

LITIKUM

A Kőkor Kerekasztal folyóirata
Journal of the Lithic Research Roundtable

12. évfolyam • Volume 12 • 2024



LITIKUM

Volume 12 | 2024



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Szerkesztők • Edited by

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2024

Budapest

HU ISSN 2064-3640

<https://litikum.hu>

LITIKUM

JOURNAL OF THE LITHIC RESEARCH ROUNDTABLE A KŐKOR KEREKASZTAL FOLYÓIRATA

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A Litikum a köeszközökkel foglalkozó szakembereket tömörítő Kőkor Kerekasztal évente egyszer megjelenő elektronikus folyóirata (ISSN 2064-3640 (Online)). A Litikum célja olyan tudományos cikkek publikálása, amelyek a Kárpát-medence és a környező területek kőkorát érintik, köeszközökkel kapcsolatos kutatások eredményeit mutatják be, elméleteket fejtenek ki, módszereket és megközelítési módokat ismertetnek. További információk honlapunkon: <https://litikum.hu>

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Publisher | Kiadó: Kőkor Kerekasztal - Lithic Research Roundtable

Registered office | A kiadó székhelye: H-1088 Budapest, Múzeum Krt. 4/B

Homepage | honlap: <https://litikum.hu> • Email: litikum@litikum.hu

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Cite as Mester, Zs., Király, A. & Lengyel, Gy. (eds) (2024) *Litikum - Journal of the Lithic Research Roundtable*, 11. Budapest: Lithic Research Roundtable. DOI: <https://doi.org/10.23898/litikumvolume202412>

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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

Cite as Péntek, A. (2024) ‘Lithic projectile points from Mexico of the collection at the Museum of Ethnography in Budapest’, *Litikum – Journal of the Lithic Research Roundtable*, 12, pp. 9–37. <https://doi.org/10.23898/litikuma0040>

Article history: Received: 08 October 2024. Accepted: 12 October 2024. Published: 15 November 2024.

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 variable 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 co-

existence 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,

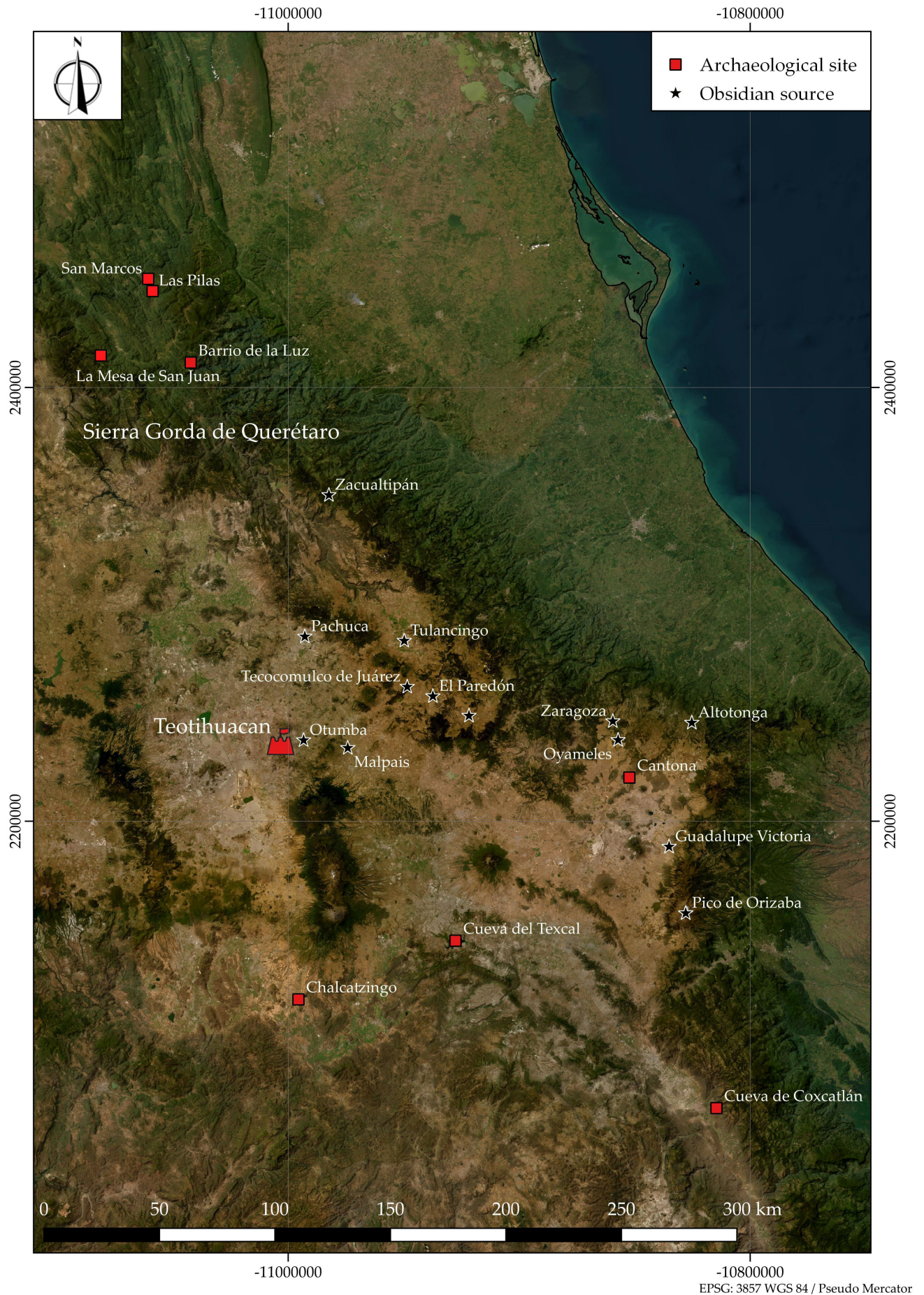


Fig. 1. Some archaeological sites and obsidian sources in Central Mexico. Compiled by the author.

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 Oztotyahualco 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 scarring 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: Muecas 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 $(83.1) \times 33.3 \times 9.9$ 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)

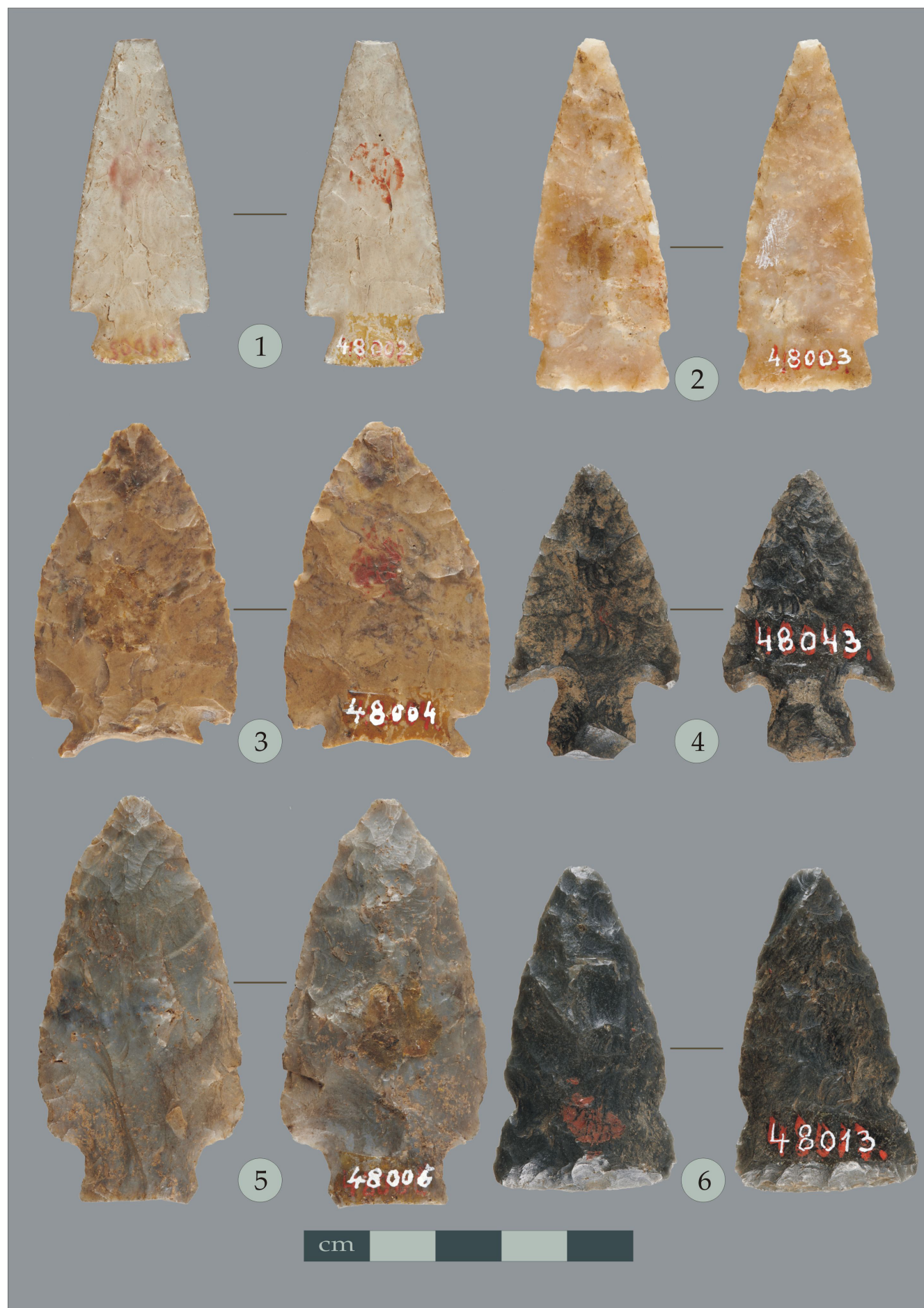


Fig. 4. Selected artefacts of the Bauer collection. Compiled by the author.

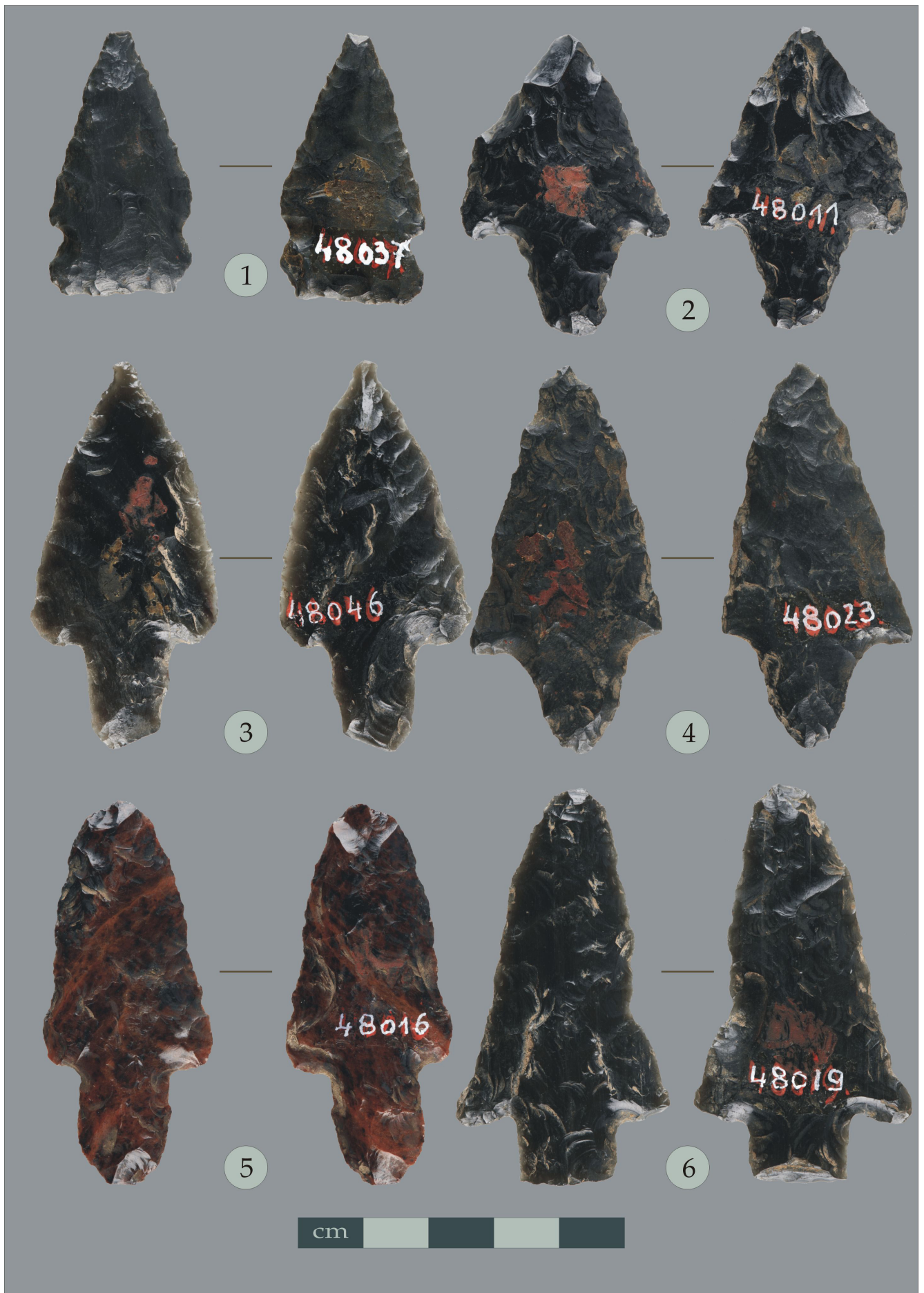


Fig. 5. Selected artefacts of the Bauer collection. Compiled by the author.

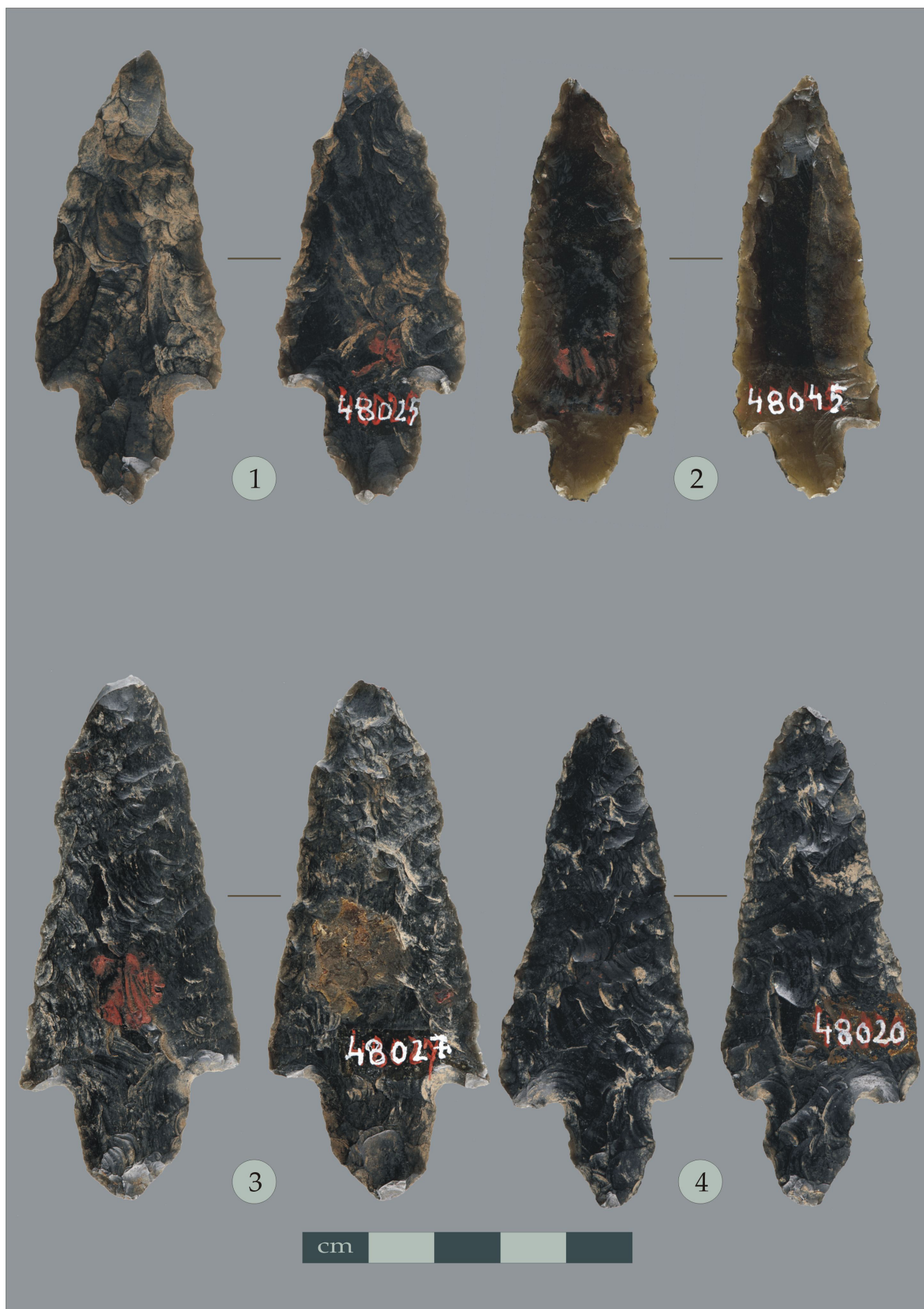


Fig. 6. Selected artefacts of the Bauer collection. Compiled by the author.

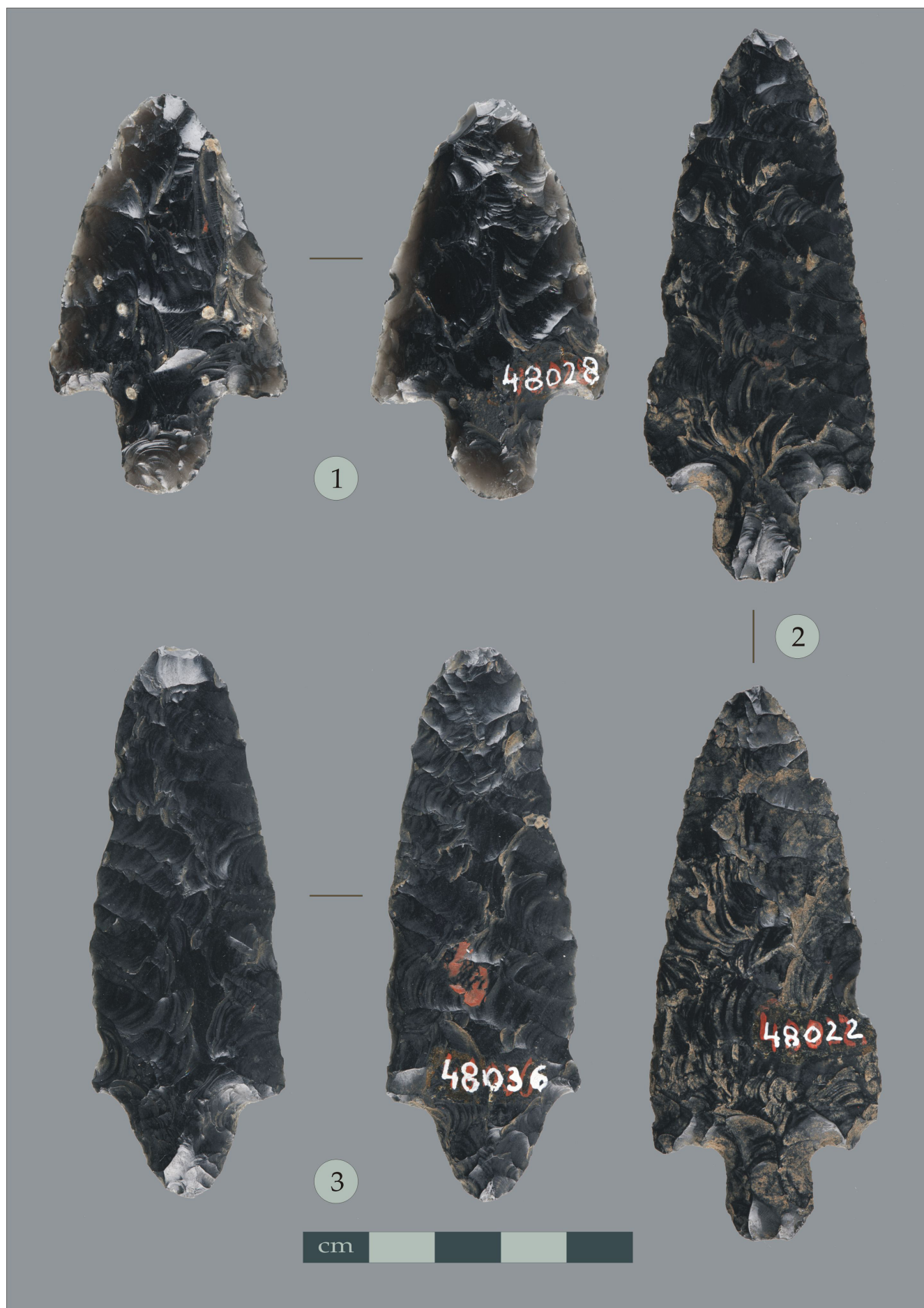


Fig. 7. Selected artefacts of the Bauer collection. Compiled by the author.

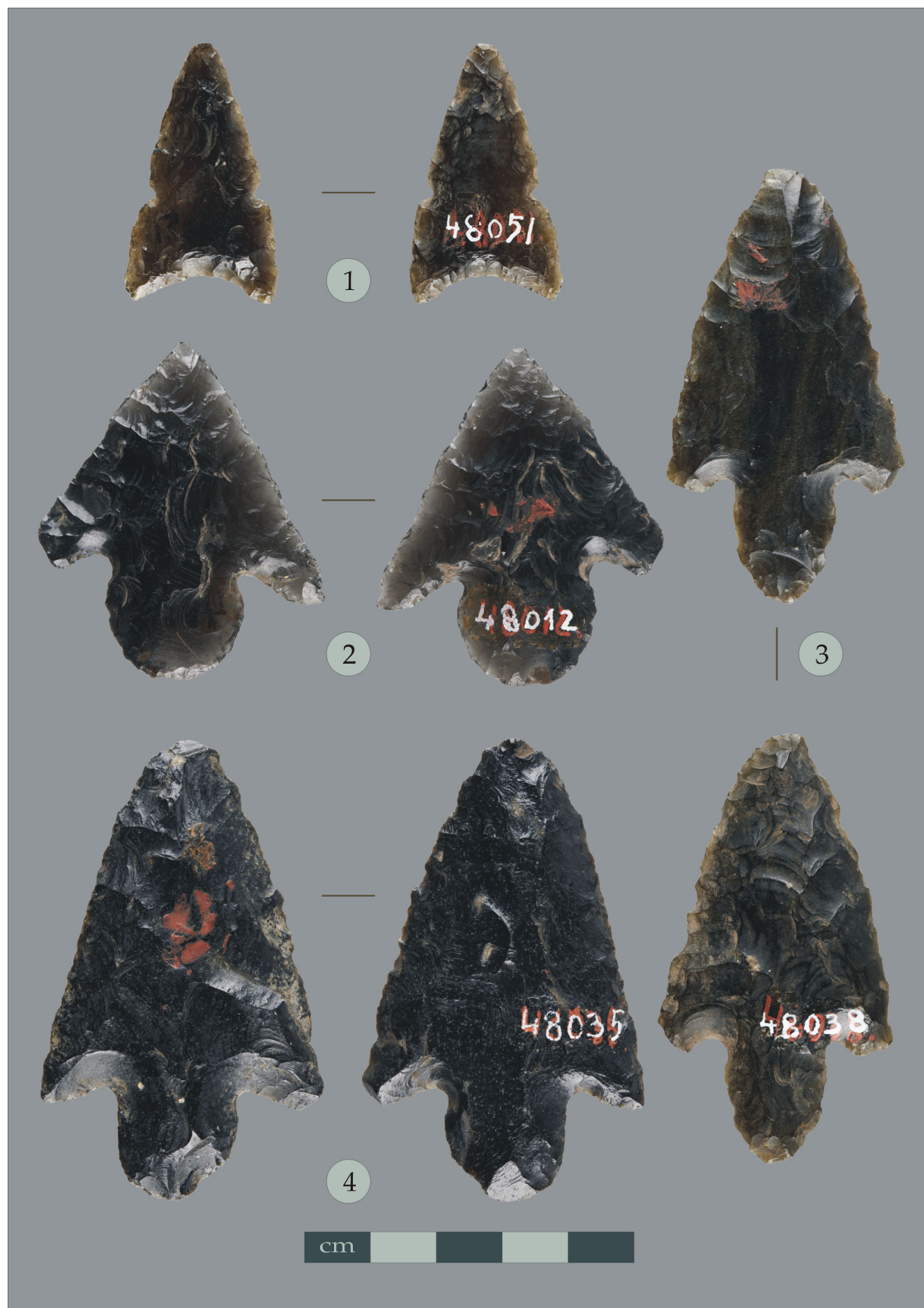


Fig. 8. Selected artefacts of the Bauer collection. Compiled by the author.

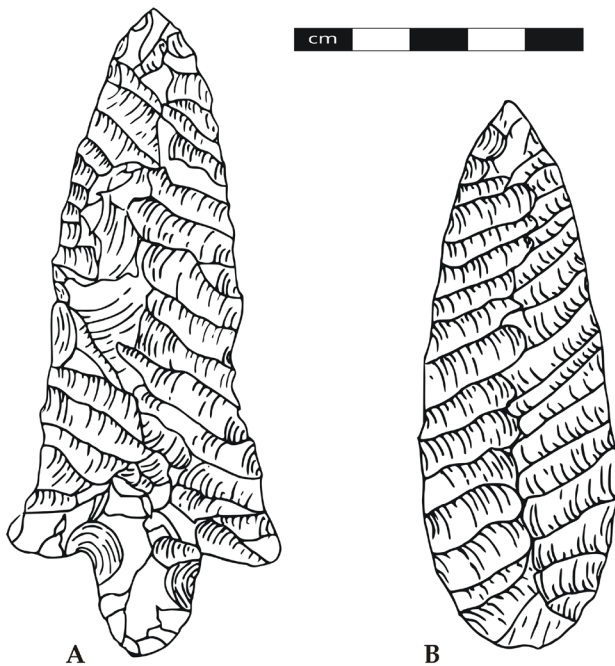


Fig. 9. (A) Zaragoza-Oyameles stemmed-A style point exhibiting upper-left-to-lower-right, diagonal flaking pattern; (B) ovate point exhibiting lower-left-to-upper-right, diagonal flaking pattern (redrawn by N. Faragó after Hirth *et al.* 2003, Fig. 10.4).

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 Cook's 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 (Glascok *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 quantitative 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 free-ware 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.

Acknowledgements

The author would like to express his special thanks of gratitude to Lajos Kemecsi, the director

of the Museum of Ethnography in Budapest, who allowed him to study the lithic collections. Special thanks as well as to János Gyarmati, ethnographer and archaeologist at the Museum of Ethnography in Budapest, who provided the necessary technical support during processing and also helped to do a lot of research concerning the provenance of the collections.

Statements

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

Disclosure statement. No potential conflict of interest was reported by the author.

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

Funding statement. The author received no financial support for the research and the publication of this article.

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