koulakovska & Usik, 2015, Fig. 9)

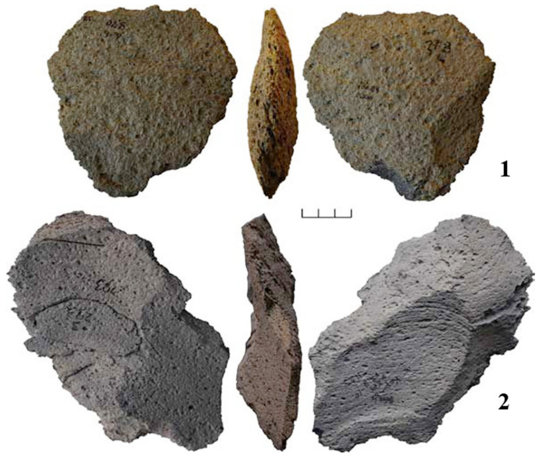

Fig. 14B. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Photos of two hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1 – a so-called "*Kombewa flake*"; 2 – a so-called flake (after Koulakovska & Usik, 2015, Fig. 9)

stratigraphic profile. Thus, this piece can not be reliably included in horizon VII and lithological unit 26.

The four illustrated flakes do not look like detached flakes and they can not be securely associated with lithological unit 26. There are no illustrations of the remaining five flakes to discuss them in detail. However, it is a usual practice in Palaeolithic archaeology publications that illustrated pieces are the most indicative of a particular artefact class. The five not illustrated flakes perhaps can not serve for any argument on their origins and makers.

There are also two more additional observations concerning the nine flakes here. The first is their dimensions. Taking either length or width data for all 7 complete pieces (one more flake with a fragmented distal part is 33.01 mm long; another flake with a fragmented lateral part is 54.52 mm long), their average maximum dimension appears to be 80.97 mm. Two pieces measure over 10 cm, and there is no flake under 5 cm, which makes this small assemblage "large". Second, of the nine flakes, two were classified as "*Kombewa flakes*". One of these flakes and the fragmented lateral part of a "*radial flake*" were said to have specific lipped or semi-lipped butts that do not correspond to the claimed use of an LP hard-hammer technique. We think that these butt definitions are the result of the misreading of the hyalodacite pieces found in lithological unit 26 at Korolevo I, especially taking into account the absence of any Kombewa cores on flakes in horizon VII.

Thus, horizon VII flakes look unusual. They do not demonstrate convincing *sensu stricto* artefact morphological features, they show a varying degree of weathering, and they are unusually large for an LP assemblage prior to the appearance of Acheulean with hand-axes and/or cleavers. Finally, some of their features do not correspond to Early Pleistocene LP lithic assemblages older than one million years (core technologies resulting in Kombewa flakes and flakes with specific lipped/semi-lipped butts).

Apart from the so-called true cores and associated flakes, another part of the assemblage consists of lithics which Kulakovska and Usik suggest represent "*Pre-Oldowan smashing technology*" as defined by Gladilin and Sitlivyi in the late 1980s (Gladilin & Sitlivyi, 1987, p. 203; 1990, p. 8). These are three "*core-like chunks*" and four "*chunk-flakes*" associated technologically with the core-like chunks. The former are not cores as follows from their description. "*The polyhedron and core-like chunks have very similar flat and convex* [underlined by the present author] *negatives on their surfaces. The morphology of the chunk-flakes conforms to these negatives. Chunk-flakes typically possess concave or flat ventral surfaces without clear traces of intentional reduction by hammering*" (Koulakovska, Usik & Haesaerts, 2010, p. 128).

Of the three core-like chunks, two are illustrated. One of them (square г-4, 10.14 m

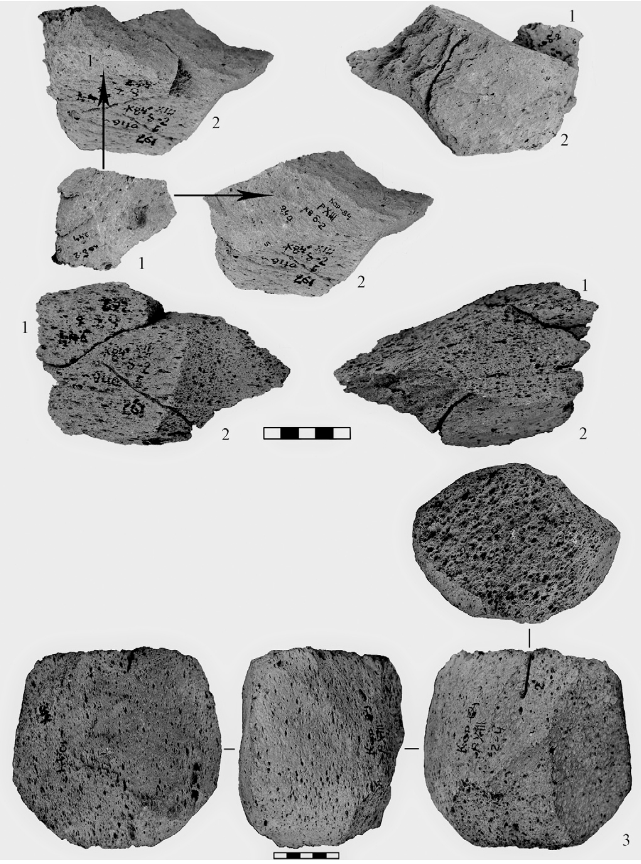

Fig. 15. Excavation block XIII, Gostryi Verkh area, Korolevo I (1983–1986). Photos of three hyalodacite lithic finds from archaeological horizon VII, as determined by Kulakovska & Usik. 1 – a so-called chunk-flake; 2 – a so-called core-like chunk refitted with a chunk-flake; 3 – a so-called polyhedron (after Koulakovska *et al*., 2010, Fig. 11)

depth, 132.67×146.53×106.14 mm, 3124 g) was classified as a large "*polyhedron*" illustrated with a photo (see Koulakovska, Usik & Haesaerts, 2010, Fig. 11, 3; Koulakovska & Usik, 2015, Fig. 7, 3) (Fig. 15: 3). The photo shows that the piece is more weathered in the upper and lower parts, and less weathered in the middle. The differently weathered surfaces were interpreted as a core-like piece with a natural cortical striking platform, and the negatives of some detached flake-like pieces. However, the so-called removal negatives do not correspond to any kind of intentional flaking when "*most surfaces along the perimeter have a convex configuration*" [translated by the present author] (Koulakovska & Usik, 2015, p. 15). Another illustrated core-like chunk (square б-2, 9.40 m depth, 129.82×71.41×71.38 mm) (see Koulakovska, Usik & Haesaerts, 2010, Fig. 11, 1–2; Koulakovska & Usik, 2015, Fig. 7, 1–2) (Fig. 15: 1–2) looks like two refitted chunk-flakes at first sight. However, it is interpreted by Kulakovska and Usik as a chunk-flake refitted to a core-like chunk with, again, one negative being "*convex and morphologically similar to removal negatives on the polyhedron*" [translated by the present author]. (Koulakovska & Usik, 2015, p. 15).

Some core-like chunk data deserve special attention. First, the two core-like chunks and the refitted proximal fragment of a chunk-flake (>79.51×59.33×28.04 mm) (Fig. 15: 1–2), demonstrate about the same degree of weathering. They are more "fresh" than the already discussed, more weathered flakes of layer VII (Fig. 14B: 1–2). Second, the illustrated polyhedron and core-like chunk are characterized by the presence of so-called "convex removal negatives" which, by definition, can not occur in the primary phase of an intentional reduction sequence done by humans. Third, the two refitted pieces have depth measurements of 9.40 m and 9.44 m in square б-2, while the polyhedron has 10.14 m in square г-4. The depths of the two refitted pieces are the highest among horizon VII lithics that were established by Kulakovska and Usik between 9.40 m and 12.0 m. They were also found in a square located far from the longitudinal eastern profile, so their stratigraphic position can not be established. As was noted above, the northern transversal profile a/A 1 to 6 in excavation block XIII (Fig. 8A) has a much shorter stratigraphic sequence, where lithological unit 26 is missing from the line of squares' a/A 1–4. This opens up the possibility that lithics found in squares a-б – 1 – 4 and perhaps square г-4 in horizon VII / lithological unit 26, represent either some artefacts from archaeological horizon VI or some redeposited natural hyalodacite objects. Looking at the northern profile (Fig. 8A), it is seen that in squares a-б – 1 – 4, paleosoil VII with lithological unit 17 and the LP archaeological horizon VI is about lying on the gravel pebble alluvium of lithological unit 27. This way, some lithic pieces from archaeological horizon VI could be attributed to horizon VII due to the noted gross excavation technique with arbitrary levels. So, the discussed objects are perhaps not related to horizon VII at all, besides, they look like unworked hyalodacite pieces instead of cores and detached flakes.

Concerning the "polyhedron" from horizon VII, these objects, together with spheroids and bolas (PSBs) (Cabanès *et al.*, 2022), are known from the oldest LP assemblages up to the Neolithic period (e.g., Cropper, 2006) in current Old World

Stone Age archaeology. Specifically, studies of LP artefact assemblages show that most polyhedrons are not just enigmatic, natural-looking stone objects but they usually demonstrate intentional flaking at least on a part of their surfaces, aiming a rounded shape, whatever function(s) of these items had (e.g., Cabanès *et al.*, 2022, Fig. 1–2). In the case of Korolevo I horizon VII, only one such item is identified without (!) intentional detachment negatives on its surface. The so-called core-like chunks associated by Kulakovska and Usik with the polyhedron do not look like human-made artefacts either. The true "artefact character and properties" of these two object types are dubious, they are perhaps a "natural" hyalodacite bomb and fragments, possibly coming from lithological units above. For example, archaeological horizon VI contained many unworked hyalodacite objects from *in situ* excavated trenches.

One more chunk-flake (square д-10, 11.23 m depth, 65.65×70.69×52.67 mm) was presented in a photograph (Koulakovska & Usik, 2015, Fig. 8, 1) (Fig. 13: 1). Its position below the diluvium horizon suggests its original deposition in lithological unit 27 of gravel pebbles. Additionally, it does not look like an artefact, being only a "natural" and very thick chunk (too thick to be a flake detached by humans in the Early Pleistocene LP) with two different weathering surfaces. In contrast to Kulakovska and Usik, the present author considers such pieces with no debitage stigmata and different degrees of weathering on their surfaces as a result of the natural breakage of hyalodacite bombs at various times.

These ambiguities around core-like chunks and chunk-flakes lead us to revisit the ideas and data of Gladilin and Sitlivyi in the late 1980s, about a "*Pre-Oldowan LP stage and its smashing technology*", and their possible connection to horizon VII lithics in Korolevo I. Gladilin well recognized that a significant amount of finds from complexes VII and VIII lacks debitage features, looking like unworked objects and their fragments or chunks. These are the "*questionable debitage pieces*" and "*chunks*" in the assemblages of complexes VIII (33.3% of 415 lithics) and VII (62.8% of 1522 lithics), not counting chips (which were re-calculated by the present author using data in Gladilin & Sitlivyi, 1990, pp. 37, 39). Moreover, the ratio of "*flakes and blades*" and "*questionable debitage pieces and chunks*" is 1.83:1 in complex VIII (236 flakes and 15 blades to 138 chunks) and 0.57:1 in complex VII (525 flakes and 19 blades to 959 chunks). So, Gladilin had to find an explanation for the overwhelming presence of seemingly unworked pieces in the assemblages he collected mostly from the surface, and he considered the oldest in Korolevo, based on their degree of weathering. The problem brought him and Sitlivyi to a hypothesis of a special smashing technology used by early LP humans, which resulted in mostly shatter and chunks, and only a few pieces with a flake morphology. This presumed technology could explain the LP finds in Korolevo I, and various Oldowan assemblages from East Africa known at that time. Their paper on the topic is interesting and thought-provoking even today, more than 35 years after its publication (Gladilin & Sitlivyi, 1987). They proposed the existence of a Pre-Oldowan stage in the LP with the following primary flaking methods and products:

"*1. Predominance of shapeless splinters and fragments over the flakes;*

2. The technique of flaking is characterized by an utterly primitive method – i.e. by breaking or shattering or by acquiring flakes from rare, non-expressive polyhedric cores;

3. Microlithism of the artefacts;

4. Utter absence of intentionally manufactured tools, namely of choppers;

5. The use of non-worked fragments, flat stone splinters and flaked-off pieces of stones as working tools" (Gladilin & Sitlivyi, 1987, p. 202).

Gladilin and Sitlivyi also emphasized (1987, p. 203) that all these traits are characteristic of *in situ* and well-excavated (!) LP site clusters dated to even before 2 Ma in East Africa, such as Olduvai George, Koobi Fora, Shungura, and Omo. They also note that these primitive primary flaking methods persisted for a long time, this is why they were present at Korolevo I *ca*. 1 Ma ago and even further on during the Middle Pleistocene, in both Africa and Eurasia.

Perhaps Kulakovska and Usik used these ideas and data of Gladilin and Sitlivyi and applied them again to the LP material in Korolevo I without a critical reassessment. However, it is all about one of the basic preassumptions of Palaeolithic archaeology that still occurs today, to consider almost all lithics within an archaeological layer and its respective lithological unit as *in situ* artefacts brought, made, and re-shaped by Palaeolithic humans. This assumption is highly contested today, especially in the case of Palaeolithic sites with their artefact-bearing levels in fluvial sediments (see, for example, for LP sites – Dibble *et al.*, 1997; Müller & Pasda, 2011; Pasda, 2012). New high-quality publications are available today about some of the oldest LP site clusters in Africa, at Olduvai Gorge Bed I (Tanzania) and Koobi Fora (Kenya) (e.g., de la Torre & Mora, 2005a; 2005b; Merino-Pelaz *et al.*, 2024), the materials of which were used by Gladilin and Sitlivyi for the Pre-Oldowan smashing technology hypothesis. These publications are, among some other topics, also devoted to taphonomic research of Oldowan sites, with reconstructions of palimpsest situations formed by human and carnivore on-site activities, and natural damage processes as well. Lithic assemblage revisions have shown a variety of artefact types and their quantitative data at numerous Oldowan sites. At the Olduvai Bed I sites, numerous "*manuports*" are now considered "*unmodified materials*" occurring in the archaeological horizons due to natural processes – "*deposited naturally*" (de la Torre & Mora, 2005a, p. 17; 2005b, p. 284). Concerning the numerous seemingly unworked pieces at Korolevo, it is worth citing the ratio of non-debitage-looking "*angular fragments*" in the Olduvai Bed I lithic assemblages. At Olduvai Bed I DK site, dated to *ca.* 1.85 Ma, there are 132 angular fragments (14,9%) in the assemblage consisting of 881 pieces (excluding chips), and the ratio of flakes (n = 666) to angular fragments is 5.1:1 (de la Torre & Mora, 2005a, p. 15, Tab. 2.1). At the Olduvai Bed I FLK Zinj site, dated to *ca.* 1.75 Ma, there are 131 angular fragments (10,6%) in the assemblage consisting of 1237 pieces (excluding chips), and the ratio of flakes (n = 990) to angular fragments is 7.6:1 (de la Torre & Mora, 2005a, p. 35, Tab. 3.1). The present author did not consider the chips in his Olduvai calculations to conducting a more correct comparison with the Korolevo I material, where the chips size category is underrepresented due to the mostly non-excavated context of the assemblage. Compared to the Olduvai data, chunks/angular fragments are far more frequent in Korolevo I than in the most well-dated and well-studied LP Oldowan sites in the Old World. Another difference is shown in artefact sizes. The Korolevo I horizon VII lithics are well over 5 cm and even over 10 cm in length and/or width (mean maximum dimension is 80.97 mm), while the Olduvai Bed I pieces are considered microlithic. The mean length and width of complete flakes are 4.0 cm and 3.7 cm respectively in the DK site, and 3.7 cm and 3.3 cm in the FLK Zinj site (de la Torre & Mora, 2005a, Tab. 2.3, 3.4). The metrical data in Olduvai recall the "*microlithism of the artefacts*" of pre-Oldowan sites due to the smashing lithic technology, which is certainly not the case with the so-called *in situ* LP Korolevo material.

Prior the appearance of the LP Acheulean with hand-axes and/or cleavers (Large Cutting Tools – LCTs) around 1 Ma, "*whose biface blank production was primarily based on large flake technology*" (Sharon, 2010, p. 230; see also Sharon, 2007) almost all LP assemblages are characterized by the reduction of technologically rather simple cores which resulted in small products because there was apparently no need of large flakes for "complex tools" like various bifacial implements. Accordingly, the presence of large lithic implements in the Korolevo I horizon VII assemblages, including the so-called "giant polyhedron" (over 13 cm long and 14 cm wide, more than 3 kg), has to be taken with due caution. The late appearance of large flakes in the LP was not obvious in the late 1980s when Gladilin and Sitlivyi worked with the Korolevo material but currently, it is.

Thus, the core-like chunks and chunk-flakes should be regarded as "natural" hyalodacite objects and fragments, not as remnants of a primitive LP smashing technology. If we accept the arguments listed above, no data supports the presence of the so-called smashing technology, producing mainly chunks and almost no debitage, in archaeological horizon VII/lithological unit 26, excavation block XIII, Gostryi Verkh area, Korolevo I.

Summarizing this section, the presented horizon VII lithics do not allow the present author to postulate an *in situ* and intentional LP artefact horizon VII in unit 26 at Korolevo I. The 33-piece assemblage consists of mostly natural-looking objects, a handful of intentional artefacts partly from sediments above, partly in uncertain stratigraphic contexts. This assemblage does not support the claim of the presence of an LP artefact-bearing horizon as the result of human activity, and it is certainly not a living floor. Instead, it most probably is a random occurrence of 33 redeposited objects alone or in groups of 2–5 pieces, scattered over an area of 128 m² (32 squares) which was excavated to the basal lithological unit 27 in 1983–1986. Even without considering their morphology, these objects do not constitute any clusters or concentrations in the excavation block as residues of human activity usually do. Their distribution, as well as the complex nature of unit 26, is better explained by natural formation processes (see below).

6. The lowermost lithological units of Korolevo, and the presence of silicified sandstone and hyalodacite pieces

In the previous sections, we argued that the lithic assemblage in the lowermost layers of Korolevo consists mostly of a few hyalodacite bombs, their fragments and silicified sandstone pebbles in unit 26. Besides, these finds occurred only in half of one 128 m² trench, only (*sic*!) in excavation block XIII, Gostryi Verkh. No such lithics were found at other locations within the Korolevo site where excavation proceeded to the basal gravel unit 27. Accordingly, the most attention should be paid to this area. However, numerous surface and/or redeposited hyalodacite pieces were collected in the Beyvar Hill area, which were also attributed to the so-called "cultural-chronological complexes" VIII and VII, by Gladilin and Sitlivyi in the 1970s–1980s.

Regarding excavation block XIII, the following note on the unit 26 finds has to be considered: "*All artefacts made of hyalodacite show heavy surface weathering, but no evidence of damage or polishing by rolling or abrasion during fluvial transport, which suggests they were buried relatively rapidly*" (Garba *et al.*, 2024, Supplementary Information, p. 7). Excavation block XIII cut the area of an active, deep ravine, where erosion, diluvium events, a talus and altitude differences permanently affected sedimentation. This is why even the Early MP lithics of archaeological horizon V were found scattered in three (!) lithological units. These natural "destruction incidents" were strengthened and added by some fluvial events during periods of river alluvium sedimentation. During these episodes, large- and medium-sized pebbles from the alluvial lithological unit 27 were also carried into unit 26, in addition to the hyalodacite bombs and their fragments, as fluvial sediments of units 26 and 27 were partially mixed. In addition, the random horizontal and vertical distribution of the few hyalodacite pieces, usually well-separated one from another within unit 26, and found in only half of the large excavated area, indicates several (!) redeposition/movement events. The good but not perfect (without sharp edges) preservation of natural hyalodacite pieces in lithological units 26 and 27 can be also explained by such rapid transport events, followed by quick fluvial sedimentation. On the other hand, the areas of sondages 18 and 26 from the 1980s, and the two profile cleanings of 1998 and 2006, 75 m away to the east from excavation block XIII, were not affected by a ravine. Here, as expected, lithics of the so-called archaeological horizon VII are missing.

Turning to the Beyvar Hill area, almost two thousand hyalodacite pieces were found there during 15 years of fieldwork from the late 1970s to 1991, belonging to the so-called cultural-chronological complexes VIII and VII. Their presence is also can be connected to ravines, both ancient and modern, that were and are responsible for the transport, breakage, and redeposition of numerous hyalodacite bombs and their fragments throughout the area. Hyalodacite pieces were periodically reworked within the *in situ* Tertiary clayey sediments that contained them. A small part of these lithics could be human-made artefacts redeposited from archaeological horizons, such as VI and V. All of these processes led to the abrasion of the artefacts, and additional weathering after reworking within disturbed sediments. However, these characteristics of redeposited hyalodacite artefacts at Korolevo I were never explored but are much needed for a better understanding of the lithics, and the "sediment histories" at different areas of the site as well.

Lastly, in connection with the lowermost units, we have to mention the specific archaeological research approach of Gladilin. The present author remembers him well, his outstanding field and analytical work both at Korolevo and then in a Kyiv lab (see Demidenko, 2017). Understandably, when he saw the rather long Pleistocene sequence of the site encompassing 1 million years, containing a series of LP, MP and Early UP archaeological horizons, he was trying to uncover artefacts from lithological units as early as possible. Moreover, a significant hyalodacite outcrop has been found in Korolevo that was frequented by Upper and Middle Palaeolithic humans, and Gladilin also expected its exploitation in the Early Pleistocene, which was, as far as we know today, not the case. Gladilin's search for the oldest lithic artefacts at

Korolevo was also derailed by his understanding of the hyalodacite pieces, mentioned above. Proceeding deeper, from Early UP and MP horizons down to archaeological horizon VI, it became gradually harder to recognize lithic objects as artefacts. With this experience in mind, when Gladilin found hyalodacite pieces on the surface or redeposited in the ground, with a higher degree of weathering, often near the raw material outcrop, he, of course, was also trying to see them as artefacts. This eventually led him to recognize "cultural-chronological complexes" VII and VIII.

As a sort of conclusion on the so-called horizon VII LP lithic artefacts, found in lithological unit 26, excavation block XIII in Korolevo, it is useful to cite the good advice of Clemens Pasda (Jena, Germany) after his revision of lithics from the Middle Pleistocene Bilzingsleben site in eastern Germany: "*... accept stones as artefacts only when any natural forces which might have produced them can be ruled out with certainty*" (Pasda, 2012, p. 40). Maybe also some recent studies on distinguishing geofacts (pseudo-artefacts or eoliths) from human-made lithic artefacts (e.g., Wiśniewski *et al.*, 2023) will motivate colleagues to study the Korolevo materials from this perspective, that would be novel research concerning hyalodacite.

7. Conclusions

The presented arguments on the lowermost lithic finds and lithological units of Korolevo I, sprouting from the review of a current paper which states that the Korolevo LP finds represent the oldest reliably dated LP site in Europe (Garba *et al.*, 2024), allow the present author to make the following observations and conclusions.

First, the unworked large- and medium-sized pebbles and their various fragments which were dated with cosmogenic nuclides to *ca.* 1.42 Ma, can not be associated with the lithics found in the 1980s in archaeological horizon VII, lithological unit 26, excavation block XIII, Gostryi Verkh area, Korolevo I. The dated pebbles are of "intrusive" character for lithological unit 26 ("*alluvial, silt/sand*" – Garba *et al.*, 2024, Fig. 2, p. 3) representing pebbles from alluvial unit 27 ("*alluvial gravel, clay matrix*" – Garba *et al.*, 2024, Fig. 2, p. 3) stratigraphically below. As a result, the *ca.* 1.42 Ma age and the dated pebbles may be related to the archaeologically sterile gravel pebble alluvium of the basal lithological unit 27 in Korolevo.

Second, the "intrusive" occurrence of 20 large- and medium-sized pebbles in lithological unit 26 in excavation block XIII is due to the following four factors: the gross excavation methods in the mid-1980s, various diluvium episodes and erosional breaks, location of the excavation block inside a huge ravine leading to additional sediment disturbance, including redeposition of pebble gravels.

Third, based on the *ca.* 1.42 Ma date, Garba and his associates (2024) suggest that the Korolevo I horizon VII finds are associated geochronologically with three interglacial warm periods, MIS 47, 45 and 43. They hypothesize that these periods allowed the first *Homo erectus* groups to penetrate Europe from the East Mediterranean Levant, either through Asia Minor and then the Danube valley or crossing the Caucasus and then the northern Black Sea region in the southern part of Eastern Europe. These hypotheses do not correspond to the well-known paleogeographical and archaeological data of the respective regions in Western Eurasia and are considered invalid.

Fourth, the "intrusive" pebbles in lithological unit 26 and other stratigraphical problems with the unit containing archaeological horizon VII necessitated a revision of the published lithic material there. The 33 pieces of the respective assemblage were found alone or in groups of 2–5, scattered randomly in half (16) of the excavated 32 squares (2×2 m, 4 m² each) of the grid dividing the 128 m² excavation area. The finds are unworked, redeposited hyalodacite and siliceous sandstone pieces and their fragments, and a handful of human-made artefacts from sediments above the unit in question. We found no evidence of an LP living floor or artefact-bearing horizon within lithological unit 26 in the 1980s excavation block XIII in Korolevo I.

Fifth, the depositional history of the lowermost finds in excavation block XIII was turbulent because this area covers a once-active deep ravine with talus, slope, elevation differences and repeated diluvium events, as well as fluvial events causing river alluvium sedimentation. During fluvial events, large- and medium-sized gravel pebbles from the alluvial lithological unit 27 were also reworked into unit 26, which was added to a few reworked natural hyalodacite bombs and their various fragments. The fluvial sediments of units 26 and 27 were partially mixed.

Finally, claims that artefacts constituting archaeological horizons VII and VIII in the lowermost units 26–27 at Korolevo I represent one of the oldest or oldest *in situ* LP material in Europe, dated to *ca.* 1 Ma previously, and *ca.* 1.42 Ma recently, should be dismissed. Nevertheless, the archaeological horizon VI in Korolevo I still can be considered the earliest LP occupation in East-Central Europe and Ukraine. This latter *in situ*, undeniably human-made assemblage was found in lithological unit 17 at the top of paleosoil VII, both in the Beyvar and Gostryi Verkh areas, in the 1970s–1980s. However, this horizon is dated on geochronological grounds (there are no reliable absolute dates yet) to the Middle Pleistocene inter-Mindel, MIS 14 period, *ca.* 550 ka BP. Thus, the Korolevo site complex is and will be at the centre of discussions concerning the initial human occupation of Europe in the LP.

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Statements

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RESEARCH ARTICLE

Late Gravettian lithic finds from Felsőtárkány-Peskő Cave, Northern Hungary

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Abstract. Peskő Cave near Felsőtárkány (North Hungarian Mountains) is known for its Early Upper Palaeolithic bone industry found in the lower layer of its sediments in the early 20th century. Besides the points, a small amount of lithics were found in the Pleistocene stratum. Two archaeological horizons were identified. The lower two layers were classified as Aurignacian and the upper two ones Magdalénian. The Aurignacian included a few retouched blades, while the Magdalénian was never published. In the second half of the 20th century, the Magdalénian was reclassified as 'Pilisszántó culture' or 'Cave Gravettian', dated to the Late Glacial period. After the replacement of 'Pilisszántó culture' with the term Epigravettian in the 1980s the 'Magdalénian' layer of Peskő Cave fell out of research focus. Our research found that the automatic conversion of Pilisszántó culture finds to Epigravettian did not work and the finds at Peskő belong to the Late Gravettian.

Keywords: cave site, Late Gravettian, Gravette point, shouldered point

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1. Introduction

Peskő Cave is well known in the Early Upper Palaeolithic research of Eastern Central Europe, since the discovery of bone points in the two lower layers of the cave in the first half of the 20th century (Fig. 1). Typologically, the bone points can be assigned to the Aurignacian (Vértes, 1965, p. 176). The first radiocarbon date calibrated to 41.7 to 39.2 kya supported the Early Upper Palaeolithic age (Vogel & Waterbolk, 1972, p. 63). Further dating of the bone points revealed ages of which as old as 42–36 kya (Davies & Hedges, 2008–2009; Hopkins, 2018). The lithic assemblage in the Aurignacian layers includes a few retouched blades and lacks typical Aurignacian tool types (Vértes, 1965, p. 176).

The archaeological finds from the two upper layers were overshadowed by the Aurignacian for a long time. The find assemblage was assigned to the 'Magdalenian' due to the presence of 'microlithic' blades (Kadič, 1944, p. 26). Later, Vértes reclassified the lithics as 'Pilisszántó culture' or 'Cave Gravettian', which served as an umbrella term for various assemblages from the cave site's uppermost layers and was dated to the Late Glacial (Allerød interstadial) period (Vértes, 1965, p. 208).

Although the 'Pilisszántó culture' was eliminated from Hungarian Palaeolithic research and generally replaced with the term Epigravettian, the Peskő assemblage remained taxonomically and chronologically uncertain (Dobosi & Vörös, 1987). In the current article, our

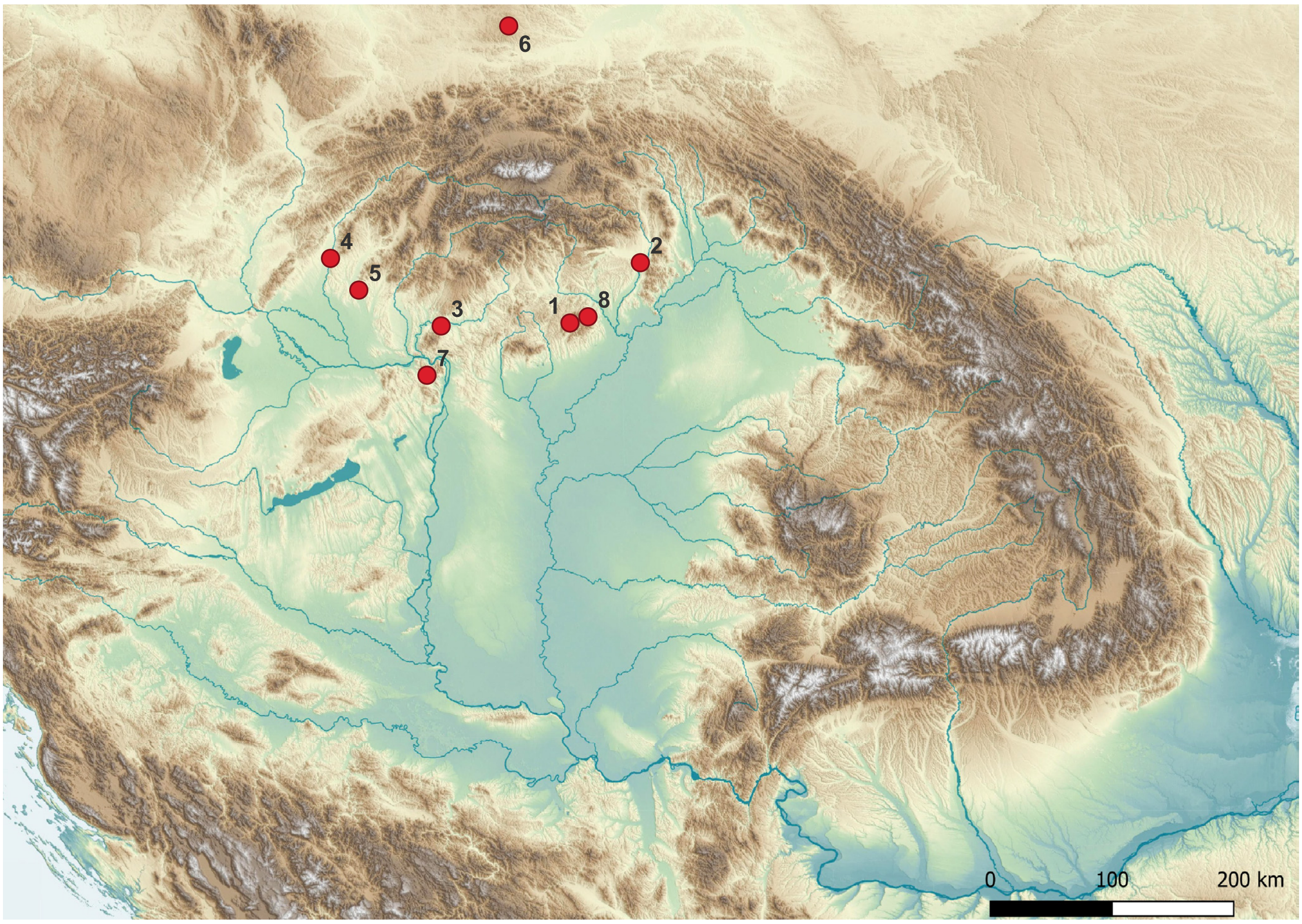

Fig. 1. Sites mentioned in the text: 1) Felsőtárkány-Peskő Cave; 2) Hidasnémeti; 3) Hont-Templombdomb; 4) Moravany nad Vahom - Podkovica; 5) Nitra I-Čermáň; 6) Krakow-Spadzista; 7) Pilisszántó I rock shelter; 8) Szeleta Cave. Compiled by K.I. Szegedi

goal is to fill this research gap and propose a new understanding of the small lithic collection from the uppermost layers of the Peskő cave.

2. Materials and methods

2.1. The site and stratigraphy

Peskő Cave is located near the village Felsőtárkány in the Bükk Mountains, Northeast Hungary. Several excavations were carried out from the beginning of the 20th century yielding a large amount of faunal remains and a small number of bone and lithic tools (Éhik, 1914; Gutay & Gasparik, 2019; Hillebrand, 1913, pp. 23–24.; Hír, 1991; Kadić, 1944; Vértes *et al.*, 1956). Bone points and knapped stones were found during the excavations of Ottokár Kadić and László Vértes (Kadić, 1944; Vértes *et al.*, 1956). According to Kadić, the fill in the cave was 2.5 metres thick on average, and consisted of the following strata from bottom to top: (1) dark brown clay with limestone rubble, containing abundant remains of cave bear, some Palaeolithic finds and bone tools; (2) greenish-grey clay with limestone rubble, containing abundant cave bear bones and Palaeolithic finds; (3) brick-red clay with limestone rubble, a low number of cave bear bones, and an increased presence of reindeer, low number of lithics and worked bones; (4) light yellow clay with limestone rubble; (5) black Holocene humus (Kadić, 1944, pp. 7–9).

Vértes excavated the site in 1955 and identified a very similar stratigraphy (Vértes *et al.*, 1956). Vértes erased the 'Magdalenian I' name and introduced the term 'Pilisszántó culture' for the assemblage of layers 3 and 4 (Vértes, 1965, p. 208). The Hungarian palaeontological research linked layers 3–4 to the 'Pilisszántó faunal phase' that was characterized by reindeer, and represented the 'Würm 3', the closing period of the Pleistocene (Jánossy, 1979, p. 149).

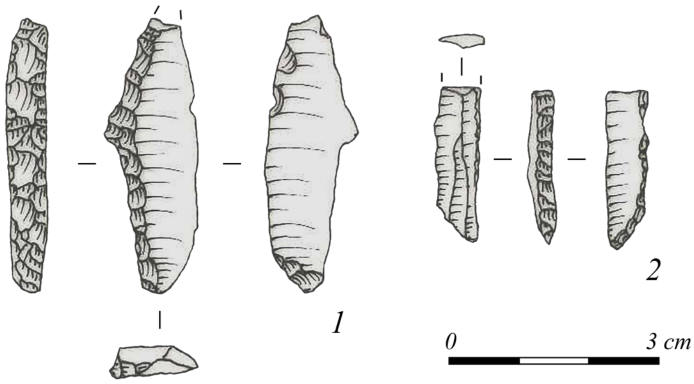

Fig. 2. The studied lithics from the Peskő Cave: 1) shouldered point; 2) Gravette point; 3) retouched point; 4) retouched blade. Drawing: T. Marton

2.2. Radiocarbon dates

Absolute dates mentioned in the text are Before Present and calibrated using the online version of Oxcal 4.4. against IntCal20 Northern Hemisphere Radiocarbon Age Calibration Curve (Bronk Ramsey, 2009; Reimer *et al.*, 2020).

2.3. Lithic inventory

According to Hillebrand, the first excavation already yielded 'microlithic' or 'Magdalenian' lithics, although their number and characteristics were not published (Hillebrand, 1913, p. 24). Kadić reported slender blades from layers 3–4 (n = 12) (Kadić, 1944, p. 26). Vértes mentioned 17 lithics from the excavations before 1955, including a few backed microliths from layer 4 (Vértes, 1965, pp. 208, 319). In 1955, Vértes found 11 additional lithic artefacts.

Currently, there are 13 lithics from layers 3–4 in the Hungarian National Museum. Most of them (n = 12) come from the excavations of Kadic and Hillebrand (inventory numbers Pb.909 to Pb.911). Only one artefact can be associated with the excavation of Vértes (Pb.62/93).

3. Results

The lithic assemblage included debris and blades, most of which were broken. The blades show the application of the direct percussion technique.

The single domestic tool is a broken retouched blade made of Carpathian 1-type obsidian. The retouch is located on the right edge (Pb910.18; Fig. 2.4). The group of armatures (n = 3) consists of a broken distal part of a retouched point made of Carpathian 1-type obsidian (Pb910; Fig. 2.3), a proximal fragment of a Gravette point, made of the same raw material (Pb910; Fig. 2.2) and a flint shouldered point with a broken off tip (Pb62/93.1. Fig. 2.1). The latter tool was shaped by abrupt retouch, and a flat retouch thinned the base on the ventral surface.

In the case of the broken Gravette point, we cannot be sure if it was broken during hunting or as a result of post-depositional effects, nevertheless, this armature type is often described as a typical part of the hunting tool kit in Eastern Central Europe during the middle Upper Palaeolithic (Lengyel, 2016; Wilczyński, 2016).

The shouldered point can be more likely associated with hunting, as it shows an impact fracture diagnostic of projectiles (Fischer *et al.*, 1984). The ventral thinning corresponds to removing the convexity of the bulb for secure hafting (Serwatka, 2018).

4. Discussion

The small number of lithics, and the lack of chips, cores and other by-products of the blade debitage indicates to classify the site as a short-term occupation most likely as a hunting stand or camp. Other sites with a high percentage of hunting weapons and the lack of domestic tools and lithic manufacture debris are known from the Upper Palaeolithic of the Carpathian Basin (Béres *et al.*, 2021; Markó & Biller, 2023). The

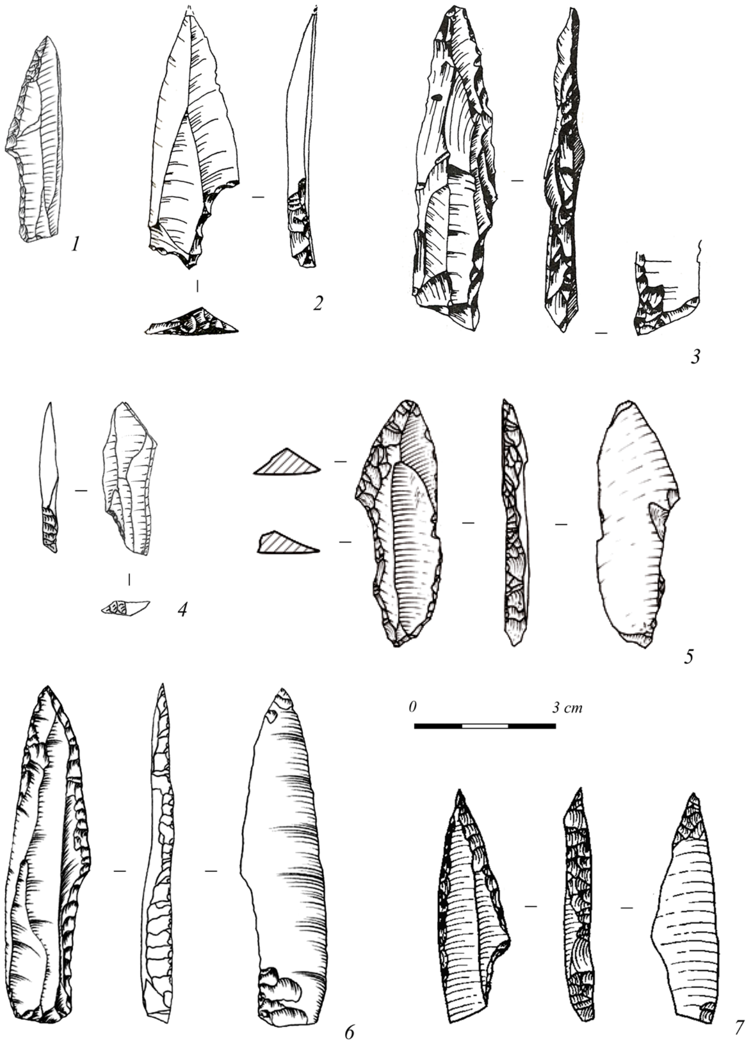

Fig. 3. Shouldered points from the sites mentioned in the text: 1–3) Hidasnémeti; 4) Hont-Templomdomb; 5) Moravany nad Vahom-Podkovica; 6) Krakow-Spadzista; 7) Nitra I-Čermáň. Compiled by the authors after Hromadová *et al.*, 2021; Kaminská & Kozłowski, 2011; Lengyel, 2016; Simán 1989; Szegedi *et al.*, 2023; Wilczyński, 2016

reindeer remains cannot be a natural component of the Peskő Cave, since the site is located over 700 m above sea level near the highest peak (960 m above sea level) of Bükk Mountains that was not a foraging territory of reindeer herds (Pryor *et al.*, 2024). Thus, the remains of layers 3–4 can be linked to human activity. Although absolute dates from layers 3–4 are unknown, since these upper layers were in superposition with the lower layers containing Aurignacian finds, we consider the former layers younger. As a result, the accumulation of archaeological and faunal remains postdates the Late Aurignacian of the Carpathian Basin dated between 37 and 32 kya (Chu *et al.*, 2019).

The typology of the lithic toolkit defines the human occupation as Late Gravettian dated between 30 and 26 kya (Lengyel, 2018; Lengyel & Wilczyński, 2018; Wilczyński *et al.*, 2020). Among the identified hunting weapons, the Gravette point may have been part of a composite tool, while the shouldered point served as a projectile point probably for big game hunting (Wilczyński *et al.*, 2019).

An important element of the tool kit is the shouldered point which is rare in Late Gravettian contexts in Hungary. The geographically closest open-air sites characterized by Late Gravettian shouldered points are in the North Hungarian Mountains like Hidasnémeti in the Hernád valley (Simán, 1989; Lengyel, 2016) and Hont-Templomdomb (Szegedi *et al.*, 2023). A greater number of tools belonging to this type was found in Slovakia at Moravany nad Vahom-Podkovica (Hromadová *et al.*, 2021) and Nitra I-Čermáň (Kaminská & Kozłowski, 2011) and at Krakow-

Spadzista in Poland (Wilczyński, 2016). Our results indicate that the Late Gravettian hunters did not establish solely open-air sites (Dobosi & Holl, 2013, pp. 75–77), but visited caves too, especially during short hunting campaigns. Thus, Peskő Cave is the third cave site where Late Gravettian occupation was identified beside Pilisszántó I Rockshelter, which was also a hunting camp with reindeer remains, but without shouldered points (Dobosi & Vörös, 1987; Lengyel, 2016; Markó & Biller, 2023). The layer sequence of Szeleta Cave also yielded a Late Gravettian shouldered armature (Lengyel *et al.*, 2015) (Fig. 3).

5. Conclusion

Our paper clarified the cultural and chronological position of the lithics from Peskő Cave's upper layers. They are mostly associated with the main armature tool types of the Late Gravettian in Eastern Central Europe dated before the Last Glacial Maximum. The low number of lithics and the presence of armatures suggest a short-term occupation of the cave site. The results expand our knowledge on the Late Gravettian occupation of the North Hungarian Mountains that most likely occurred between GS-5.1 and GS-3. We also lowered the number of plausible Late Glacial archaeological sites in the Carpathian Basin as neither Magdalenian or Final Palaeolithic taxonomical attribution could be proved in the upper layers of Peskő Cave.

Statements

Data availability statement. The authors confirm that the data supporting the findings of this study are available within the article.

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REVIEW ARTICLE

Lithic Research Roundtable 14, 2024

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Abstract. The 14th annual meeting of Hungarian lithic specialists was held on December 13, 2024, at the Department of Archaeology, Faculty of Arts, University of Szeged, Szeged, organized by András Markó. The abstracts of the presentations and posters are as follows.

Keywords: Lithic Research Roundtable, conference, Palaeolithic, Mesolithic, Neolithic

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The chipped stone assemblage of the Late Neolithic Borđoš site

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This paper focuses on the chipped stone material, discovered in the Late Neolithic part of the Borđoš site between 2014 and 2022 in Vojvodina, North-Serbia. The aim is to briefly overview raw material and typo-technological categories of chipped stone assemblage. The comparative units are organized by the archaeological context in tell and flat settlements to see any potential tool-making and use differences between the two different spatial areas. Altogether 1193 pieces of chipped stone tools were discovered at the site of Borđoš, which is one of the biggest published stone assemblages from Neolithic sites in Vojvodina besides Čoka-Kremenjak, Donja Branjevina (Deronje), Opovo-Ugar Bajbuk, Gomolava and Potporanj-Kremenjak, but also one of the most numerous assemblages in comparison to other Neolithic materials e.g. Vinča-Belo Brdo, Popovića Brdo, Blagotin and Drenovac in North-Central Serbia. This lithic assemblage opens up the possibility to analyse the potential proxy function of the Late Neolithic community at Borđoš for transporting raw materials and stone artefacts besides the transmitted lithic technological information along the Tisza. We provide a cross-section of raw materials and typo-technology of the chipped stones, which gives a rich basis to study the economic and social connections of the local and extended surroundings of the Late Neolithic Borđoš community based on the chipped stones.

A comprehensive petrographic and geochemical evaluation of the sandstone ground stone tools from the Hódmezővásárhely-Gorzsa site

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In total, 1061 polished and ground stone tools were unearthed from the stratified tell settlement of Hódmezővásárhely-Gorzsa. During the excavation of the multiperiod tell site (in the 1980s and 1990s), detailed archaeological study of the excavated archaeological finds (mainly chipped-, polished stone tools and ceramics) was started, including archaeometric sourcing of the lithic raw materials. Among the numerous polished stone tools and ground stone tools (GSTs), the latter ones dominate (they represent three-quarters of the total amount) (Starnini *et al.*, 2015; Miklós *et al.*, 2021; 2024). Due to their quantity, the investigation of these macro-lithic tools is an important task in the provenance analysis of the stone tools. The archaeometric investigation, including petrography and geochemistry, of such artefacts to determine their raw materials has not been conducted routinely. Over the last two decades, research on GSTs showed exponential growth, not only from an archaeological point of view but also from their raw material analysis (e.g., Wright, 1992; Adams *et al.*, 2009; Dubreuil *et al.*, 2015; Christiani & Zupancich, 2021). Since then, they have served as the basis of much provenance research in Hungary (e.g., Makkai *et al.*, 1996; Starnini & Szakmány, 1998; Horváth *et al.*, 2015; 2016; Péterdi, 2020; Priskin, 2022; Kósa *et al.*, 2023) and at the same time, in the international literature, the archaeological questions predominate.

GSTs from Gorzsa show a rather varied composition, the most common types are different types of sandstones (50%), andesite and granitoid-metagranitoid varieties. Our research focus is the identification of the sandstone tools' provenance. We comprehensively investigate artefacts and potential geological source samples, using petrographic-mineralogical and geochemical methods. Our research explores an understudied field because only a few studies looked at sandstone tools (e.g., Szakmány & Nagy, 2005; Péterdi, 2012; 2020; Kósa *et al.*, 2023). So far, Hódmezővásárhely-Gorzsa Neolithic tell settlement is the only one where a multidisciplinary approach was applied. In the international specialized literature, they mainly focus on macroscopic petrographic examinations of the raw materials.

Based on the petrographic examination of the Gorzsa sandstone tool (402 pieces), the following grouping system can be established: red, grey, white meta-, carbonate-bound and other sandstones-metasandstones. The sandstone raw materials have been divided into two main groups: 'red' and 'grey'. The former includes exclusively the Permian red sandstones with various shades of red, while the latter includes grey, white meta-, and carbonate-bound, which have typically grey, yellow and white colours. Each type of raw material was submitted to petrographic, heavy mineral and geochemical (SEM-EDX, PGAA and NAA) analysis. This resulted in four 'red' and three 'grey' sandstone types (grey, white meta- and carbonate-bound), as well as several variants within each type. In addition, we also carried out comparative studies of possible raw materials from natural sandstone occurrences. Therefore, it can be established that the raw materials are sourced non-locally, in regions located to the east of the settlement (more than 60-70 km), primarily within the river Maros upper valley and its surroundings.

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From broken to whole. Archeometric and archaeological analysis of a prehistoric polished stone tool

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The artefacts collected during archaeological field surveys receive little attention beyond the possibly most precise establishment of the date and extension of the site. Besides ceramics and metal artefacts, lithic finds have little importance. In our presentation, we would like to show the amount of information that can be obtained via archaeological and natural scientific investigations of a single, highly damaged polished stone tool found during a field survey in the territory of Szerep (a village in Hajdú-Bihar County).

During the primary macroscopic examination, it became obvious, that despite the broken surface, the piece could be further investigated. Based on the documentation of the use-wear and surface damage, data can be obtained about the individual phases of its life cycle. The tool, originally produced and used as an axe, after fragmentation was reshaped and used as an adze. In addition to the archaeological determination, the relatively long time of the use of the tool is closely connected to the raw material of the stone tool, which was shown to be amphibolite or metabasite based on primary macroscopic and stereomicroscopic examinations.

In order to determine the raw material more precisely, we carried out non-destructive, so-called "original surface test measurements" on the stone axe surface using a scanning electron microscope equipped with an energy dispersive spectrometer (SEM-EDS), an X-ray fluorescence spectrometer (XRF), a Raman microspectrometer and magnetic susceptibility meter at the Archaeometry Laboratory in the National Institute of Archaeology of the Hungarian National Museum Public Collection Centre.

In our presentation, we would like to answer two important research questions. What is the raw material of the tool? Can the choice of raw materials support multiple changes of function and long-term use?

Obsidian blade cores from Füzesabony

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During the 2022 autumn field survey of the István Dobó Castle Museum, in the eastern outskirts of the town of Füzesabony, located in the Northern Great Plain region of Hungary, we discovered an obsidian blade core accompanied by the dense spread of late Chalcolithic find material. Despite the surrounding find material, based on technological and typological attributes, the artefact can most likely be dated to the Neolithic. The core shows parallels with another, similar item from the Neolithic found in the late 80's, also from the vicinity of Füzesabony, at a site called "felszámolt gyümölcsös „kiskert", 10. számú terület". We have done the non-destructive element composition measurements of the cores. Based on the measurements of the fingerprint-like composition made with prompt-gamma activation analysis (PGAA), we have identified the items clearly as C1-type material, but we weren't able to determine a more specific source (Kasov, Cejkov, Vinicky) of the obsidians. The research further enriches the data on obsidian use in the Northern Great Plain region's Neolithic period.

Core tradition in the Middle and Late Neolithic period in Western Hungary

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The natural occurrence of the knappable raw materials used during the Neolithic can be divided into two major groups: the various nodular formations (Tevel flint, obsidian, northern flint and in some cases radiolarites from the Bakony) and the block formations (limnic silicites and Bakony radiolarites). Technological analysis of these cores has shown that the appearance and morphology of the raw material already anticipate the process of preparation and the debitage itself. We are dealing here with a fixed and characteristic sequence of operations which is predestined by the naturally occurring shape of the raw material itself.

In the Middle and Late Neolithic, we can distinguish between prismatic (block or rectangular), conical, natural wedge-shaped (splinter-like) and irregular shapes that cannot be classified in these groups. Unipolar and bipolar cores occur based on the shape of the striking surfaces. In terms of striking directions, unidirectional and multidirectional, including orthogonal and alternating strikes are known. Looking at their debitage surface, we can distinguish unilateral or multilateral and circular separations. Based on these complex features, we can arrange the individual cores into groups: unipolar conic core with unidirectional circular separations, prismatic core with unilateral and multilateral as well as unidirectional and multidirectional separations, wedge-shaped core with unilateral and unidirectional separations, and the circle of irregularly shaped core with ad hoc unilateral and unidirectional separations.

Reassessment of the presence of Świeciechów flint in the Palaeolithic of Hungary

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Since the 1960s, two tools found in the Sólyomkút Rockshelter (Bükk Mountains, Hungary), attributed to the Mousterian, were considered one of the oldest evidence of the use of the Świeciechów flint as lithic raw material. In the 1990s, though the archaeological revision of the site revealed uncertainties about the cultural attribution of these artefacts, further pieces were reported from Sajóbábony-Méhész-tető open-air site, the eponymous site of the Middle Palaeolithic Bábonyian. The new French-Hungarian excavations at Sajóbábony unearthed the most numerous collection of artefacts made of Świeciechów flint ever found in Hungary. Although the Bábonyian is characterized by bifacial and leaf-shaped tool production, the assemblage of Polish flint demonstrates a blade production and contains Aurignacian tool types. Most probably it represents a different occupation episode. This discovery shed new light on the problem of the appearance of this specific raw material in the Palaeolithic of Hungary. Moreover, the use of the Świeciechów flint during the Palaeolithic of the neighbouring regions (Poland, Moravia, Slovakia) is reconsidered too.

The Middle Palaeolithic assemblage of Gyöngyöstarján 10

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Systematic Palaeolithic research in the Mátra Mountains region began quite late, in the early 2000s. As a result of the field surveys, numerous sites, mainly Upper Palaeolithic, were identified.

The presence of Middle Palaeolithic archaeological sites in the Mártaalja region was initially proposed by Katalin Simán (Simán, 1986, pp. 271–275). She assumed that the circulation of the quartz-porphyry lithic raw material from the Bükk Mountains through the Mátra Mountains to the west indicates the potential presence of previously unknown sites in the latter region. The earliest known lithic artefact there, which can be linked to the Middle Palaeolithic, is a bifacial knife made of quartz-porphyry found in Parád-Marhád-tető. Katalin Bíró (Biró, 1984, pp. 5-11) considered this carefully knapped piece with bifacial retouch a diagnostic tool of the Micoquian culture.

In 2011, Mónika Gutay and Gyula Kerékgyártó (Gutay *et al.*, 2012, pp. 12–17) collected four bifacial leaf points during field surveys in the Mátra region. The second leaf point was found in the vicinity of the Mulató-hegy hill in Gyöngyöstarján.

The site of Gyöngyöstarján 10 was identified by Mónika Gutay and Gyula Kerékgyártó in 2006. Further research (Gutay, 2021) was carried out in 2011, 2017, 2020, and 2021 in the form of field surveys, test excavations, as well as luminescent dating, and sedimentological sampling. Some of the tools were examined and assigned to the Middle Palaeolithic by Zsolt Mester and Mónika Gutay (Gutay & Mester, 2024). Through the typological and technological analysis of the lithics, the assemblage was linked to the Micoquian of Eastern and Central Europe. However, some features show differences from the already-known Micoquian-like industries in Hungary.

The typological examination of the whole assemblage was the subject of my BA thesis. Due to the presence of debitage products and waste, which makes up the majority of the finds, and the lack of intact tools, the site can be interpreted as a workshop phenomenon. In terms of lithic raw material, it is characterized almost exclusively by the use of locally sourced limnosilicite.

The assemblage contains 178 tools out of a total of 2817 finds. Retouched flakes and various types of sidescrapers constitute the largest part of the collection, but the number of leaf points, bifacially backed knives (*Keilmesser*), and handaxes are also significant. In this presentation, I will discuss the results of the typological examination of the assemblage, briefly supplemented with the results of the field surveys conducted recently with Attila Péntek in the Mátraalja region.

A Middle Palaeolithic site in the Cserhátalja region: Ecseg-Sándor-hegy

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The site was located in the spring of 2003, during field research of the area around the nearby Buják–Szente Palaeolithic site. In the autumn of 2005, the Ecseg-Sándor-hegy site became uncollectible, and the surface collection did not resume until the spring of 2022. Given the fact that the area of the site that can be collected is practically flat and that there has been no significant deep ploughing, the find intensity is rather low, but the finds are intact and there are relatively few freshly damaged or broken finds. In the course of the collections so far, archaeological findings typical of the Younger Prehistoric Age have only been found sporadically in the form of a few chipped stones, there are no ceramics or characteristic settlement features. Up to the present, a total of about 700 knapped stones have been recovered, and due to the local limnosilicite raw material and the fossil-rich coastal soil, apart from other taphonomic features, most of the finds are either unpatinated or only slightly patinated. The number of chipped stone tools in the assemblage is around half a hundred, of which nearly half are formal tools. The Buják–Szente site, probably a lithic workshop based on the processing of local limnosilicite, with 1,495 pieces, was previously classified by the authors as belonging to the Szeletian culture. However, based on the intensive field surveys of the last two decades, due to the presence of a large number of atypical bifacial tools found at both sites, the existence of a Middle Palaeolithic culture and industry unknown elsewhere in the Cserhát Mountains must be assumed.

Human-associated bone remains and revision of the fauna of the Remete Upper Cave

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The cave is located in the northwest part of Budapest, on the border of Remeteszőlős, in the Remete gorge. The entrance to the cave is situated above the Remete cave, 70 m above the valley floor (approx. 350 m above sea level). Veronika Gáboriné Csánk excavated the cave on behalf of the Budapest History Museum. The cave is divided into two parts, the front room was excavated in 1969 and the back room in 1970. During the excavation, the bones were packed separately in sections and layers. The Pleistocene fauna recovered from the sediment was determined by Miklós Kretzoi. The find material of the cave was published by Veronika Gáboriné Csánk in 1984. The examined remains are now in the collections of two museums (BTM Aquincum Museum Prehistoric Collection and the Collections Department of the Supervisory Authority for Regulated Activities). Except for a few items, they are not inventoried. In a significant part of the finds packed in paper bags, mixing of the bones could be determined. Pleistocene fauna also occurred in the Holocene layers, and vice versa. The mixing of fauna was mainly caused by wintering bears during the formation of the sediment, and by burrows or diggings of badgers living in the cave during the Holocene period. According to the latest research, the remains of mammals from several Pleistocene periods were mixed in the cave fill. Taphonomic observations were made on the bone remains; particular attention was given to traces of human activities. Each bone was examined using a hand-held magnifier. In many cases, the bone surface was difficult to examine due to the tooth and chewing marks of predatory mammals. Most of the bone remains were identified at the species level. During the review of the findings of both rooms, several bones with cut marks, human remains (five vertebrae belonging to one individual) and a pierced red deer canine were identified. Among the large mammals, the remains of several taxa could not be found in the mentioned collections (mammoth, woolly rhinoceros, giant deer). The cave fill left in the back room can provide an opportunity for further research.

Use-wear analysis of the Vértesszőlős Lower Palaeolithic stone tool assemblage

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The Lower Palaeolithic site of Vértesszőlős is the oldest known prehistoric settlement in Hungary, which was excavated in the 1960s. The processing of the excavated finds also started in those years, using the knowledge available and a novel methodology at the time. In the years since then, our knowledge of this period has increased, and new analytical possibilities have emerged in Palaeolithic research.

In this presentation, we will present two methodologies and their results that have not been applied to the Vértesszőlős artefacts yet. These are the geometric morphometry (Log Shape Ratio - LSR) and use-wear analysis with the help of different microscopes. Using LSR, the objective is to identify potential support pieces in the artefact assemblage, for which a detailed data table with a large amount of data is essential. With use-wear analysis, we should be able to identify the worked materials and the type and intensity of work done with the stones can also be observed. Furthermore, we will present the basics of the methods and the tools used to get the data, together with the possibilities for later applications of them in the future.

Thoughts about a late prehistoric knapped lithic industry. Preliminary analysis of the knapped lithic assemblage from Șardu – Lângă Podeț (Romania) site

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Șardu (Hungarian: *Magyarsárd*) is located in Cluj County, Northwestern Romania. During an extensive field survey conducted in 2022, the author identified the Șardu - *Lângă Podeț* site. A total of 268 lithic artefacts and 39 ceramic fragments were collected from the site. The unusually high proportion of lithic artefacts compared to ceramic fragments strongly suggested a multi-period site.

The collected ceramic assemblage includes prehistoric, Roman, and modern-era fragments. Due to the nature of the prehistoric ceramics, it was not possible to precisely date the prehistoric occupation, however, the coarse craftsmanship suggests a Late Bronze Age or Early Iron Age origin. The lithic toolkit from the site contains notched and denticulated tools, side-scrapers, and splintered pieces. Blades are present only in small quantities, while end-scrapers are absent. The raw material used for the lithic artefacts exclusively consists of the local, low-quality "Șardu type" chert. Initially, the large number of lithic artefacts and the simple, atypical toolkit appeared to indicate a Middle Palaeolithic occupation; however, the assemblage finds closer analogies with Late Prehistoric (Late Bronze Age, Early Iron Age) sites.

The current state of research suggests that the use of lithic tools gradually declined in the Carpathian Basin following the Koszider period. If we accept the provisional dating of the studied site, it can be concluded that the intensive use of lithic tools persisted in certain contexts during the Late Prehistoric period. This case study aims to illustrate the interpretative challenges and pitfalls that arise when a surface lithic assemblage is approached with preconceived notions.

Macrolithic tools from Scythian burials in Békés County: A Pilot study

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The grave goods of the Vekerzug (or, Vekerzug-Chotín) culture include stone artefacts of various materials and designs. Research explains the burial of these objects with different cultural and religious reasons. Grave goods of the inhumated burials are thought to be of pre-Scythian origin, while the cremated burials are associated with the surviving traditions of local Late Bronze Age and Early Iron Age communities, or perhaps with a steppe tradition.

Thirteen macrolithic tools were analysed from four graves in Békés County. Each piece was placed in inhumation burials, apart from the three cremation graves from Gyopáros. Their placement in these burials may also indicate the position of the buried person in society. They are typically female grave goods, often with traces of red ochre(?) and the presence of a realgar. In the case of male burials, these objects may have served as weapon-sharpening tools.

The macrolithic grave goods from the cemeteries of the period are traditionally defined as polishing or grinding stones. However, the simple, macroscopic definition of stone tools is no longer sufficient for a more thorough interpretation of the graves. Our investigation includes functional analysis and use-wear analysis. In the presentation, we present the first results of this research, proceeding along with the following questions. What were the phases of the use of the tools? In which phase of fragmentation were they placed in the graves? Can traditionally defined types be substantiated and can they be linked to standard forms? How can deformed tools be interpreted?

In the presentation, we present the first results of a new research project and we describe the main directions and future objectives of the research.

Nephrite tools from Maria Enzersdorf–Hirschkogel (Austria, Jevišovice culture) – raw material and provenience studies (poster presentation)

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Two neighbouring Austrian Late Neolithic sites, Maria Enzersdorf–Hirschkogel (Jevišovice Culture) and Mödling–Jennyberg (Boleráz culture) have already been presented recently (Péterdi *et al.*, 2022, 2023a, 2023b; Horváth *et al.*, 2023). Although the two nearby sites were inhabited partly at the same time (from 3400/3300 BC to 2900/2800 BC) significant differences could be observed amongst the macrolithic artefacts: at Maria Enzersdorf–Hirschkogel, polished stone tools dominate but at Mödling–Jennyberg, ground stone tools and pebbles can be found in greater numbers. Nephrite, which is usually the raw material of polished stone tools, is only known from the Maria Enzersdorf–Hirschkogel assemblage.

The special „nephrite texture" makes nephrite an excellent raw material for polished stone tools, especially for axes and adzes. The interweaving and interlocking thin, fine amphibole (tremolite – actinolite) fibres make a very tough rock – and give an aesthetic appearance to the finished tools. Nephrite was a widespread raw material in Europe during the Neolithic but its use is usually found only in small numbers at each site since it was not available in large quantities at the geological sources either. This is also the case at Maria Enzersdorf–Hirschkogel: Among the 67 macrolithic finds we examined, only 5 finds were made from nephrite.

During our raw material investigations, only non-destructive techniques were used. After macroscopic description and grouping, first, the magnetic susceptibility (MS) of the findings was measured using a KT-5 type Kappameter. To avoid measurement errors due to the shape of the adzes, we applied corrections that take into account the size and shape of the artefacts (Bradák *et al.*, 2005; 2009). To determine the mineral composition and texture more precisely, scanning electron microscopy and energy dispersive X-ray spectrometry from the original surface (OS-SEM-EDX, Bendő *et al.*, 2013) were applied to one of the artefacts. Amphibole species were defined based on the nomenclature of the International Mineralogical Association (IMA) (Hawthorne *et al.*, 2012).

Nephrites discovered at the Maria Enzersdorf–Hirschkogel site were very fine-grained rocks with a silky lustre. The characteristic „nephrite texture" is also visible on their surface by the naked eye: amphibole fibres that exhibit a tissue-like interweave or spread out like a fan. Their colours are different shades of green (dark green, pale green) or almost white (very pale green in spots). During weathering, the surface of the originally green specimens can also fade to white. Likewise, the surface of a specimen with a macroscopically uncertain classification turned dark (almost black) in spots due to weathering.

The magnetic susceptibility value of the nephrites found on the site is low: 0,090-0,210 SI units except for the specimen with macroscopically uncertain classification mentioned above, where the MS value is slightly higher: 0,814 SI units.

Based on the OS-SEM-EDX results, the main rock constituents are amphiboles: tremolite, actinolite and edenite (an amphibole species with higher calcium and iron content). The characteristic „nephrite texture" which can be seen with the naked eye in places is mainly created by the amphiboles with tremolitic composition which were formed last, and to a lesser extent by the amphiboles with actinolitic composition. As accessories opaque minerals (magnetite and chrome spinel) can be found in the rock in small quantities and sizes.

The previously examined Prehistoric nephrite artefacts from Hungary were classified into five groups based on their mineral composition, texture and mineral chemical characteristics (Péterdi *et al.*, 2014a). The most probable source areas of several groups have also been identified (Péterdi *et al.*, 2014a; 2014b).

The artefact from Maria Enzersdorf–Hirschkogel is similar to types 1 and 2 in that it contains only small amounts of accessory minerals in addition to the main rock-forming amphiboles, and these are only grains of magnetite and spinel. However, while type 1 is almost pure tremolite nephrite and type 2 is almost pure actinolite nephrite, the amphiboles in the artefact we examined have a more varied composition. The most probable source area of type 1 is Jordanów (Lower Silesia, Poland), while the source area of type 2 is probably in the Swiss Alps but it has not yet been precisely identified (Péterdi *et al.*, 2014a).

Although we detected several types of amphibole in the examined raw material, the fabric of the find is most similar to the Jordanów nephrite, and various authors have shown the presence of actinolite in addition to tremolite in these (Heflik *et al.*, 1987; Łobos *et al.*, 2008; Gil *et al.*, 2015), and also in nephrite from other sources near Jordanów (Nasławice, Lower Silesia, Poland) (Łobos *et al.*, 2008). A type very similar to the raw material we examined – almost completely homogeneous, and containing only a few chromite inclusions in addition to the rock-forming amphiboles – was also presented from the Nasławice site (Łobos *et al.*, 2008).

The Jordanów nephrite and the serpentinites found on the surface, in an area have been known since the Neolithic. It has been proven that the latter was also quarried, and mainly based on finds in Poland they were used for tool making since the same time (Wojciechowski, 1995; Foltyn *et al.*, 2000; Gunia, 2000; Majerowicz *et al.*, 2000; Skoczylas *et al.*, 2000). The raw material has also been identified in archaeological sites in the Czech Republic and Hungary. Their cultural connections to the Carpathian Basin are also known from a wide period of Prehistory, in several archaeological cultures (Přichystal, 2000; Péterdi, 2011; Přichystal *et al.*, 2012; Péterdi *et al.*, 2014b; 2014c).

Taking all of this into consideration, the most likely source area for the raw material of the nephrite artefacts found at the Maria Enzersdorf–Hirschkogel site is Jordanów (Lower Silesia, Poland) and its surroundings.

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New data on the prehistoric utilisation of ignimbrite from the Bükkalja region (poster presentation)

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Ignimbrite is the burnt-through version of the pyroclastic rock rhyolite tuff. Our first data on its prehistoric utilisation in Hungary came from the investigation of the lithic material of the site

Mezőkövesd-Mocsolyás, where it was spotted as the raw material for various grinding stones from various chronological contexts including prehistory. A new and significant addition to the use of ignimbrite was provided by the Late Copper age stele from Mezőcsát-Hörcsögös, which according to recent analysis was made of this material. The new studies were made on the initiatives of Mária Bondár, re-evaluating the megalithic remains of the Copper Age in the central parts of the Carpathian Basin, together with Anna Endrődi and Attila Horváth from the Budapest Historical Museum. The results of the work will be published soon in the 40th volume of the periodical Antaeus. Such an extension of the utilisation of ignimbrite provides us with indirect proof regarding the knowledge of Copper Age mining as well.

The Middle-to-Upper Palaeolithic transition period and new research in Szeleta Cave (poster presentation)

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The Middle-to-Upper Palaeolithic transition period begs for a revision due to the latest findings concerning modern humans. Three cultures are known from this period in Central Europe: Bohunician, Lincombian-Ranisian-Jerzmanowician (LRJ), and Szeletian. According to the shape and the technology of the lithic tools the latter two show a certain similarity, but the concepts behind the formation of their archaeological record are hardly known. This is partially due to the fact that key archaeological sites were excavated in the early period of Palaeolithic research with a methodology different from today's standards. A project started in 2024 aims at excavating the two eponymous sites: Nietoperzowa Cave and Szeleta Cave. Szeleta Cave was excavated in 2024. The preliminary results shed light on the stratigraphic position of the Szeletian in the cave concerning the Middle-to-Upper Palaeolithic transitional period and the Upper Palaeolithic. The geological, palaeobotanical, radiocarbon, stable isotope, paleontological including ZooMS, and aDNA samples are under analysis, therefore our preliminary results stem strictly from recent field observations.

Szeged-Öthalom: the first Palaeolithic find in the Great Hungarian Plain (poster presentation)

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The first Palaeolithic archaeological site in the Great Hungarian Plain was discovered and excavated in 1935.

Of the few dozen recovered artefacts, only 25 lithics are available for analysis today. Retouched tools and cores are missing, however, refitted flakes clearly document on-site core reduction.

The most abundant among the utilized lithic raw materials is a medium-quality rock similar to rocks of hydrothermal origin (called hydroquartzite in the Hungarian technical literature), covered with a white patina. In addition, we have data on the use of small siliceous pebble fragments, Northern flint, jasper and perhaps Jurassic flint from southern Baranya County.

In conclusion, the archaeological significance of the rather atypical artefacts, dated to about 17 thousand years before present via stratigraphic and calibrated radiocarbon data, is mostly topographical.

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