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Ildikó Szathmári

ON THE METALLURGY OF THE FÜZESABONY CULTURE
BRONZE FINDS AND CASTING MOULDS FROM THE FÜZESABONY
BRONZE AGE TELL SETTLEMENT

The high-level metallurgy and craftsmanship of the Bronze Age tell cultures are primarily known from burials and hoards. In spite of the fact that most tell settlements yielded objects denoting local bronze casting (moulds, clay bellow pipes etc.), the number of bronze finds on the settlements is fairly low. On the Füzesabony-Öregdomb tell settlement altogether some 25 pieces of bronze objects and seven casting moulds indicate local bronze casting. This paper presents the bronze finds of the settlement in details with modern archaeometrical studies and discusses the questions arising on the metallurgical research of the Füzesabony Culture.

A bronzkori tell kultúrák magas színvonalú fémművességét, ötvösművészetét elsősorban a temetkezésekből, a kincsleletekből ismerjük. Annak ellenére, hogy a legtöbb tell telep leletanyagában előfordulnak a helyi bronzöntésre utaló tárgyak (öntőminták, agyag fújtatócsövek, stb.) a telepek bronzleleteinek száma igen csekély. A füzesabonyi telepen előkerült alig 25 darab bronzlelet, valamint a hét darab öntőminta valószínűsíti a helyi bronzöntést. A tanulmány a füzesabonyi telep bronzleleteinek részletes közlése mellett kiegészül azok fémvizsgálati eredményeivel, illetve kitér a füzesabonyi kultúra fémművességével kapcsolatos kutatások néhány felmerülő kérdésére is.

Keywords: *Bronze Age tell cultures, Füzesabony Culture, Füzesabony-Öregdomb, bronze finds, casting moulds, Bronze Age metallurgy*

Kulcsszavak: *bronzkori tell kultúrák, füzesabonyi kultúra, Füzesabony-Öregdomb, bronzleletek, öntőminták, bronzkori fémművesség*

Introduction

The current research of Bronze Age tell settlements is characterised by a specific duality. Modern projects aiming at the study of tell sites (BORBAS, BAKOTA, KEX1,2) are promising, dealing with the Bronze Age settlement network of different regions in Eastern Hungary (Borsod Plains, Hernád valley, Berettyó–Körös region, Central Danube valley) and the internal structure of the sites. The results are convincing, using basically non-destructive research methods like extensive and intensive field surveys, aerial photography, metal detectors, geodetic and geophysical research yielding important

new information (DANI–P. FISCHL 2009; KULCSÁR et al. 2014; P. FISCHL et al. 2016). The past few years have brought about intensive research on the settlement history of the Hatvan and Füzesabony Cultures, using the aforementioned methods on the Bronze Age settlements of the Hernád valley and the Borsod plains revealing, apart from local differences, also similarities in between the settlements of the plains and the river valleys, respectively. In case of the multi-layered stratified settlements it was observed that their structure is basically similar: the central multi-layered tell is surrounded by a wide ditch encircled by an external settlement unit (with horizontal layout); the settlement is formed by the

whole complex (P. FISCHL 2016, 11. kép). This settlement structure is seemingly different from that of the contemporary Vatyá culture settlement system where the central settlement (tell, earthwork) is surrounded by a network of satellite settlements.

The application of the above mentioned non-destructive techniques are indispensable for modern archaeology, however, they can be considered as a necessary first step only and cannot substitute excavations, the observation of the archaeological phenomena and the authentic find material excavated by stratigraphic layers and its full elaboration and publication. The cultural classification of the ceramic material collected on the surface can be misleading or improper and we cannot expect a full image of settlement history on settlements inhabited for several periods of the Bronze Age as well.

At the same time the research of multi-layered sites are essentially hindered to the present time by the fact that the complete monographic publication of the Bronze Age tell sites of outstanding importance, excavated several decades ago, has not been accomplished as yet (see summarised by SZATHMÁRI 2011, 485, notes 1, 2). Though several, smaller and bigger studies have been published on the East Hungarian (Tószeg-Laposhalom, Jászdózsa-Kápolnahalom, Polgár-Kenderföldek, Tiszafüred-Ásotthalom, Füzesabony-Öregdomb, Túrkeve-Terehalom, etc.) and Southeast-Slovakian (Barca/Bárca, Nižná Mýsl'a/Alsómislye, Spišský Štvrtok/Szepescsütörtök, Včelince/Méhi, etc.); multi-layered settlements, but they are typically centred around particular problems like the typochronological analysis of specific object categories or general cultural and chronological problems in a comprehensive manner (to quote some, without aiming at completeness: STANCZIK 1978; BÓNA 1980; GAŠAJ-OLEXA 1992; MEIER-ARENDT 1992; CSÁNYI-STANCZIK-TÁRNOKI 2000; GANCARSKI 2002; SZATHMÁRI 2009; FURMÁNEK-MARKOVÁ 2008; BÁTORA 2009; MOLNÁR 2011; SZATHMÁRI 2011; JAEGER-OLEXA 2014).

Due to the lack of the Bronze Age tell site publication and the almost complete lack of find material publications from these sites,¹ the basic evidence for the study of the Füzesabony (Otomani-Füzesabony) Culture is seen in the published cemetery materials that could essentially bias the directions of research. Individuals buried according to strict rites and the ceramic and metal grave goods cannot fully reflect

the world of the living, their everyday life, network of connections, daily ritual activities as well as the social and economic structure of the settlements.

In the followings the metallurgy-related finds of the Füzesabony-Öregdomb Bronze Age tell settlement (Fig.1) will be published, completed with the results of metal analyses of the bronze objects. The paper will deal with some emerging problems related to the metallurgy of the Füzesabony Culture as well.

Find circumstances of the metallurgy-related objects of the Füzesabony tell settlement

The eponym site of the Füzesabony Culture is Füzesabony-Öregdomb (Nagyhalom), known since the excavations by Ferenc Tompa between 1931 and 1937. The excavations lasted for several years, typically in one week periods opening approximately half of the tell estimated for a total area of 4000 m², altogether 1900 m². The layer sequence of the tell settlement extended to, typically, 260–240 cm layer thickness. The excavations brought to light several important settlement features (houses with wooden floor, circular form buildings of economic function, ovens, etc.), as well as a large amount of archaeological finds. More recent excavation of the site was performed forty years later, in 1976 (STANCZIK 1978). The modern methods of excavation on the authenticating-rescue operation (digging by layers and proper documentation) allowed the re-evaluation of the results of former excavations (SZATHMÁRI 1992; SZATHMÁRI 2009; SZATHMÁRI 2011). While the excavations of Ferenc Tompa were mainly performed on the central parts of the Bronze Age settlement, by the time of the rescue excavations, due to modern construction development of the region, only the marginal parts of the tell were accessible for archaeological research. On the question, whether the central tell comprising five settlement horizons had an external inhabited zone, the 1976 excavations could not give an unambiguous answer. This problem can be solved, perhaps, by recent magnetometric research, though the possibilities for research are strongly limited by modern construction activities. Parallel to this, the surface collected field survey finds should be also evaluated.

On the tell settlement founded, and continuously inhabited by the Füzesabony Culture, abundant archaeological finds typical for the multi-layered

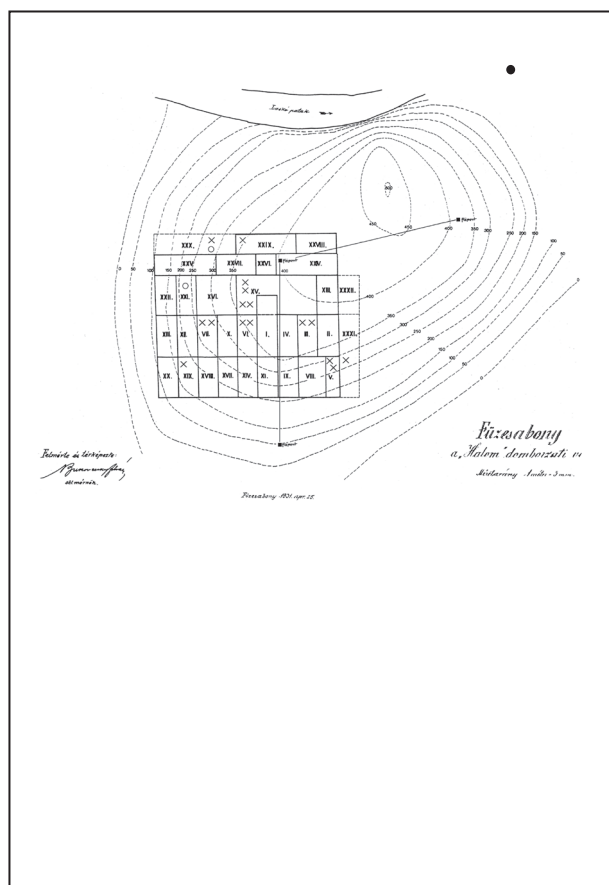


Fig. 1 Location of the Füzesabony-Öregdomb tell settlement, with the two cemeteries associated with the settlement (Pustaszikszó and Kettőshalom)

1. kép Füzesabony-Öregdomb tell telep, a telephez tartozó két temető, Pustaszikszó és Kettőshalom jelölésével

settlements came to light. Most of these finds are pottery, animal bones, bone tools, less stone artefacts and even less bronze implements.² The find material of the 1931–1937 excavations was essentially more plentiful and varied than that of the 1976 rescue excavations. In the time of the old excavations, the cultural layer was more intact and better preserved; partly, F. Tompa excavated on a very large surface, altogether in 32 sections³ (Fig. 2). While the finds of the 1976 rescue excavations did not contain the evidences of the youngest horizon, from the excavations of F. Tompa several finds got into the Hungarian National Museum which can be dated to this period (SZATHMÁRI Manuscript).

There are approximately 25 finds related to Bronze Age metallurgy from Füzesabony-

Öregdomb (see note 2) involving bronze objects, casting moulds and clay bellow pipe remains, exclusively from the 1931–1937 excavations. From the excavation handnotes of F. Tompa written in pencil (Archives of the HNM 106 F II, 45–47 F II) we can reconstruct the occurrence spots for part of the bronze objects and their depth, in spite of the fact that the excavator did not open and document the site and the finds by habitation layers. The excavation notes were written in different complexity and details in the different excavation seasons. The bronze finds were registered exclusively from the context of the Füzesabony Culture belonging to different layers, mostly from the territory of the houses or their immediate surroundings, or the environs of the fireplaces. In respect of spatial distribution, most bronze finds were located at the central part of the tell in the northern half of Section I. and in Section VI situated to the West of the former as well as the adjacent Section XV connected to the previous ones from the North, near the highest point of the tell in those days. On the territory close to the Southern, Southwestern margins of the settlement (Sections XI, XIII, XIV, XVII–XX) hardly any bronze objects were found. F. Tompa wrote in the excavation notes when documenting on Section XX: „almost everywhere we found humous soil void of finds ... so after the third spadeful we stopped working” (Fig. 2).

On the basis of the excavation notes in the earliest phase of the Füzesabony settlement, from the lowermost levels of the tell (240–170 cm) only a few bronze objects were recovered from Section III and its northernly adjacent neighbour, the aforementioned Section XV. According to the excavation documents, these were fragments of one or two bronze pins and two or three punching awls. In the younger levels (150–110 cm) more bronze objects were found, still without exact context. The spatial distribution of these finds roughly corresponds to that of the older levels (Fig. 2). Apart from various bronze pins and their fragments and a few punching awls it is important to mention a bronze lancehead found on the territory of Section XV. Roughly at the same location and in the same depth a bird-shaped clay rattle with expanded wings, well known from publications (KOVÁCS 1989–1990; SZATHMÁRI 2003, 518–519) was also found. On the basis of the sketches in the excavation notes, the pair of casted hollow head pins with ornamented head, of stable

chronological implications, considered today as one of the youngest finds from the settlement was found in the top layer of the settlement at the Western part of Section I in the depth of 35–40 cm (Fig. 7, 1–2; KOVÁCS 1977, 60, Abb. 7; SZATHMÁRI 2011, 491–492, 5. kép 3–4). From the more recent layers of the settlement, the excavator mentioned only a bronze awl in the diaries.

Unfortunately, several bronze finds were mentioned by F. Tompa only in a comprehensive manner in the annual excavation reports. Thus the three bronze axes found on the settlement, discovered, according to the notes of the excavator, at a small distance from each other. Two of them were found already in 1931 in Section V opened at the Southeastern margin of the settlement, allegedly close to the fireplace, and one was found years later in 1937 in Section XXXI (Fig. 2). No data on depth is known about the axes, from the description of the settlement features we can infer that the two axes found in Section V might have been found at 130 cm, in the third level of the five settlement horizons. A small bronze dagger was found in 1933: we only know that it was found in Section VII.

Concerning the casting moulds, F. Tompa commented on the exact provenance of two items in his excavation notes. The two moulds were found quite close to each other but at different depth. The mould of a chisel (probably the specimen presented on Fig. 8, 4) originated from the younger period of the site, i.e., the upper layers of Section XXI, the casting moulds of two conical head bronze pins was found in the depth of 110 cm from the territory of Section XXX (Fig. 2).⁴

In his comprehensive work on Hungarian prehistory, published in the period of the Füzesabony excavations, Ferenc Tompa gave a short summary of the results of the Füzesabony settlement studies as well. On the basis of three destruction layers identified on the whole settlement he separated three living floors. For the dating of the tell he erroneously used the evidence of much younger (Early Iron Age) graves deepened into the cultural layer and consequently dated the life of the settlement to the Late Bronze Age (TOMPA 1936, 93–96, Taf. 41–42). Apart from the characteristic ceramic and bone tool finds found on the Füzesabony settlement he shortly presented the bronze objects found on the site as well. He listed the bronze pins of various types and the two axes found near the fireplace; these pieces

were described as „angled” axes (‘Absatzbeil’), a small triangular bronze dagger, two punching awls and one lancehead. It is clear from the list that Tompa did not publish all the Füzesabony bronze objects, most probably, a large part of the material transported to the Hungarian National Museum was still in crates by the time of the publication (Tompa 1936). The bronze finds were published partly in the form of a photo plate. On Table 41 he presented two spearheads from Füzesabony (TOMPA 1936, Taf. 41, 2, 8). One of them (TOMPA 1936, Taf. 41, 8) is certainly not from the Füzesabony tell, it was probably accidentally mixed among the Füzesabony bronzes. That piece can be identified as a spearhead from Grave 39 of the Hernádkak cemetery, found roughly simultaneously with the excavations of the Füzesabony settlement, also excavated by F. Tompa, (MNM, Inv. nr.: 3.1952.12; MOZSOLICS 1967, Taf. 7, 3; BÓNA 1975, Taf. 163, 27; SCHALK 1992, Taf. 10, 1). One of the bronze axes also presented on Table 41 is strongly distorted by fire and can hardly be identified typologically (TOMPA 1936, Taf. 41, 3), in case of the other narrow axe, the „wings” – protruding margins at the central part of the axe – are almost touching each other (TOMPA 1936, Taf. 41, 4).⁵

Bronze finds and casting moulds from the Füzesabony settlement⁶

Most of the bronze finds recovered from the Füzesabony tell settlement comprised various types of bronze pins. Among the tools, narrow chisels and punching awls with two pointed tips are the characteristic forms. The three excavated bronze axes served probably as tools on the settlement. Bronze weapons were rarely found: F. Tompa mentioned a small bronze dagger, a dagger tip fragment and one bronze spearhead in his excavation documents.

Arms

Bronze dagger: small triangular blade with slight axial rib in its middle part. Its bruised, widening, rounded handgrip blade used to have three rivets, two of them preserved. The rivets were unevenly hammered: one is more flat, the other has a conical head. On the handgrip blade the traces of the grip are well preserved. According to the notes of Amália Mozsolics, who inventoried the piece in 1956, the dagger had double

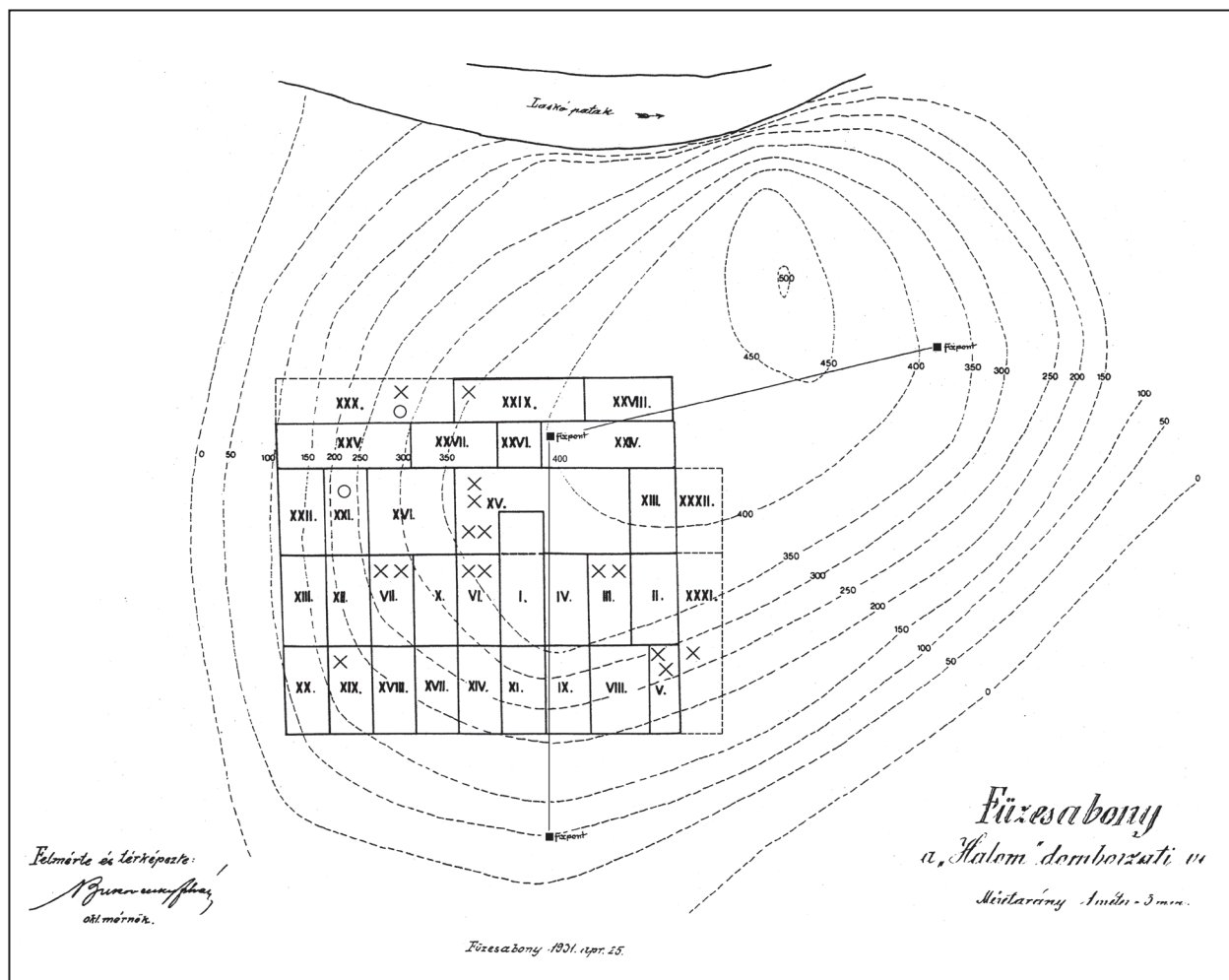


Fig. 2 Füzesabony-Öregdomb. Excavation trenches by Ferenc Tompa between 1931–1937. Bronze finds (x) and casting moulds (o) are marked

2. kép Füzesabony-Öregdomb. Tompa Ferenc 1931–1937. évi ásatási szelvényei az előkerült bronzleletek (x) és öntőminták (o) jelölésével

blade on its upper part. She made a sketch on it in the inventory book (Fig. 3, 1a). In her opinion, the object became smaller after conservation. Current dimensions: length: 8.2 cm; max. width: 3.9 cm; diam. of the rivets: 4 mm. Inv.nr.: 56.15.1568 (Fig. 3, 1–1a).

Fragment of bronze dagger: probably also of small size. Fragment of the blade, at the lower part with traces of a slight axial rib. Dimensions: 1.9x1.8 cm. Inv.nr.: 83.451.48 (Fig. 3, 2).

Socketed bronze spearhead: missing, its photo was published by F. Tompa (TOMPA 1936, Taf. 41, 2). In all probability, this is the bronze lancehead found in 1933 in Section XV at the depth of approx. 130 cm. Description (based on the published photo): elongated laurel-leaf form blade, with relatively long socket extending to the tip of the blade. On the lower, widening

part of the socket bored holes serve for the fastening the weapon in a row parallel to the direction of the blade. Both edges are strongly fractured. Approximate length: 10 cm (Fig. 3, 4).

Ornamented bronze socketed spearhead: this item was inventoried to the collection of the Herman Ottó Museum in Miskolc as originating from the „Füzesabony” site in 1953 (HOM Inv.nr.: 53.409.14). According to the inventory data, the object allegedly came from the Füzesabony settlement excavations of F. Tompa. As this piece is an outstanding item but we have found no reference to it either in the excavation notes or the published summary on Hungarian prehistory (TOMPA 1936, 96), it is possible that the object was originally not a settlement find but it was among the grave goods of the burials associated with the Füzesabony tell. Description

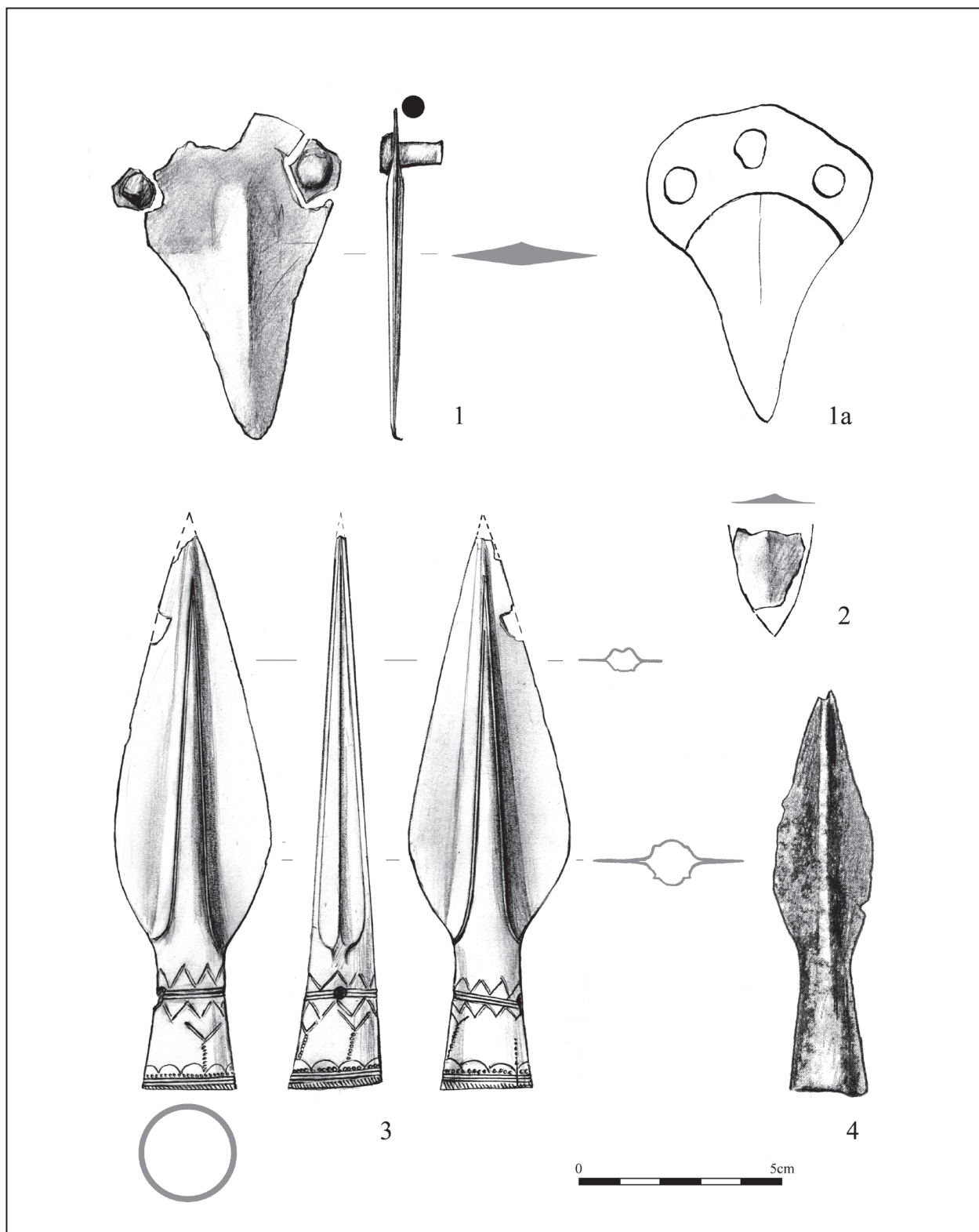


Fig. 3 Füzesabony-Öregdomb 1931–1937. Bronze weapons from the settlement
3. kép Füzesabony-Öregdomb 1931–1937. Bronz fegyverek a telepről

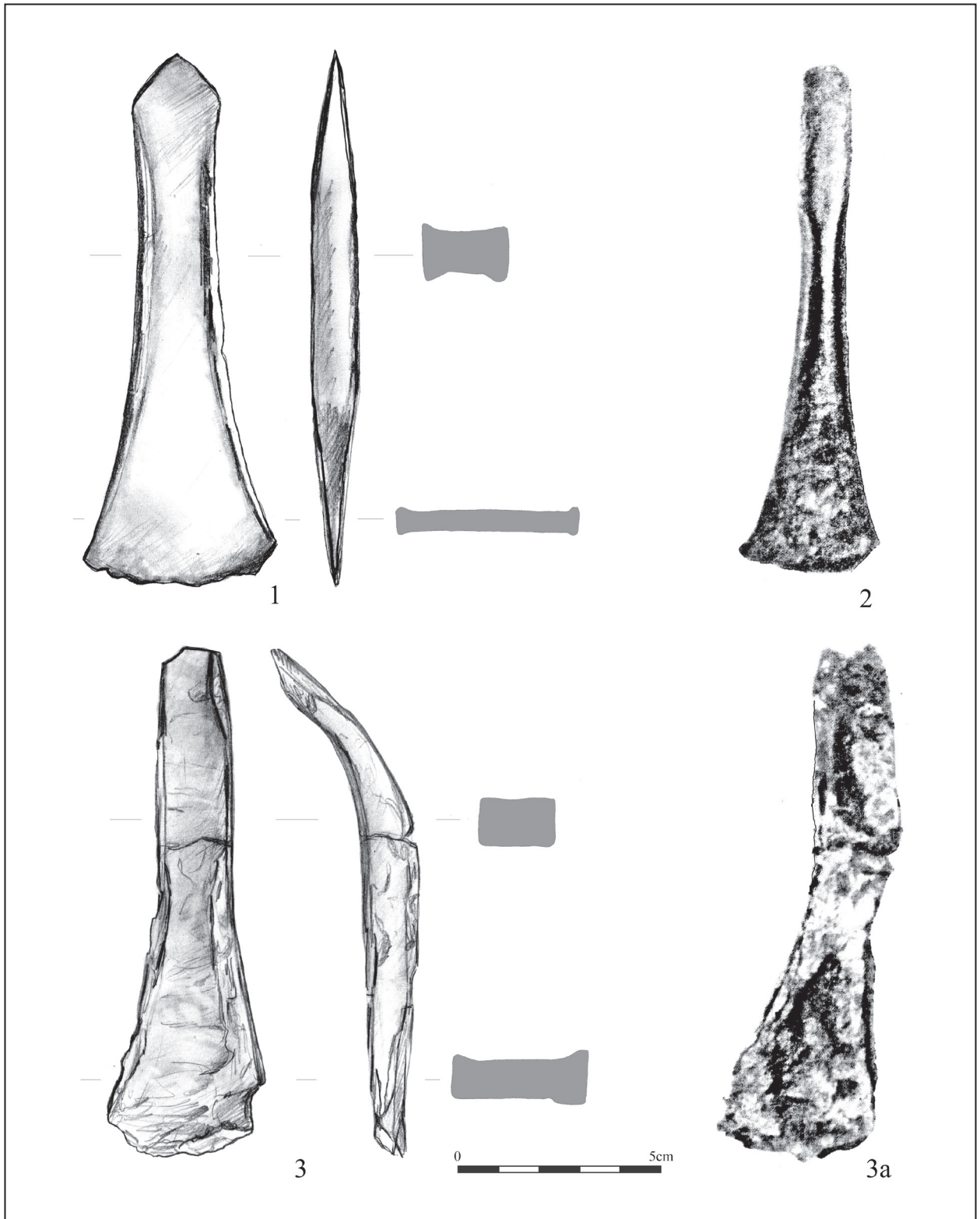


Fig. 4 Füzesabony-Öregdomb 1931–1937. Bronze tools from the settlement
4. kép Füzesabony-Öregdomb 1931–1937. Bronzeszközök a telepről

of the object: the blade is of an elongated laurel-leaf shape, the shaft is relatively short. The widening socket of the spearhead is connected to the plate of the blade in an arched manner. On the ornamented socket we find piercing in the plane of the blade serving for fixing the haft. The ornamentation is a combination of punching and engraving covering almost the whole surface of the socket. On the upper part two rows of zigzag patterns separated by a bundle of horizontal lines, under these, „Y” form motives closed by a semicircular pattern from the lower part. At the margin of the socket, an encircling decoration appears consisting of punching, engraved lines and hatching. The tip of the spearhead and one side of the blade is damaged. This piece was published first by T. Kemenczei (KEMENCZEI 1968, 19, 1. kép). Length: 13.6 cm; max. width: 3.9 cm (Fig. 3, 3). Recently, the Fűzesabony find was re-investigated in connection with the ornamented Bronze Age spearheads (SZEVEÉNYI 2008, 59–60).

Tools

Flanged bronze axe: the edge is strongly arched, the upper part is terminated in an angled peak. The damaged, fractured edge shows distinct traces of hammering. This piece was not published by F. Tompa. Dimensions: length: 13 cm; width of the blade: 4.5 cm. Inv.nr.: 56.15.1581 (Fig. 4, 1).

Bronze axe: missing, its photo was published by F. Tompa (TOMPA 1936, Taf. 41, 4). Description on the basis of the published photo: narrow axe, the flangs in the middle of the two sides are almost touching. Arched edge, damaged, with missing parts. Inv.nr.: 37.1931.3 (Fig. 4, 2).⁷

Bronze axe: in very bad state of preservation, badly deformed in fire, broken into two pieces. We can only assume the original form must have been a winged axe (Absatzbeil), as well. The edge is damaged, with missing parts. The piece was published by F. Tompa (TOMPA 1936, Taf. 41, 3). Probably this is the axe found beside the fireplace on the South-Eastern margin of the settlement, together with the aforementioned axe. Length: 13.2 cm. Inv.nr.: 37.1931.4 (Fig. 4. 3–3a).⁸

Bronze awl: multifunctional tool of good preservation. Gradually narrowing towards the two tips, on one half, with narrow oval section, on the other half, angular with rhombic section. Both tips are bent because of the use. Published by F. Tompa (TOMPA 1936, Taf. 42, 15). Length: 16 cm. Inv.nr.: 46.1948.69 (Fig. 5, 1).

Bronze awl fragment: small size, probably of similar shape as the previous object. Length: 5.8 cm. Inv.nr.: 83.951.46 (Fig. 5, 2).

Bronze awl fragment: probably of similar shape as the previous objects. Length: 7.1 cm. Inv.nr.: 37.1931.8 (Fig. 5, 3).

Bronze awl-chisel: complete, in good state of preservation. With quadrangular cross section, on one side it is cut off straight like a chisel, on the other side pointed. Tool of double function. Length: 12.6 cm. Inv.nr.: 37.1931.7 (Fig. 5, 4).

Fragment of bronze tool: heavily bent, its function was probably the same as of the previous ones. Length: 6.2 cm. Inv.nr.: 83.951.53 (Fig. 5, 5).

Fragment of bronze tool: with flat narrowing end, length: 5.6 cm. Inv.nr.: 893.951.47 (Fig. 5, 6).

Bronze punching awl: small, narrow, with gradually pointed ends. Length: 5 cm. Inv.nr.: 37.1931.9 (Fig. 5, 7).

Bronze awls: with quadrangular cross section on their thickening middle parts, one narrowing end pointed, the other slightly rounded. One of the tools has a broken end. Length: 7.3 cm and 10.2 cm. Inv.nr.: 83.951.45 (Fig. 5, 8–9).

Objects belonging to the attire (accessories)

Fragment of a bronze pin: large pin (probably a ‘Hülseknädel’) with flattened, hammered head, the upper part was probably originally twisted backwards. The upper third of the thick stem is screwed. Length: 12.6 cm. Inv.nr.: 83.951.49 (Fig. 6, 1).

Bronze pin: small pin, the margins of its hammered plate-like head are twisted backwards (‘Hülseknädel’), the narrow stem is screwed on its full length. The head part is fragmented. Published by F. Tompa (TOMPA 1936, Taf. 42, 6). Length: 13.3 cm. Inv.nr.: 46.1948.70 (Fig. 6, 2).

Fragments of a bronze sewing needle: with looped head, straight stem, the lower part of the stem is missing. Length: 11 cm. Inv.nr.: 83.951.52 (Fig. 6, 3).

Fragments of a bronze sewing needle: with looped head, screwed body and head. During the preparation of the pin, the wire was bent back like a loop, thus in the upper third of the stem it is running in double line. Length: 6 cm. Inv.nr.: 83.951.50 (Fig. 6, 4).

Stem fragments of an ornamented bronze pin: with screwed body, horizontally encircling hatches under the missing head part. Length: 10.5 cm. Inv.nr.: 37.1931.6 (Fig. 6, 6).

Stem fragments of bronze pins without ornament: inv. nr.: 83.951.53 (Fig. 6, 5, 7–9).

Long stem fragment of a bronze sewing needle: length: 20 cm. Inv.nr.: 83.951.51 (Fig. 6, 10).

Bronze pin with twisted head: small specimen pub-

lished by F. Tompa. Missing. (TOMPA 1936, Taf. 42, 1). Length: 8.2 cm. Inv.nr.: 46.1948.71.

Bronze pin with ornamented conical head: the head of the pin is hollow inside, cast in one piece with visible traces of the casting seam on the lower part of the head and the upper, thickening part of the stem. The head is pierced by two holes in an oblique plane. The stem is bent. The head of the pin is ornamented by garland motif accompanied by a row of engraved dots, the upper part of the stem is decorated with horizontal hatches. Published by F. Tompa (TOMPA 1936, Taf. 42, 2). Length: 15 cm. Inv.nr.: 37.1931.1 (Fig. 7, 1).

Bronze pin with ornamented conical head: the type is completely identical with the former implement but the stem is more straight. The ornamentation is also identical but more worn. Published by F. Tompa (TOMPA 1936, Taf. 42, 1). Length: 14.6 cm. Inv.nr.: 37.1931.2 (Fig. 7, 2).

*Casting moulds:*⁹

Casting mould for conical head pins: one sided combined casting mould. Contains moulds for three conical head pins of different size as well as for the stem of another pin. Raw material: rhyolite tuff (PÉTERDI 2004, 497). Dimensions: 11x8.4x3 cm. Inv.nr.: 83.951.43 (Fig. 8, 1).

Casting mould for the stem of a pin: broken on both ends. Raw material: fine grained sandstone (PÉTERDI 2004, 513). Dimensions: 7x3x1.6 cm. Inv.nr.: 56.15.1209 (Fig. 8, 2).

Casting mould for spherical head pins: casting mould for two pins. The edges are heavily fractured. Raw material: rhyolite tuff (PÉTERDI 2004, 498, 513). Dimensions: 8.5x3.4x2 cm. Inv.nr.: 56.15.2056 (Fig. 8, 3).

Casting mould for chisel: with rounded corners, one end of the groove inside is horizontally closed, the other side is open. Raw material: fine grained sandstone (PÉTERDI 2004, 513). Dimensions: 9.2x7.8x2.1 cm. Inv. nr.: 56.15.1386 (Fig. 8, 4).

Two-sided casting mould for axe: on one side, the edge of the axe, on the other, the upper rib-ornamented fragment of the shaft-hole axe (pickaxe). Raw material: mica schist (PÉTERDI 2004, 513). Dimensions: 7x4.6x3.5 cm. Inv.nr.: 83.951.44 (Fig. 9, 1).

Cover plate for casting mould: elongated flat stone plate, narrowing on one end, its surface is sooty on some parts. Raw material: fine grained sandstone (PÉTERDI 2004, 513). Dimensions: 15x7x2.5 cm. Inv.nr.: 56.15.2205 (Fig. 9, 2).

Fragment of unidentified casting mould: length: 9 cm. Inv.nr.: 56.15.2236.

End of a clay bellow pipe: length: 7 cm; lower diameter: 4.9 cm. Inv.nr.: 83.951.42 (Fig. 9, 3).

Clay plug for casting objects with shaft-hole (?): length: 4.3 cm; lower diameter: 3.6 cm (Fig. 9, 4).

Among the bronze objects excavated by F. Tompa on the Füzesabony tell settlement we find only a few arms. The weaponry of the Bronze Age population living in the Carpathian Basin, coeval with the Füzesabony culture is characterised by daggers of different shape and length with grip plate as well as some daggers with short solid grip (in much smaller number), early socketed spearheads as well as various forms of battle axes and pickaxes (with shafthole, shaft with ridged half-sleeve, shaft tube and disc-butted). Among the Füzesabony settlement finds we have a small bronze dagger with rounded shoulder and three rivets, the tip fragment of another dagger and two socketed spearheads that could be defined as weapons. Among the casting moulds found, one used to serve also for the production of arms, i.e. the two-sided casting mould of a battle axe (pickaxe).

The dating of the small triangular daggers with grip plate similar to the Füzesabony bronze dagger (Fig. 3, 1–1a) represents wider chronological horizons within the Bronze Age. This dagger type is known from the end of the Early Bronze Age (KOVÁCS 1973, 161–162; P. FISCHL–KIENLIN 2015, 118, Abb. 6) and it is still in use during the Middle Bronze Age apart from, and beside the dominance of, other dagger types. These small, originally flat daggers, the cross-section of which is becoming later rhombic, and which typically have three to six rivets, were known so far mainly from burials. They are reported from the graves of the Kisapostag Culture (VICZE 2011, Pl. 17, 6), the Vátya Culture (BÓNA 1975, Taf. 19, 20, Taf. 23, 11, Taf. 24, 14; VICZE 2011, Pl. 86, 14) as well as the sites of the Transdanubian Encrusted Pottery Culture (MOZSOLICS 1967, Taf. 23, 2; summed up in: KISS 2012a, 127, Pl. 67, 1–3). The two or three riveted versions of this specific dagger type are characteristic grave goods of the Füzesabony (Otomani-Füzesabony) Culture at Nižná Myšľa/Alsómislye in the large cemetery comprising several hundreds of graves, together with other Bronze Age dagger types with grip plate (OLEXA–NOVÁČEK 2013, 41, Tab. 2–3, 5; OLEXA–NOVÁČEK 2015, Tab. 40, 9). Among the daggers with rounded grip plate, we typically

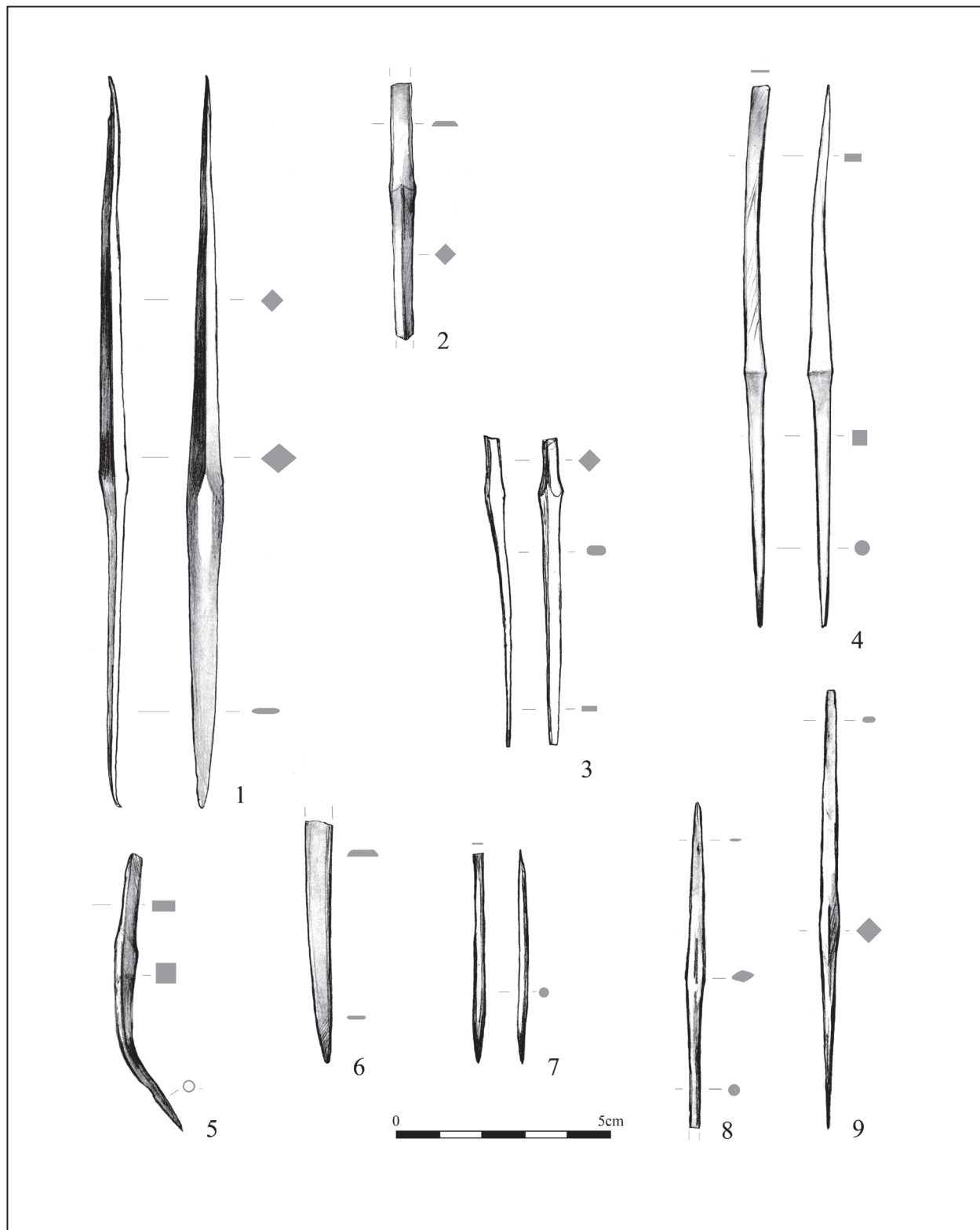


Fig. 5 Füzesabony-Öregdomb 1931–1937. Bronze tools from the settlement
 5. kép Füzesabony-Öregdomb 1931–1937. Bronzeszközök a telepről

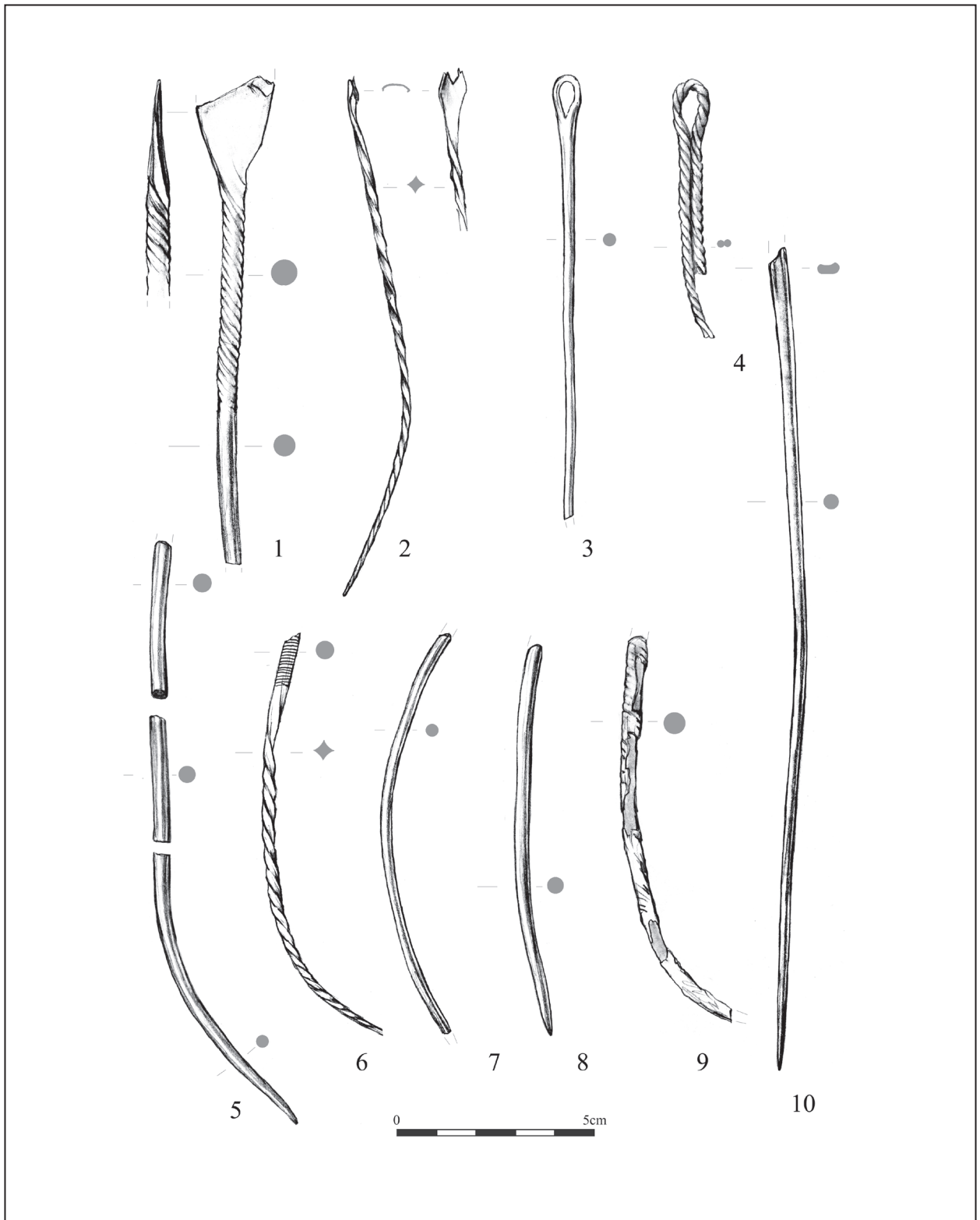


Fig. 6 Füzesabony-Öregdomb 1931–1937. Bronze tools from the settlement
6. kép Füzesabony-Öregdomb 1931–1937. Bronzeszközök a telepről

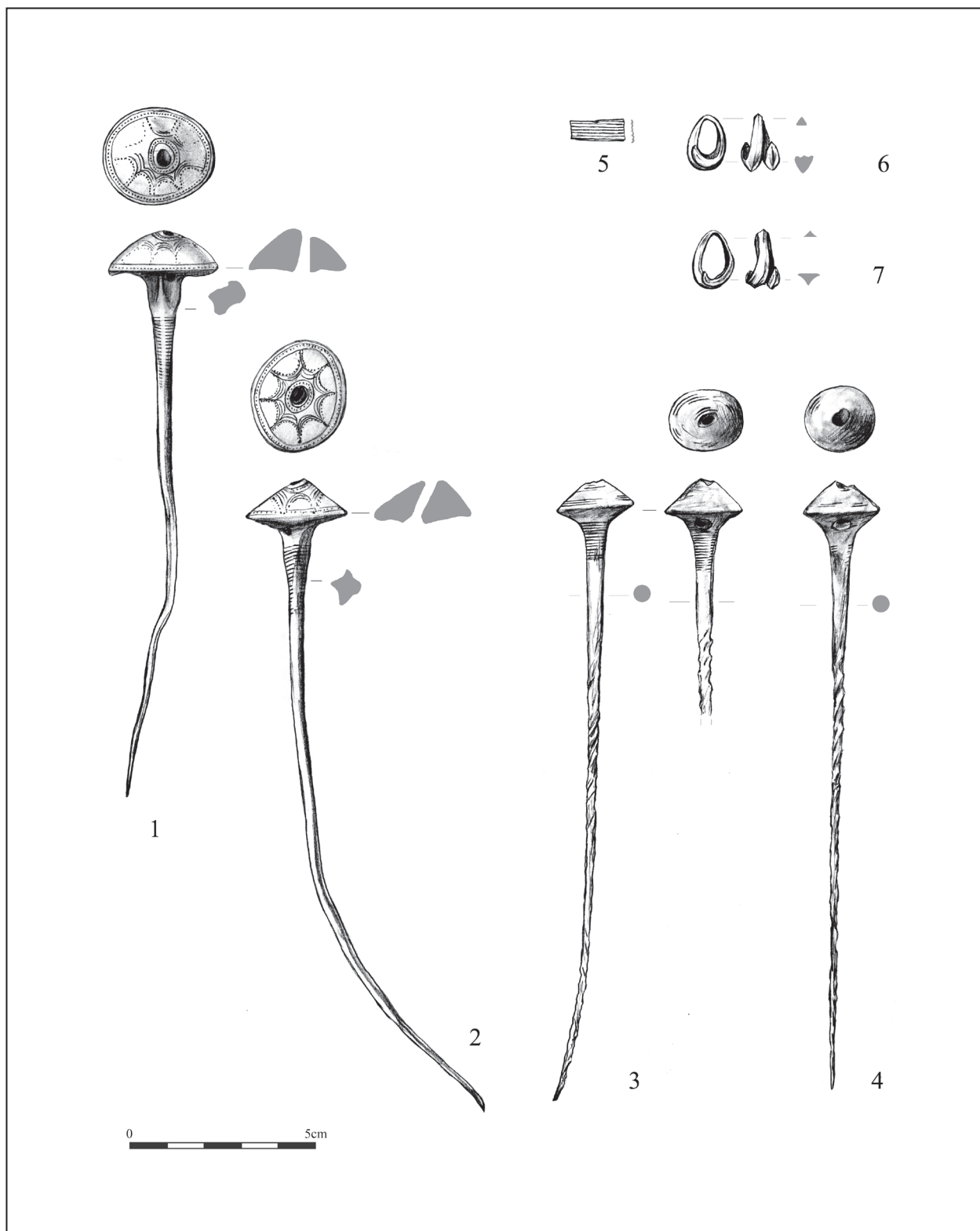


Fig. 7 Füzesabony-Öregdomb 1931–1937. 1–2: Bronze pins from the settlement; 3–4: Bronze finds from graves; 5–7: Gold finds from graves
 7. kép Füzesabony-Öregdomb 1931–1937. 1–2: Bronztűk a telepről; 3–4: Sírok bronzleletei; 5–7: Sírok aranyleletei

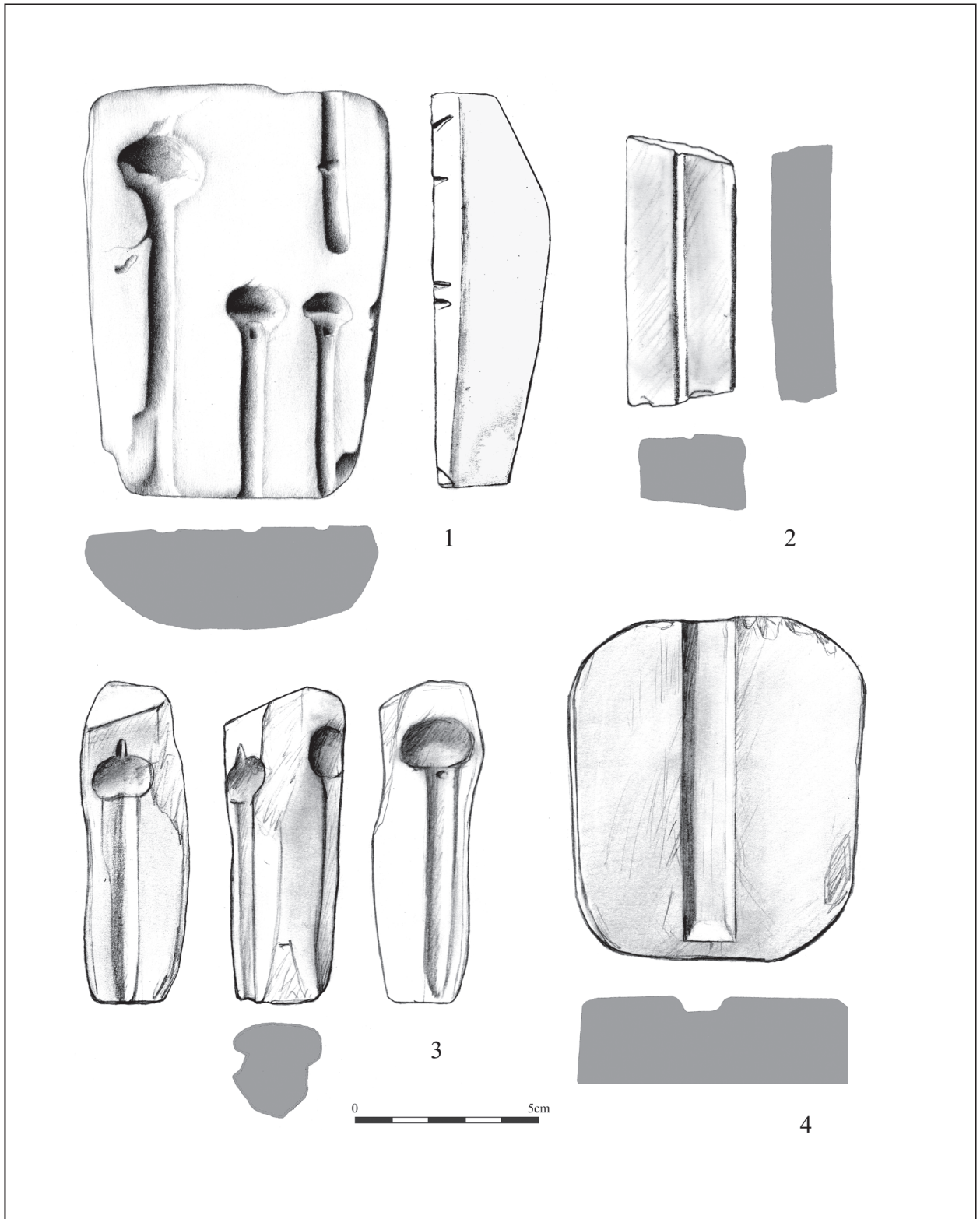


Fig. 8 Füzesabony-Öregdomb 1931–1937. Casting moulds from the settlement
8. kép Füzesabony-Öregdomb 1931–1937. Öntőminták a telepről

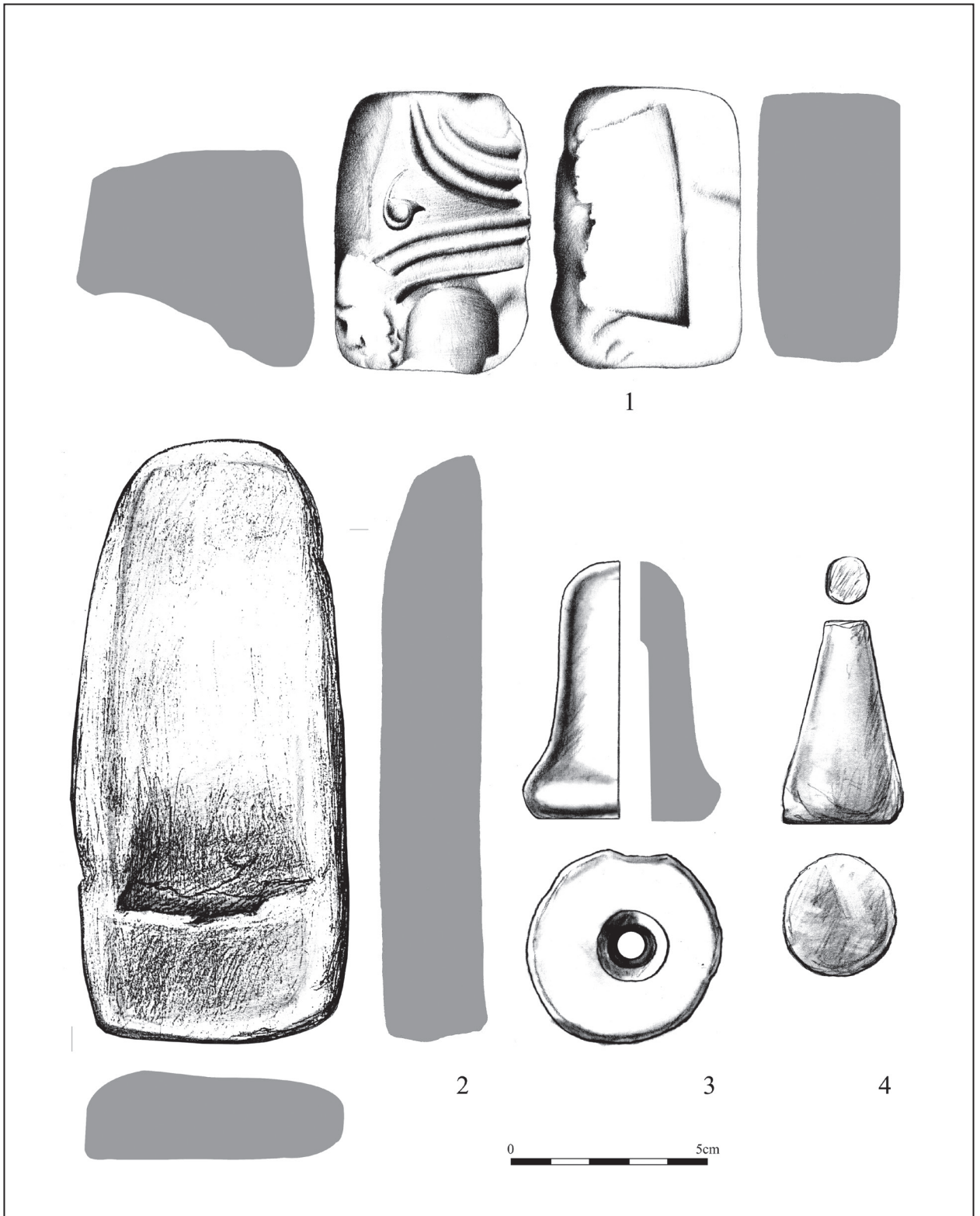


Fig. 9 Füzesabony-Öregdomb 1931–1937. Casting moulds from the settlement
 9. kép Füzesabony-Öregdomb 1931–1937. Öntőminták a telepről

find versions with longer blade and rhombic cross section in the Füzesabony Culture, sometimes richly ornamented ones. These daggers typically originated from burials, and they are known from various sites of the Füzesabony (Otomani-Füzesabony) Culture like Hernádkak, Megyaszó (DAVID 2002, Taf. 260, 2, Taf. 262, 1), Tiszapalkonya (KOVÁCS 1979, 2. ábra 3), Barca/Bárca, Bracovce (DAVID 2002, Taf. 86, 1). A dagger with rounded grip plate in a more angular version was found in grave B115 of the Tiszafüred-Majoroshalom cemetery (KOVÁCS 1995, Abb. 5, 1). The ornamented specimen, also with rounded grip plate from Săcuieni-Cetatea Boului/Székelyhíd-Ökörvár, is probably also originated from a tell settlement (MOLNÁR 2011, 295–296, Abb. 1, 9). According to the opinion of T. Kovács, these types of daggers were mainly produced in the Transylvanian–Upper-Tisza-region metallurgical workshops (KOVÁCS 1979, 64). There were different opinions concerning the dating of the Megyaszó type rounded grip-plated daggers, a characteristic type of weapon for the Füzesabony Culture. While A. Mozsolics and I. Bóna dated them after the Hajdúsámson depot horizon, i.e., the end of the Middle Bronze Age (MOZSOLICS 1967, 55; BÓNA 1975, 156), more recent studies prefer to place them coeval with the Hajdúsámson horizon (in summary, see MOLNÁR 2011, 296).

The local bronze metallurgy of the multi-layered Bronze Age settlements and tools of metalworking, primarily casting moulds, have been recently studied by several researchers (ILON 2006; KIENLIN 2007; BÁTORA 2009; GĀVAN–GOGÁLTAN 2014). Though not in very high number but certainly common, we can find casting moulds for daggers in the Carpathian Basin. From the often fragmented pieces it is not always evident which type of dagger was produced in them. Dagger moulds are known so far, from the distribution area of the Füzesabony (Otomani-Füzesabony) Culture, from the fortified settlement of Spišský Štvrtok/Szepescsütörtök (BÁTORA 2009, 212, Fig. 21), the Barca/Bárca I site (GAŠAJ 2002, Fot. 43) and the Rozhanovce multi-layered site (GAŠAJ 2013, Fot. 30). All of the dagger types possibly casted from these moulds are younger than the piece found on the Füzesabony settlement. Casting moulds for Middle Bronze Age daggers were also found on the Vatyá Culture settlements: Érdliget (HORVÁTH 2004, 20, 9. kép 1; ILON 2006, 278), Soroksár-Várhegy (ENDRÖDI–GYULAI 1999,

Fig. 18, 6a–b; ILON 2006, 280) Százhalombatta-Földvár (HORVÁTH 2004, 30–31, 15. kép; ILON 2006, 280), Dunaújváros-Kosziderpadlás (HORVÁTH 2004, 20, 6. kép 3a–b), on the site of the Magyarád Culture at Málé Kosihy/Kiskeszzi (BÁTORA 2009, Fig. 7, 4; ILON 2006, 279), on the tell settlement of the Vattina Culture at Mošorin-Feudvar/Mozsorin-Földvár (HÄNSEL–MEDOVIĆ 2004, 99, Abb. 14, 1; ILON 2006, 279), as well as the Pecica/Pécska tell settlement (ILON 2006, 279; GĀVAN–GOGÁLTAN 2014).

We have the authentic photo of an undecorated bronze socketed spearhead found on the Füzesabony tell settlement (Fig. 3, 4). Unfortunately the piece is lost by now. Probably it is the specimen found in the central part of the settlement in the depth of 130 cm and this is the piece presented by F. Tompa in his summary paper on Hungarian prehistory (TOMPA 1936, Taf. 41, 2). The best parallel for the laurel-leaf shaped socketed spearhead was found on another multi-layered site of the Füzesabony Culture, i.e. Ároktő-Dongóhalom from a pit in the depth of 165 cm (P. FISCHL 2006, 76, 160). In the case of both spearheads, the holes for the rivets to fasten the piece on the haft are placed parallel to the plane of the blade. Only the position of the holes for fastening are different in the case of the Füzesabony spearhead and of the other laurel-leaf shaped earlier specimen, excavated from Grave 39 of the Hernádkak cemetery. In the case of the latter, the hole was pierced frontally. E. Schalk assigned the grave in her monograph on the Hernádkak cemetery, on the basis of the pottery grave goods, to the relics of the Hatvan Culture (SCHALK 1992, 186, Taf. 10, 1–6).

T. Kovács has dealt with the Bronze Age socketed spearheads in connection with the Koszider period Mende bronze depot find. In his opinion, by the end of the Middle Bronze Age, in the Koszider period, the bronze casting workshops of the Carpathian Basin produced two types of spearheads at the same time. The type with laurel leaf form blade, the socket part of which is shorter (Kölesd, Sárszentlőrinc, Mezőberény, Mende) was produced parallel to the other type with the more elongated blade, arched on the lower part (Ócsa, Sárszentlőrinc). In the case of the earliest Bronze Age socketed axes, T. Kovács separated three variants (A–B–C). The laurel-leaf formed spearhead of the Hernádkak cemetery was assigned to type „B” (KOVÁCS 1975, 24–26). On the basis of this ty-

pological classification, the spearheads from the Füzesabony and Ároktő-Dongóhalom settlements belong to the same category.

According to the generally accepted opinion, the laurel-leaf form spearheads are related to and probably contemporary with the Bühl type spearheads, widely distributed in Central Europe. Most recently, T. Bader has collected the known specimens of this type (BADER 2015). Most of the 46 weapons came to light from hoards but there are also 12 specimens known from settlement context. Most remarkable are the specimens from Romania, as the pieces found on the tell settlements of the Gyulavarsánd/Otomani Culture, for example from Otomani/Ottomány and Vărşand/Gyulavarsánd-Laposhalom (BADER 2015, 237–238, Taf. I. 3–4, 6). From the Slovakian sites of the Otomani-Füzesabony Culture, the author classified in his paper the specimens from the sites Barca/Bárca, and Nižná Myšľa/Alsómislye (BADER 2015, 241–242, Taf. IV, 28, 30). In the material from Hungary he mentioned seven Bühl type spearheads, among them the Ároktő piece which is contemporary to the Füzesabony specimen, as well as some items known from the Koszider period hoards (Békés, Dunaújváros, Mende, Mezőberény, Orosipusza, Sárszentlőrinc). He mentioned here the only mould for casting spearheads known from Hungary, the specimen found at Szólád on the settlement of the Transdanubian Encrusted Pottery (BÓNA 1975, 217, Taf. 270, 25; ILON 2006, 280; BADER 2015, 243–244, Taf. V, 39–45).

The other ornamented spearhead published here is certainly a stray find (Fig. 3, 3). This piece is held in the Herman Ottó Museum, Miskolc, allegedly originating from the Füzesabony settlement excavations of F. Tompa. On the socket of the spearhead we find a rare and special „Y” pattern that is similar to the motive found on a Füzesabony ceramic bowl.

Ornamented Bronze Age spearheads were studied in details by W. David on the occasion of analysing the motives on bronze implements for the Hajdúsámson-Apa-Ighiel-Zajta depot horizon (DAVID 2002, 395–398, Taf. 97). Among the collected and published spearheads we can find specimens resembling the Füzesabony item, however, only certain elements of their ornamentation is similar to our piece. The most similar ornamentation to the Füzesabony spearhead is probably represented by the spearhead of the Bavarian depot find from Langquaid (BADER 2015, 240, Taf. 3, 18).

Ornamented battle axes (pickaxes) were casted in one of the casting moulds of the Füzesabony settlement. On one side of the double sided casting mould we can find the arched back details of a shaft-hole axe decorated with a plastical rib, on the other side we can see the almost straight edge of the axe with angular closure (Fig. 9, 1). Bronze Age shaft-hole axe types of the Carpathian Basin were studied in detail by A. Mozsolics. Her basic typological classification is still valid with minor modifications (MOZSOLICS 1967, 13–24, Abb. 1). Accordingly, the axe casted from the Füzesabony mould belongs to shaft-hole axe type C and within this category, into variant „b” or „c”. Axes with arched, shorter dorsal part of the hafting are typical for the territory of the Gyulavarsánd (Otomani) Culture, and mostly we know analogous casting mould finds from the same territory (Kisvárd, Pir/Szilágypér, Cehălut/Magyarcsaholy, Berea/Bere) (BADER 1978, Pl. LXII, 1–3; BÓNA 1992, 52; MOLNÁR 2011, 278, Abb. 3, 3–8). On many examples the two edges of the shafthole are supplied with plastical rib ornament as it is observable on the Füzesabony casting mould. The shaft-hole axe produced from the Füzesabony mould must have been similar to some axes of the Hajdúböszörmény hoard, different only in their specific ornamentation (MOZSOLICS 1967, Taf. 11, 1–4).

During the morphological and typological analysis of the Bronze Age shafthole axes, W. David investigated the decorative motifs of the axes as well. The rib ornamented casting mould of Füzesabony-Öregdomb is mentioned together with the similar mould found during the 1876–1907 excavations of the Tószeg-Laposhalom tell settlement (BANNER-BÓNA-MÁRTON 1957, 10, Abb. 9; DAVID 2002, 428, Taf. 3–4).

On the Füzesabony tell settlement three bronze axes were found, which were probably used by the inhabitants as tools and not as weapons. One of the axes is broken and heavily bent in fire to an extent, that its type cannot be identified exactly (Fig. 4, 3–3a). According to the excavation diaries, it was found together with another axe classified by F. Tompa as ‘Absatzbeil’, the raised flangs of which on the central part of the axe are almost touching (Fig. 4, 2). Unfortunately lost by now, there was another narrow axe with central wings, also classified by Tompa as ‘Absatzbeil’ (Fig. 4, 2). It lacks exact parallels, although these flanged axes were fairly common in the Carpathian Basin in the second half of

the Middle Bronze Age. They are common especially in the Koszider horizon depots of Transdanubia (Sárbogárd, Dunaújváros-Kosziderpadlás, Sárszentlőrinc) (MOZSOLICS 1967, 63–65, Taf. 36, 4, Taf. 50, 1, Taf. 56, 7–8).

The third bronze axe belongs to the simple flanged axes (Fig. 4, 1). This type was in use from the beginning of the Early Bronze Age. It is known in several variants according to the shape of the edge (arched, straight) and the opposite end (arched, straight, angular), respectively. Several parallels to the Füzesabony bronze axe are known from the sites of the Füzesabony (Otomani-Füzesabony) Culture: Hernádkak, Grave 96 (SCHALK 1992, Taf. 27, 4), Ároktő-Dongóhalom (P. FISCHL 2006, 35, 16), Tiszafüred-Majoroshalom, Graves B 75, B 176 (KOVÁCS 1982a, Abb. 2, 2; KOVÁCS 1982b, 2. kép 4), Tíream/Mezőterem-Kenderhalom (MOLNÁR 2011, 275, Abb. 4, 1), Nižná Myšľa/Alsómislye (OLEXA 2002, 75, Fot. 85). Flanged axes were distributed not only in the Eastern part of the Carpathian Basin: its examples with semi-circular rounded edge are known from Transdanubia (KISS 2012, 133, Pl. 68, 8–9) and even more of them, to the West of Hungary. The distribution of the strongly rounded edge type in Transdanubia is mainly characteristic for assemblages of the late periods of the Hungarian Middle Bronze Age (KOVÁCS 1994, 122).

During the Füzesabony excavations several bronze tools were found that served as indispensable implements for the various artisan activities performed on the settlement. Apart from awls, pointed at both ends (Fig. 5, 7–8) there were some multi-function tools identified. Such tools could be the implements with thickening middle part, with rhombic cross section on one half with pointed edge and on the other part, with more flat, oval cross section and rounded end. Besides the only complete specimen (Fig. 5, 1), several fragments of this tool type were found on the settlement (Fig. 5, 2–3, 5). Another complete tool must have served as awl and chisel at the same time (Fig. 5, 4). Currently these craftsmen's tools are known primarily from graves, lacking the detailed publication of the large Bronze Age settlements. They are known from the Hernádkak cemetery of the Füzesabony (Otomani-Füzesabony) Culture (SCHALK 1992, 127–128, Abb. 49, 2–8), frequently found at the Nižná Myšľa/Alsómislye cemetery in Slovakia (OLEXA–NOVÁČEK 2013, Tab. 6, 3, Tab. 44, 3; OLEXA–NOVÁČEK 2015,

Tab. 42, Tab. 65, 6, Tab. 111, 5, Tab. 120, 3). These tools are also encountered in some of the published graves from the Tiszafüred-Majoroshalom cemetery (KOVÁCS 1982b, 2. kép 2, 5–6; KOVÁCS 1995, Abb. 5, 9). Among the large Bronze Age tell settlements of the Carpathian Basin, we know similar craftsmen's tools from Pecica „Șanțul Mare"/Pécska, Nagysánc from the context of the Maros (Perjámos) Culture, published in details (GOGÁLTAN–GÁVAN 2014, 18, Taf. I. 1–4, 7).

The most numerous category of bronze finds from the Füzesabony settlement is represented by bronze pins. We do not only know these pieces of attire (accessories) but also the casting moulds necessary for their production. One of the casting moulds used to serve for the production of three different sized globular-head pins (Fig. 8, 3). As the bronze pins are among the most frequent pieces of attire from the beginning of the Middle Bronze Age, their casting moulds are also fairly common on the settlements. Apart from the sites of the Vátya Culture (Kakucs-Balladomb, HORVÁTH 2004, 9. kép 3; Lovasberény-Mihályvár, 10. kép 2, 11. kép 1b), we can find them in the find material of the Füzesabony (Otomani-Füzesabony) Culture as well. Apart from the Füzesabony casting moulds presented above, a mould for the stem of a bronze pin was found on the settlement Ároktő-Dongóhalom (P. FISCHL 2006, 137, 160), casting moulds for several pins were located in the find material of the Nižná Myšľa/Alsómislye cemetery (GAŠAJ 2002, Fot. 39), and we know the casting mould of a globular-head pin from Ciumești/Csomaköz (Molnár 2011, Abb. 5, 8) as well.

On the Füzesabony settlement, several types of bronze pins were found, all of them generally known from Middle Bronze Age context, i.e. pin with rolled head (Rollenkopfnadel) (TOMPA 1936, Taf. 42, 12), flattened roll-headed pin (Hülsennadel) (Fig. 6, 1–2), sewing needle (Fig. 6 (Fig. 3–4, 9), conical head pin (Kegelkopfnadel) (Fig. 7, 1–2), casting mould for spherical head pin (Kugelkopfnadel) (Fig. 8, 3). Among these pin types, the rolled head pins cannot be dated exactly as they were in use from the beginning of the Bronze Age till the end of the Koszider period. Flattened roll-headed pin, globular head and conical head pins can be frequently found both in the Transdanubian Middle Bronze Age material (comprehensively summarised in: KISS 2012, 123–124, Pl. 66, 1–14),

and among the Eastern Hungarian finds (KŐSZEGI 1968, Taf. XXIV; KEMENCZEI 1979, 39; SCHALK 1992, 131–132; SZATHMÁRI 1997, 67–68; OLEXA–NOVÁČEK 2015, Obr. 11). Only the use of simple sewing needles is specifically characteristic for the Füzesabony population. These were probably used not only as simple accessories but sometimes the funeral shroud covering the deceased in the grave was also fastened by them (DANI–V. SZABÓ 2004, 97).

The pair of decorated head pins (Fig. 8) were found certainly in the upper layer of the Füzesabony tell in 1931. The head of the conical head pins is closed, seemingly casted in one piece. The seams of casting are observable on the lower part of the head and the starting point of the stem, respectively. The head is hollow inside, transected by two holes in an oblique plane. The head part of both needles is ornamented with a garland motive accompanied by engraved row of dots, on the neck with encircling linear ornament. The conical head bronze pins, bored obliquely, sometime with decorated head and twisted stem can be well dated on the basis of extended analogies to the classical period of the Hungarian Middle Bronze Age. The longer time period of their use is shown by the joint occurrence of such pin together with a Koszider type double lunula in Grave 68 of the Gelej cemetery (KEMENCZEI 1979, 39, Taf. IX. 9, 12). The special feature of the presented pins is their hollow head (DÜZS–SZATHMÁRI–T. BIRÓ 2005). Archaeological research has dealt with pins produced with similar technique on the occasion of the publication of the Mende hollow disc-head pins, mainly with the conical hollow head pins distributed mainly on the Vátya Culture quarters. In the Middle Bronze Age find material we can trace a gradual transition between the double conical head pins frequently occurring on Füzesabony sites to the development and manufacturing of the pins with disc form head. The bronze pins from the Füzesabony settlement mark the „stages” of this development and represent the youngest version of the conical head pins on the Tisza region (KOVÁCS 1975, 37–42, Abb. 8). In connection with the hollow head Bronze Age pins we have to mention the gold hoard found at Szeged, within the distribution area of the Füzesabony Culture containing among other golden objects of attire the head part of a roughly conical head pin as well (KOVÁCS 1979, 70–73, 9. ábra 6).

The ornamentation of the head of the presented pins show a striking similarity to the ornamental

motifs of the Körösetetlen specimens (KOVÁCS 1977, Abb. 6, 1), and other Koszider period sickle-shaped pins (NOVOTNÁ 1980, Taf. 10, 342, Taf. 11, 345–346). The hollow head bronze pins probably belong to the oldest relics of the Koszider period.

The bronze finds and casting moulds found on the Füzesabony settlement support the previously expressed opinion of the author on the chronology of the tell settlement, formed primarily on the basis of ceramic finds (SZATHMÁRI Manuscript). The dating potential of some of the bronze finds is limited or simply too wide. The small triangular daggers, simple twisted head pins are both known from the transitional period between the Early and Middle Bronze Age and they were in general use for a longer period. The battle-axe, represented on the Füzesabony settlement by a casting mould, the flanged axes, different craftsmen's tools (awls, chisels) and most of the bronze pins (globular and conical head pins, sewing needles) are typical products of Middle Bronze Age metallurgy. The winged bronze axe (Absatzbeil) belongs to the youngest finds of the settlement, probably representing a transition towards the angular axes found in the Koszider period hoards. The youngest finds are represented by the pair of casted hollow head pins presented above, the location and depth of which could be unambiguously determined exactly on the basis of the excavation notes by F. Tompa. Accordingly, the Füzesabony tell settlement was founded in the classical phase of the Füzesabony Culture, contemporary with the younger burials of the Megyaszó cemetery (BzA₂) and its termination can be dated around the beginning of the Koszider period (at the turn of BzA₂–BzB₁ periods). Compared to other large tell sites of the Great Hungarian Plain (Tiszafüred–Ásotthalom, Tószeg–Laposhalom, Jászdózsa–Kápolnahalom, Túrkeve–Terehalom), the Füzesabony tell was relatively short-lived, its life extending over some 200 years. The relative chronological observations are corroborated by four AMS ¹⁴C dates, dating the lower layers around 1940–1750 BC while the age of the upper layers could be placed between 1740–1530 BC.

Bronze and gold finds in the cemeteries associated with the Füzesabony settlement

To estimate the actual role of local bronze metallurgy on the Füzesabony tell settlement we have to consider the metal finds of the associated ceme-

teries. There were several, probably not very large cemeteries around the settlement, surrounding the tell in a semi-circular arch to the Northwest, Southwest and Southeast of the settlement. Already during the first series of excavations, F. Tompa observed Bronze Age graves with skeletons in contracted position in two places. In 1934, trial excavations were performed to the South of the tell, at the end of the pasture in direction of the village Dormánd, immediately beside the so-called Csörsz-ditch in the sandpit owned by Antal Szajlai, where allegedly some 20 graves were found. The other place where graves were reported from was some 400 meters away to the Southeast from the tell, along the road to Mezőtárkány. According to the reports of F. Tompa, in one grave two golden rings were found. Concerning the Bronze Age graves, he noted that „the pottery finds are completely identical with those of the habitation site...” (TOMPA 1936, 97). Unfortunately, by now we know hardly anything about the 1934 grave finds. In the Prehistoric Collection of the Hungarian National Museum there are two conical head bronze pins with twisted stem which, according to the inventory data, came from a grave of one cemetery belonging to the Füzesabony settlement. On the head part of the pins we find heavily worn ornamentation formed by engraved lines and punched motifs (length: 16.9 cm, 16.7 cm; Inv. nr.: 8.1952.1, Fig. 7, 3–4). Together with the aforementioned two pins, a rectangular gold plate fragment with ribbed horizontal pattern, probably also from the same grave was inventoried (length: 1.4 cm; Inv.nr: 8.1952.2, Fig. 7, 5). The small gold plate was originally bent backwards along the longer side and could serve as element of women’s wear belonging to a headdress or tress ornament. According to our current knowledge, this rare piece of women’s attire is known from the Carpathian Basin only from the distribution area of the Füzesabony Culture. There are authentic grave finds of this type from the Tiszafüred-Majoroshalom cemetery: gold plates of a few centimetres, ornamented by punching, occurring around the skull, the collar bone and the ribs (KOVÁCS 1979, 6871, 7–8. ábra; KOVÁCS 1999, 39–40, Abb. 13, 1). Similar gold plates are known from the Eastern Slovakian Nižná Myšl’a/Alsómislye, where graves 386 and 404 contained such plates together with other gold finds (buttons and heart-shape golden hairrings) and characteristic pottery (bowls) of the Füzesabony

(Otomani-Füzesabony) Culture (OLEXA–NOVÁČEK 2015, Tab. 71, 4–8, Tab. 87, 7–9). On the basis of the existing archaeological evidence, it seems that these gold plated objects were produced in the workshops of the Füzesabony Culture. This is further supported by a casting mould found at the Nižná Myšl’a/Alsómislye fortified settlement, serving for casting gold plates (GAŠAJ 2002, Fot. 44).

In the 1970’s, the Hungarian National Museum purchased two golden hairrings with „Füzesabony” as site locality (SZATHMÁRI 1982, 4. ábra 1, 2). The oval shape solid hairrings have triangular cross section and the ends are bent over each other. It cannot be excluded that they were found in one of the Füzesabony contracted position skeleton graves of 1934 along the Mezőtárkány road, mentioned by F. Tompa (TOMPA 1936, 97) (Fig. 7, 6–7). Heart-shaped hairrings with ends bent over each other, with oval and semi-oval, more typically triangular cross section were widely distributed in the Carpathian Basin and used as trinkets in large amounts from the first half of the Middle Bronze Age till the beginning of the Koszider period. Specimens made of bronze are known from characteristic Füzesabony Culture burials (Hernádkak: SCHALK 1992, Taf. 25, 1–4, Taf. 32, 2–5; Megyaszó: BÓNA 1975, Taf. 183, 9–10, 14–16, Taf. 189, 16–17; Tiszafüred-Majoroshalom: KOVÁCS 1982a, Abb. 4, 1–2, 6, Abb. 5, 4; Füzesabony-Kettőshalom: SZATHMÁRI 1997, Abb. 9, 4–5, Abb. 11, 7–8). Occasionally they occur in hoard finds as well (Szelevény: KOVÁCS 1994, 1. kép 6–12). Specimens made of gold are most frequently found in the hoard finds of the Tisza region (Tiszaug, Jászdózsza, Tiszafüred, Szerencs: summarised in CSÁNYI–STANCIK–TÁRNOKI 2000, 161–162; SZATHMÁRI et al. Manuscript). One of the stray hairring finds, with Füzesabony marked as locality, is slightly concave on the interior side (Fig. 7, 6). This variant is considered to be younger than the specimens with flat interior side, its use extended until the Koszider period (KOVÁCS 1979, 70–71, 9. ábra 1–4).

Füzesabony-Pusztaszikszó was beyond doubt one of the cemeteries associated with the Füzesabony tell settlement. This site was excavated by Frigyes Kőszegi between 1957 and 1959. Lying at a larger distance from the tell, approximately 3000 meters to the Northwest 30 burials were excavated here, 23 of them with skeletons in contracted position and seven cremation burials (KŐSZEGI 1968). On the basis of the pottery grave goods, this

cemetery was in use for the late periods of the settlement as the ceramic material shows identical features to that of the upper layers of the tell (levels I–II). The cemetery was poor in bronze finds, only five graves contained bronze implements, all of them pins (KŐSZEGI 1968, Taf. XXIV). The single conical head pins or simple sewing needles occurring in the graves were mainly found near the skull or the upper arms. Even in the most well-equipped grave (Grave Nr. 10), only four pins were found: fragment of a pin at the skull, a pair of conical head pins at the hands and a simple sewing needle between the two shins. This latter probably served for the fastening of the funeral shroud (KŐSZEGI 1968, 105–106).

The other known cemetery of the Füzesabony settlement was richer in bronze finds. It was excavated by János Győző Szabó in 1961, 1965 and 1971 at Füzesabony-Kettőshalom (SZATHMÁRI 1997). About 1200 meters to the Southwest of the Bronze Age tell, altogether 24 graves belonging to the Füzesabony Culture could be unearthed. This cemetery must have been larger than the Pusztaszikszó graveyard, but due to the continuous extraction of sand, most of the burials were destroyed. Probably, the cemetery extended to the area opposite the Kettőshalom sand-pit on the other side of the Csörsz-ditch where, during the plantation of a vineyard, a grave with a contracted position skeleton was found in 1938.¹⁰

The contracted position skeleton graves excavated on the Kettőshalom were considerably rich in gravegoods. Most of them comprised ceramic vessels, however the number of jewellery and pieces of attire was also high. Bronze objects came to light from 11 graves (SZATHMÁRI 1997, Abb. 8–11). The most frequent category among them was again represented by the bronze pins. 13 pieces of bronze pins were found in eight graves. They can be classified into three types: simple sewing needles, obliquely drilled pins with globular head as well as pins with conical head. The three bronze hairring pairs belong to the oval form type, ends bent over each other and one end bent backwards in a „Noppen”-like manner with solid, triangular section. Further metal items of attire in the excavated parts of the cemetery comprised, apart from bronze spiral tubes, a lunula shaped bronze pendant with a small ear. Weaponry was only found in a rich grave containing several bronze implements (Grave Nr. 16.), namely a small bronze dagger with grip plate with three rivets that is a good analogy to the small bronze dagger found

on the Füzesabony tell settlement (SZATHMÁRI 1997, Abb. 8, 7). The bronze dagger found in the grave probably had a status-marking role rather than denoting a warrior. The Füzesabony-Kettőshalom cemetery was probably used by the inhabitants of the Füzesabony tell settlement earlier than the Pusztaszikszó cemetery, as the ceramic grave goods of the former site correspond to the finds of the lower layer of the tell settlement.

Thus we know at least two cemeteries associated with the Füzesabony tell settlement so far: their location and part of the cemetery, the more distant Pusztaszikszó graveyard and the closer cemetery at Kettőshalom. Probably we have to consider a third cemetery, already destroyed, observed by F. Tompa along the road to Mezőtárkány. This latter graveyard must have been in a distance of only 300–400 meters from the settlement. The cemeteries were used not parallelly but with some time shift, which is corroborated by the character of the pottery types found in the graves.

The metal finds of the excavated graves were, with one exception, elements of attire and jewellery. Bronze pins were found in the highest number, representing types known from the settlement as well. Only one grave contained weaponry, notably a small triangular bronze dagger, corresponding completely in its form to the specimen found on the settlement.

Conclusions

The high level metallurgy of the Bronze Age tell cultures, including the Füzesabony (Otomani-Füzesabony) Culture is basically known from burials and depot finds from the late (Koszider) period (Tiszaladány, Tiszafüred-Ásotthalom, Košice-Barca/Kassa-Bárca, Nižná Myšľa/Alsómislye, Spišský Štvrtok/Szepescsütörtök, Včelince/Lászlófalva). In spite of the evidence at most of the large settlements, containing variable amounts of relics for local bronze production (casting moulds, bellow tube ends, clay crucibles etc.), compared to other finds, the number of bronze objects actually found on the settlements is relatively low.

On the rescue and authenticating excavation of the Füzesabony-Öregdomb tell settlement in 1976 there were no finds associated with metallurgy at all; on the excavations by F. Tompa between 1931–1937, however, seven pieces of casting moulds, a

bellow tube end and more than twenty bronze objects came to light proving the presence of craftsmen experienced in bronze metallurgy who could produce the simple bronze tools (bronze awls, chisels) and elements of attire (bronze pins) locally. This is supported by the presence of casting moulds for various types of bronze pins (Fig. 8, 1–3), as well as that of a bronze chisel (Fig. 8, 4). On the basis of the available archaeological information we can no longer decide where exactly did the bronze metallurgical activity take place on the settlement, if there were specific buildings associated with the industry on the settlement. It is known however that both the casting moulds and the bronze finds were found in the same area within the settlement, for example, the central part of the tell (Fig. 2). The three bronze axes (Fig. 4) were found somewhat further on, among them two actually located near a fireplace at the Southeast margin of the settlement.

It is unlikely that Füzesabony-Öregdomb would belong to the significant metallurgical centres of the Middle Bronze Age, most probably, the production met the local needs. Even supposing that the Füzesabony settlement had an external horizontal settlement part, the casting of bronze and the production of bronze objects was confined to the central multi-layered tell settlement. Among the settlement finds we can also find bronze objects requiring higher level of craftsmanship. The ornamented bronze spearhead was probably produced elsewhere (Fig. 3, 3). The production of cast pins with hollow head (Fig. 7, 2) also required special skills. We cannot totally exclude, however, that these pins were experimental products of a local bronze smith as the casting seams are not smoothed properly, in spite of the special care taken in ornamenting the head part of the pins.

Recent studies on Bronze Age metallurgy are no longer centred on the typo-chronological study of bronze objects, they are more interested in reconstructing former bronze casting workshops, the operation sequence of bronze artefact production. Among other issues, the specialisation of Bronze Age metalworkers, their commitment to this specific craft is investigated as well as the study of the casting moulds if they were suitable for multiple casting and series production. The increase of archaeo-metallographical studies, raw material analyses can serve important data for this aspects (summarised recently by KISS 2012b).

There are currently few authentic sources on the existence of Middle Bronze Age bronze casting workshops. Among the Hungarian sites, the casting workshop details of the Vatyá Culture from Lovasberény-Mihályvár are known from old excavations (PETRES-BÁNDI 1969). The building with special spatial arrangement belonging to the Vattina Culture, excavated on the tell settlement Mošorin-Feudvar/Mozsorin-Földvár must have served for a bronze casting workshop. This building did not essentially differ from the other houses of the settlement but there were larger areas left open in the internal parts of the house, a part of the southern wall was missing, and a large number of objects necessary for bronze casting were found within and around this house, supporting the idea of a metallurgical workshop (KIENLIN 2007, 2–5, Abb. 1).

Analysing the metallurgy of the large multi-layered fortified settlements of the Bronze Age in Slovakia, J. Bátorá examined in details the sites of Otomani (Otomani-Füzesabony) Culture as well. We have to consider extensive metallurgical activity in the Late Middle Bronze Age (Koszider Period) for the settlements Nižná Myšľa/Alsómislye, as well as Košice-Barca I/Kassa-Bárca, Spišský Štvrtok/Szepescsütörtök and Včelince/Lászlófalva. This is apparent not only from the casting mould finds, but also the number of hoard and depot assemblages containing bronze and gold jewellery and accessories for attire. On the Nižná Myšľa/Alsómislye settlement, the bronze- and goldsmith craftsmen could certainly rely on the local raw material sources lying close to the settlement. As proofs of intensive local metallurgical activity, several bronze objects and casting moulds were found on a roughly 50x60 m area (BÁTORA 2009, 210–214). The abundance of casting moulds made of clay and stone originating from old excavations indicates the presence of a significant bronze metallurgical centre on the large Bronze Age settlement of the Maros Culture, Pecica „Sanțul Mare”/Pécska, probably supplying the needs for bronze artefacts over a wider region by local trade network (GOGÁLTAN-GÁVAN 2014).

The flow of work for Bronze Age metallurgical activity, bronze casting within the settlement, furnace technology and the specialised activity of bronzesmith craftsmen is little known so far. Two graves of the Vatyá Culture may refer to specialised

craftsmen dealing with metallurgy (HORVÁTH 2004, 41–42), as well as Graves 133 and 280 of the Nižná Myšl'a/Alsómislye cemetery of the Füzesabony (Otomani-Füzesabony) Culture. In the case of the two latter graves, the deceased received different tools and casting moulds as grave goods. The authors interpreted this fact as a proof for contemporary craftsmen's specialisation in the field of bronze casting and metallurgy (JAEGER–OLEXA 2014).

On the basis of the finds of metallurgical character from the Middle Bronze Age, found during the 1931–1937 excavations at Füzesabony-Öregdomb it is not likely that large scale bronze metallurgy,

producing for external needs would take place on the tell settlement. Probably the craftsmen working on the settlement supplied goods for local needs. At the same time, the production (casting) of bronze pins was significant, thus we cannot exclude the possibility that they could supply the immediate surroundings of the tell with such pins. It requires further research to prove whether the considerable number of bronze pins found in the cemeteries associated with the settlement could have been produced from the casting moulds of the settlement or only belong to same types but made in different casting series.¹¹

Notes

- 1 An exception from this rule among the multi-layered settlements of the Füzesabony Culture is Ároktő-Dongóhalom, completely elaborated and published by P. Fischl (FISCHL 2006).
- 2 According to the inventory data, the 1931–1937 excavations yielded approximately 500 bone tools, more than 150 stone tools (including seven casting moulds), and only about 25 bronze finds which got into the Prehistoric Collection of the Hungarian National Museum. It is difficult to give the exact number for the bronze finds because several fragments may belong to one or more pins as unidentified stem fragments. On the 1976 rescue excavation, no bronze or other finds related to metallurgy were found.
- 3 F. Tompa had a geodetic survey made on the tell settlement already in 1931, the first year of the excavation. The system of annual excavation sections complemented the groundplan every year. The original documentation is only lacking the last three sections, excavated in 1937 (Sections XXX–XXXII), marked on Fig. 2. by dashed lines.
- 4 It is not possible to judge which of the two pin casting moulds found on the settlement, was mentioned here by F. Tompa in the excavation diary.
- 5 The identification of the bronze finds of the Füzesabony settlement, excavated between 1931–1937 encountered several difficulties. On one hand, the notes by F. Tompa in the excavation diary did not always match the annual excavation reports and neither did they agree the publication in the volume of the *Bericht-* (TOMPA 1936, 93–96). Moreover, most of the Füzesabony settlement material was inventoried much later, after the World War II in 1951 and 1956 in the Hungarian National Museum. Thus, some bronze objects from Füzesabony got lost in the damaged storeroom of the Museum and some of them became difficult or impossible to identify. In this study, not only those bronze finds and casting mould are published which can still be found in the depot of the prehistoric collection of the HNM but I have tried to reconstruct and identify those which got lost in the course of time.
- 6 The lithic material of the Füzesabony-Öregdomb tell settlement was studied by Tünde Horváth and colleagues several years ago. They published the results in English in 2015 (HORVÁTH et al. 2015), the same paper was published later in Hungarian as well (HORVÁTH et al. 2016). In the two studies the author published not only the stone but also the bronze finds. In respect of these bronze objects the author utilised the unpublished doctoral dissertation of the present author (SZATHMÁRI 1990, 'A füzesabony-öregdombi bronzkori tell telep' [The Bronze Age Tell settlement of Füzesabony-Öregdomb] (see references on the tables of the unpublished dissertation, – HORVÁTH et al. 2015, 49–51; – HORVÁTH et al. 2016, 66–67), containing several inaccurate data. The recent revision of the excavation notes by F. Tompa (1931–1937), the finds in the collection of the HNM and the inventory notes allow a more exact view on the metal finds of the Füzesabony excavation – the current study is based on the updated evidence. Without aiming at a complete critical revision on Horváth's paper, some inaccurate information shall be mentioned here: one of the spearheads allegedly originating from Füzesabony has proved to be the spearhead from Grave 39 of the Hernádkak cemetery (HORVÁTH et al. 2015, 49; HORVÁTH et al. 2016, 66). In the English language study published in 2015, one of the casting moulds claimed to be of Füzesabony (Fig. 11, op.cit.) is not identical with any of the moulds known from Füzesabony (HORVÁTH et al. 2015, Fig. 4.). The inventory number listed by Horváth (,Inv. nr.:

- 56.15.1386”) refers to another piece in the HNM Collection, the casting mould of a chisel presented here on Fig. 8. (Fig. 8, 4).
- 7 István Bóna published the bronze axe erroneously as from Grave 96 of the Hernádkak cemetery (BÓNA 1975, Taf. 164, 16). In the Hernádkak grave, another type flanged axe was found (SCHALK 1992, Taf. 20, 2).
- 8 The bronze axe is currently stored in the Prehistoric Collection of the HNM under erroneous inventory number. Currently the entry „56.15.1581” stands for two Füzesabony bronze axes but the original inventory book listed only one piece. It is almost certain that the mentioned bronze axe was found in 1931, therefore its correct inventory number is 37.1931.4.
- 9 The lithic finds of the Füzesabony site, including a casting mould, were studied by T. Horváth and colleagues (HORVÁTH et al. 2016). The raw material of the lithic finds was identified by Bálint Péterdi (PÉTERDI 2004).
- 10 I am indebted to László Bernáth for the localization of the cemeteries of the Füzesabony tell, who lives in Füzesabony and who is specially interested in archaeology. He took an active role in re-discovering the Bronze Age Füzesabony sites and the collection of the surface finds (BERNÁTH 2006).
- 11 The publication of this study was supported by the „Lendület” research project of the HAS (From bones, bronzes and sites to society: Multidisciplinary analysis of human mobility and social changes in Bronze Age Hungary /2500–1500 BC/), (KISS 2016). The drawings in this study were made by Katalin Nagy. The English text of the study was translated by K.T. Biró.

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A FÜZESABONYI KULTÚRA FÉMMŰVESSÉGÉRŐL. BRONZLELETEK, ÖNTŐMINTÁK A FÜZESABONYI BRONZKORI TELL TELEPRŐL

Összefoglalás

Az utóbbi években megkezdett magyarországi bronzkori tell-kutató programok (BORBAS, BAKOTA, KEX1,2) a különböző kelet-magyarországi földrajzi régiók, valamint a Közép-Dunavölgy bronzkori településhálózatának vizsgálatát tűzték ki célul. A roncsolásmentes vizsgálati módszereken alapuló kutatások eredményei vitathatatlanok, de csak az első lépésnek tekinthetők, semmiképpen nem pótolhatják a hiteles ásatásokat. A többrétegű telepek kutatását a mai napig erősen korlátozza az a sajnálatos tény, hogy az egyre növekvő forrásanyag mellett a már több évtizede feltárt, kiemelkedő jelentőségű bronzkori tellek teljes körű monografikus publikálása elmaradt. Bár mind a kelet-magyarországi (Tószeg-Laposhalom, Jászdózsa-Kápolnahalom, Polgár-Kenderföldek, Tiszafüred-Ásotthalom, Füzesabony-Öregdomb, Túrkeve-Terehalom, stb.) mind a délkelet-szlovákiai (Bárca/Barca, Alsómislye/Nižná Mýsl'a, Szepescsütörtök/Spisšký Štvrtok, stb.) többrétegű telepek kutatásával kapcsolatban számos kisebb-nagyobb tanulmány született, ezek általában egy-egy kiemelt tárgycsoport tipokronológiai elemzésével vagy összefoglaló jellegűknél fogva elsősorban kulturális-kronológiai kérdésekkel foglalkoznak.

A bronzkori tell kultúrák, így a füzesabonyi (Otomani-Füzesabony) kultúra magas színvonalú fémművességét jelenleg elsősorban temetkezésekből, illetve a kultúra késői (koszideri) időszakából származó kincsleletekből (Tiszaladány, Tiszafüred-Ásotthalom, Kassa-Bárca/Košice-Barca, Alsómislye/Nižná Mýsl'a, Szepescsütörtök/Spisšký Štvrtok, Lászlófalva/Včelince) ismerjük. A tanulmányban egy többrétegű tell telep, az Alföld északi peremén fek-

vő Füzesabony-Öregdomb fémművességhez köthető leleteit adom közre, kiegészítve a bronztárgyak fémvizsgálati eredményeivel.

A füzesabonyi kultúra által alapított és hosszabb ideig folyamatosan lakott telepen bőséges leletanyag került elő, legnagyobb részben kerámialelet, kevesebb csont- és kőeszköz, és még kisebb a bronzleletek száma. Az 1976-os leletmentő-hitelesítő ásatáson helyi fémművességre utaló emlékanyagot nem tártak fel, de Tompa Ferenc 1931–1937. évi nagyobb felületű ásatásaiból előkerült 7 darab öntőminta, agyag fűjtatócső vég, valamint a húsznál több bronzlelet feltételezi, hogy a telepen bronzművesek dolgoztak.

A bronztárgyak között kevés fegyver volt. Egy három nitszeges, trianguláris kis bronztőr, egy másik pengéjének töredéke, valamint két tokos lándzsa (az egyik díszített) képviseli a fegyvereket. Fegyver öntésére szolgált a telepről származó harci balta (csákány) kétoldalas öntőmintája is. A tell telepről három olyan bronzbalta került elő, melyeket a telepen élők valószínű szerszámként, és nem fegyverként használtak. Kézműves tevékenységek munkaeszközei voltak a különféle, olykor több funkciós bronzvésők, áruk.

A füzesabonyi telep bronzleletei között a különböző típusú bronztűk (fűzőtű, pödrött-, lapát-, gömb- és kúpfejű tűk) fordulnak elő legnagyobb számban. Nemcsak maguk a viseleti tárgyak kerültek elő, hanem az öntésükhöz szükséges öntőminták is. Az egyik öntőminta három különböző méretű kúpfejű tű, egy másik két gömbfejű tű öntésére szolgált. Mivel a bronztű a középső bronzkor elejétől az egyik leggyakoribb viseleti tárgy, öntő-

mintái sem ritkák a telepleletek között. Jól keltezhető az a díszített fejű tű pár, mely Tompa Ferenc 1931-ben írt ásatási naplója szerint biztosan a telep felső rétegéből került elő. A kúpfejű bronztűk feje zárt, belül üreges, egybeöntött. Jól látható a fej alsó részén, illetve a szár kezdeményénél az öntővarrat nyoma. Az ilyen technikával készült bronztűket a kutatás a kúpfejű tűk legfiatalabb változatának tartja.

A füzesabonyi telepről előkerült bronzleletek és öntőminták alátámasztják a füzesabonyi tell korával kapcsolatos korábbi véleményünket, melyet elsősorban a telep kerámialeletei alapján alakítottunk ki. A bronzleletek közül néhánynak kevés a keltező értéke (trianguláris kis bronztörök, egyszerű, pödrött fejű tűk). Az egy öntőmintával képviselt harci balta, a peremes balták, a különféle kézművesszerszámok (árak, vésők), a bronztűk nagy része (gömbfejű, kúpfejű tűk, fűzőtűk) a középső bronzkori fémművesség jellegzetes termékei. A telep fiatalabb leletei közé tartozik az a szárnyas bronzbalta (Absatzbeil), mely valószínű átmenetet képez a koszideri kincsekben található, sarkított balták felé. A legfiatalabb bronztárgy a fentebb ismertetett, öntött, belül üreges fejű tűpár. Ennek megfelelően a füzesabonyi telepet feltehetően a megyaszói temető fiatalabb temetkezéseivel egy időben alapították (BzA₂) és megszűnését valamikor a koszideri korszak kezdetére (BzA₂–BzB₁ határa) tehetjük. A relatív kronológiai megállapításokat alátámasztja négy újabb AMS ¹⁴C dátum is: az alsó rétegek abszolút kora Kr.e. 1940–1750 közé, míg a felső rétegeké Kr.e. 1740–1530 közé tehető.

A füzesabony-öregdombi tell telepen előkerült öntőminták és bronzleletek alapján valószínűsíthető, hogy a telepen az egyszerűbb bronzeszközöket, (bronzárak, vésők stb.) valamint a viseleti tárgyakat, elsősorban a bronztűket helyben készítették. Ezt támasztja alá a különböző típusú bronztűk készítésére

szolgáló öntőminták viszonylag nagy száma, valamint a bronzvéső öntőmintája. A rendelkezésünkre álló régészeti adatok alapján ma már nem dönthető el, hogy a bronzműves tevékenység pontosan hol, milyen jellegű épületekben folyt a telepen, az azonban megállapítható, hogy mind az öntőminták, mind a bronzleletek nagyjából azonos területről, a tell központi részéről származtak. Nem valószínű, hogy Füzesabony-Öregdomb a középső bronzkori nagyobb fémműves központok közé tartozott, bizonyára elsősorban a helyi igényeket elégítették ki. Ha volt is a füzesabonyi telepnek külső egyrétegű teleprésze, a bronzöntés, a bronztárgyak készítése a központi tellen folyt. A telepleletek között előfordult nagyobb szaktudást igénylő bronztárgy is. A bizonytalan telepleletek közé tartozó, díszített bronz lándzsahegyet valószínűleg nem helyben készítették. A belül üreges fejű öntött bronztűk készítése (Fig. 7, 2) is magas színvonalú technikai tudást feltételez. Nem lehet teljesen kizárni azonban, hogy ezek kísérleti jelleggel a helyi bronzöntő-kovács mester első próbálkozásai voltak, ugyanis az öntött fejrészekben az öntővarratok nincsenek eldolgozva, annak ellenére, hogy a tű fejrészének mintáját gondosan készítették.

Füzesabony-Öregdombon az 1931–1937. évi ásatások során előkerült, a bronzkori fémművességhez köthető leletanyag alapján nem tartjuk valószínűnek hogy a tell telepen nagyfokú, megrendelésre is történő bronzműves tevékenység folyt. Valószínű, hogy a telepen dolgozó mesteremberek elsősorban a helyi igényeket elégítették ki. Ugyanakkor, miután a füzesabonyi telepen a bronztűk készítése (öntése) jelentős volt, nem lehet kizárni, hogy ezekkel a közvetlen környezetet is ellátták. További kutatást igényel annak vizsgálata, hogy vajon a telep temetőiben jelentős számban található bronztűket a telepen előkerült öntőmintákból öntötték-e, illetve készülhettek-e az azonos típusú bronztűk már sorozatban.

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APPENDIX

Boglárka Maróti–Ildikó Harsányi–Zsolt Kasztovszky¹NON-DESTRUCTIVE ANALYSIS OF BRONZE OBJECTS
FROM FÜZESABONY-ÖREGDOMB

Chemical composition of bronze findings from the Füzesabony-Öregdomb hoard and gold stray finds from Füzesabony were determined using non-destructive methods. The main components of the bronze objects are copper and tin, with small amount of nickel and lead. The latter objects are made predominantly of gold with 16–23 weight percent silver.

A Füzesabony-Öregdomb leletegyüttesből származó bronztárgyak, valamint füzesabonyi arany szórványleletek kémiai összetételét határoztuk meg roncsolásmentes vizsgálati módszerekkel. A bronztárgyak fő alkotói a réz és az ón, kisebb mennyiségben tartalmazzák ólmot és nikkelt. A szórványleletek az aranytartalom mellett 16–23 tömegszázalékban tartalmazzák ezüstöt.

Keywords: *bronze, gold, PGAA, XRF, non-destructive chemical composition analysis*

Kulcsszavak: *bronz, arany, PGAA, XRF analízis, roncsolásmentes kémiai összetétel meghatározás*

Eleven pieces of archaeological bronze objects from the Füzesabony-Öregdomb hoard were examined, in the frame of Momentum grant entitled 'From bones, bronzes and sites to society: Multi-disciplinary analysis of human mobility and social changes in Bronze Age Hungary (2500–1500 BC)'. Some objects consist of several fragments, thus object fragments belonging to the same inventory numbers were occasionally also measured. In order to determine the elemental composition of the artefacts non-destructively, the prompt gamma neutron activation analysis (PGAA) technique and an InnovX Delta Premium handheld X-ray fluorescence (XRF) spectrometer were used.

During the PGAA measurements (RÉVAY–BELGYA 2004), the objects are irradiated with cold neutrons, the nuclei of the irradiated material capture a part of the neutrons and emit gamma photons. The photons are detected by a semi-conductor detector simultaneously with the irradiation (SZENTMIKLÓSI et al. 2010; SZENTMIKLÓSI et al. 2013). The energy of the peaks in the gamma spectrum is specific to the chemical components of the objects, whilst

the area of the gamma peaks is in correlation with the amount of the elements. The identification of the elements and the calculation of concentrations (RÉVAY 2009) are based on the PGAA library (RÉVAY et al. 2004). Due to the high penetration depth of neutrons and gamma photons, the resulting elemental composition gives the average composition of the total irradiated bulk volume, which can be tens of mm.³ The PGAA method is suitable to determine the main and minor constituents of the alloys (for bronzes Cu and Sn, sometimes Pb) and some trace elements (e.g. As, Ag, Co, Ni). Based on the results, the original alloy composition can be determined (KASZTOVSZKY et al. 2000). As PGAA has moderate sensitivity for Pb and Sn, these elements can be detected only above two weight percent quantity as major alloying components.

The XRF technique is based on the detection of characteristic X-rays. The energy of the detected X-ray is characteristic to the chemical elements present in the object. The Sn and Pb content of metal objects can be determined using XRF down to the magnitude of 0.05% concentration. The results

Table 1 Bulk elemental composition data of eleven archaeological metal objects determined with PGAA. As some objects were fragmentary, 14 measurements were done. The results are listed in weight percentage (<D.L. – under detection limit)

1. táblázat 11 régészeti tárgyon és töredékein végzett 14 roncsolásmentes PGAA mérés eredménye tömegszázalékban megadva (<D.L. – kimutatási határ alatti mennyiség)

	Detection limit	Cu 1.0	Cu ±	Sn 2.0	Sn ±	Ag 0.02	Ag ±	Ni 0.07	Ni ±
Description	Inv.nr.								
Ornamented bronze pin with disc-shape head	HNM 37.1931.1	92	0,5	7,5	0,4	<D.L.		0,12	0,007
Ornamented bronze pin	HNM 37.1931.1	93	0,4	6,9	0,3	0,03	0,006	0,15	0,01
Ornamented bronze pin	HNM 37.1931.2	93	0,4	6,9	0,4	<D.L.		0,10	0,008
Bronze chisel	HNM 37.1931.7	88	0,4	11,3	0,4	<D.L.		0,08	0,006
Fragment of small bronze chisel	HNM 83.951.46	93	0,4	6,4	0,3	<D.L.		0,087	0,002
Bronze pin with twisted stem	HNM 83.951.49	87	0,4	11,5	0,4	<D.L.		<D.L.	
Bronze pin with twisted stem	HNM 8.1952.1	94	0,9	6,0	0,3	0,057	0,004	0,14	0,01
Small dagger (with 3 rivets)	HNM 56.15.1568	96	0,4	3,6	0,4	<D.L.		0,49	0,01
Rivet 1	HNM 56.15.1568	94	0,3	5,4	0,3	<D.L.		0,54	0,02
Rivet 2	HNM 56.15.1568	92	0,5	6,3	0,3	<D.L.		0,37	0,00
Rivet 3	HNM 56.15.1568	90	0,4	6,0	0,4	<D.L.		0,25	0,01
Flanged bronze axe in bad state of preservation	HNM 56.15.1581	89	0,4	10,4	0,4	<D.L.		<D.L.	
Flanged bronze axe	HNM 56.15.1581	92	0,3	6,6	0,3	<D.L.		0,75	0,05
Ornamented spearhead	HOM 53.409.14	87	0,4	11,1	0,4	0,19	0,007	0,289	0,007

obtained with the XRF method are however, characteristic to the surface layer of the archaeological finds (depth of 10–50 µm). In the surface-covering corrosion layer the distribution of Sn is uneven. Elevated concentrations on the surface at different locations can be most varied and distort the mea-

sured values of the original alloy composition (SZABÓ 2010). When examining inhomogeneous objects, it is important to use different complementary methods and to interpret the results together (KISS et al. 2015). Compared to the PGAA concentration data, the surface XRF results can provide additional in-

Table 2 Surface elemental composition data of seven archaeological metal objects and fragments, determined with XRF. The results are listed in weight percent unit

2. táblázat Hét régészeti tárgyon és töredékein végzett felületi XRF mérések átlageredményei tömegszázalék egységben megadva

Description	Inv.nr.	Cu	Cu ±	Sn	Sn ±	Pb	Pb ±	Ni	Ni ±
Ornamented bronze pin with disc-shaped head	HNM 37.1931.1	84,2	0,2	11,3	0,1	0,17	0,01	0,03	0,01
Ornamented bronze pin	HNM 37.1931.1	88,5	0,2	8,0	0,1	0,14	0,01	0,03	0,01
Ornamented bronze pin	HNM 37.1931.2	82,9	0,4	10	1	0,30	0,01	0,04	0,03
Fragment of small bronze chisel	HNM 83.951.46	86,0	1,0	4,9	0,3	0,010	0,004	<K.H.	
Bronze pin with twisted stem	HNM 8.1952.1	91,4	0,3	7,8	0,4	0,050	0,003	0,12	0,07
Small dagger (with 3 rivets)	HNM 56.15.1568	84	4	7,8	0,7	1,9	0,5	0,7	0,3
Rivet 1	HNM 56.15.1568	83	2	6	2	0,61	0,15	0,1	0,06

Table 3 On-site XRF measurement results of three pieces of gold stray find at the Hungarian National Museum (<D.L. – under detection limit. The detection limit of copper in case of the hairring Nr 5 is 0.2 weight percentage)

3. táblázat Három régészeti arany szórványlelet helyszíni XRF méréseinek eredménye (<D.L. – kimutatási határ alatti mennyiség. Az 5-ös számú hajkarika esetén a Cu kimutatási határa 0,2 tömegszázalék)

Description	Au	Au ±	Ag	Ag ±	Cu	Cu ±	Fe	Fe ±
Golden plate with rib (3)	82,4	0,4	15,9	0,2	1,2	0,3	0,37	0,07
Golden hairring (4)	78,2	0,7	21,5	0,7	0,22	0,07	0,10	0,04
Golden hairring (5)	77,5	0,3	22,4	0,3	<K.H.		0,08	0,02

formation about the condition of the surface of the object investigated (e.g. whether there is a corrosion coating or surface modification caused by substances used in the conservation of the object).

In addition to the bronze items, we also performed non-destructive XRF measurements on gold objects found as stray finds in Füzesabony. The investigations took place at the Hungarian National Museum.

Tables 1 and 2 summarize the results of the elemental composition of bronze objects obtained by the PGAA and XRF measurement techniques. For some objects, the XRF concentration values were found to be significantly different at the examined points. These results are not shown in the table. The interpretation of these results is in progress.

Based on the PGAA and XRF results, the objects are made of tin-bronze. The spearhead with inven-

tory number HOM 53.409.14 contains 0.51 ± 0.04 weight percent of Sb, 0.40 ± 0.02 weight percent of As and 0.032 ± 0.002 weight percent of Co besides the elements listed in Table 1.

The XRF results of the examined objects from the Hungarian National Museum are summarized in Table 3. The results are given in weight percentage unit.

Notes

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