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Andrzej Pelisiak[1], Thomas Saile[2], Maciej Dębiec[3]

A CONTRIBUTION TO RESEARCH ON THE KNAPPED LITHIC ASSEMBLAGE FROM THE LATE NEOLITHIC SITE OF ALTHEIM IN LOWER BAVARIA

ABSTRACT

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The lithic artefacts from Altheim, being regarded as essential for the interpretation of the site, have for a very long time attracted attention. Here we concentrate on the discoveries made during the excavation of sections of ditches in 2013-2020. Certain earlier observations were confirmed by the latest excavations, namely the high proportion of arrowheads among the flaked stone tools. A large number of the arrowheads were burnt. Many of them have broken tips, and all the analysed arrowheads with broken tips bear diagnostic impact fractures: step-terminating bending fractures or spin-off fractures specifically in the shape of small fractures on the edge between one surface of the arrowhead and the surface of the fracture of the tip. These suggest an angle of impact of the arrow into a hard surface of about 60°-70°. Broken and burnt arrowheads were found in the solid context of the structures. The context suggest that these arrowheads can be connected with conflict.

Keywords: Late Neolithic, Altheim culture, earthworks, lithics studies, arrowheads, conflict
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1 Institute of Archaeology, Rzeszów University, Stanisława Moniuszki 10, 35-015 Rzeszów, Poland; a.pelisiak@gmail.com; ORCID: 0000-0001-9870-9656
2 Chair of Prehistory and Early History, Regensburg University, Universitätsstraße 31, 93053 Regensburg, Germany; thomas.saile@ur.de; ORCID: 0000-0003-0834-5567
3 Maciej Dębiec: Institute of Archaeology, Rzeszów University, Stanisława Moniuszki 10, 35-015 Rzeszów, Poland; debiecmaciej@gmail.com; ORCID: 0000-0002-8679-6278

1. INTRODUCTION

The earthwork of Altheim in Lower Bavaria makes up the eponymous site of the Altheim culture of the Later Neolithic (4th millennium BC). Excavations carried out in 1914 and 1938 produced a rich inventory of finds, namely pottery, stone artefacts, human skeletal remains and animal bones. Objects made of copper prove the technological innovation of the Altheim population, who were processing metal for the first time. The alignment of the site allows the observation of the movements of the moon and refers to the implementation of astronomical knowledge in architecture.

The earthwork of the (eponymous) Altheim (site) is located north of Landshut in the transition area from the Tertiary hills to the loess-covered high terrace (Fig. 1). Despite their location in the intensively used agricultural landscape of Lower Bavaria, the ditches are still preserved up to a depth of 2 m, especially in the eastern part of the site. However, in the last century alone, about 0.4 m of the feature substance was lost through erosion, as

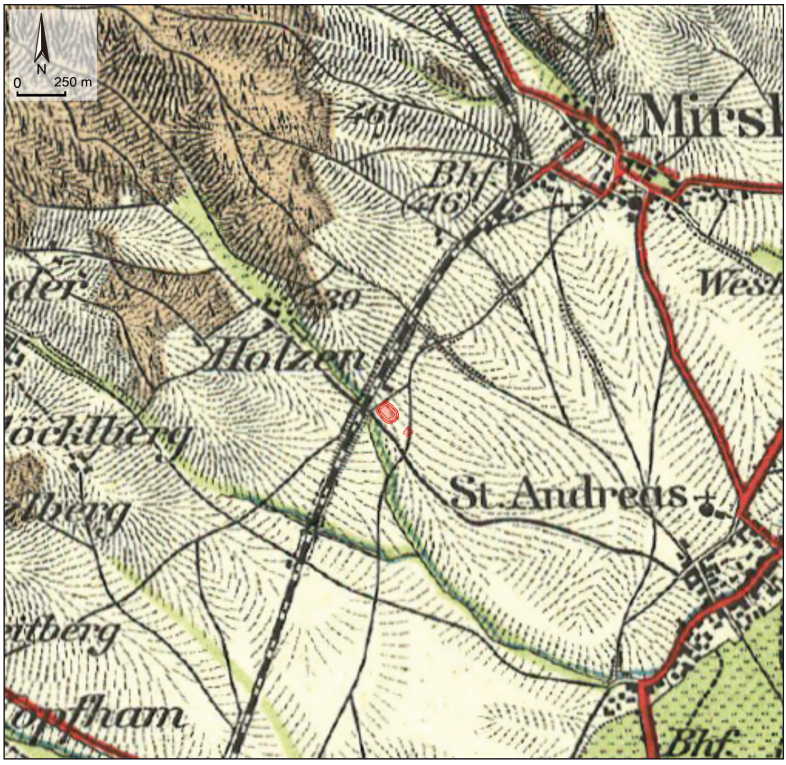

Fig. 1. The two Altheim earthworks on the lower slope of a loess ridge at the exit of the Holzener Tälchen, extending southwestward to the Eichelbach. Map basis: Map of the German Empire 1:100,000 sheet 611 Landshut (1890). Graphic: M. Posselt

Fig. 2. Section of a magnetic image of the landscape on both sides of the Eichelbach with the Altheim I and II earthworks. Graphic: M. Posselt

evidenced by, for example, a comparison of the differences in the profile documentation of the middle ditch between 1914 and 2014 (Saile *et al.* 2021).

A large-scale magnetic prospection of the site on both sides of the Eichelbach stream has yielded evidence of intensive occupation activity (Fig. 2). In the greyscale image, the well-thought-out building scheme of the prehistoric enclosure clearly emerges: aesthetic proportions instead of monumental size (dimensions). The external dimensions of the northwest-southeast oriented complex are about 120 × 90 meters. The enclosed inner space, about 35 m wide and 60 m long, is enclosed by three ditch rings, which are spaced at intervals of 7-10 m (more in: Saile *et al.* 2017).

The two Altheim earthworks are spatially related to each other. The longitudinal axis of the older known structure Altheim I is aligned almost exactly northwest-southeast, as is the line running over both earthworks of the recently discovered earthwork Altheim II.

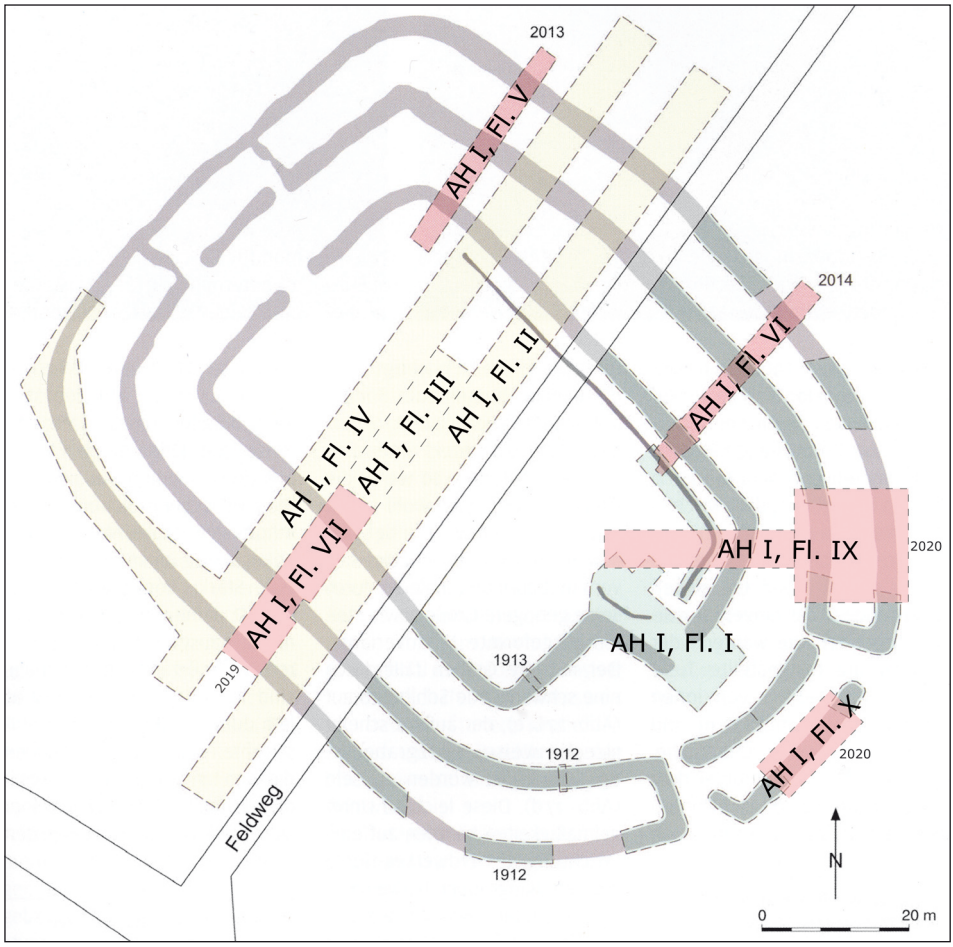

Fig. 3. Interpretative drawing and location of the excavation trenches 1912, 1913, 1914, 1938, 2013, 2014, 2019, 2020

Accordingly, ^{14}C dating on samples of domestic animal bones from Altheim II indicate that the small rectangular enclosure existed at the beginning of the 37th century BC. Dates on samples of cereal grains from the lower backfill layers of the inner ditch of Altheim I suggest excavation at around the turn of the 37th and the 36th century BC. In the 36/35th century the interconnected horseshoe-shaped semicircular ditches were backfilled.

During excavations in 2013, 2014, 2019 and 2020 (Fig. 3), abundant archaeological artifacts were recovered, among them many knapped lithic materials, which are the core of this study. Special attention was paid to the numerous recorded arrowheads.

2. KNAPPED LITHIC MATERIALS

2.1. Altheim I, 2013

2.1.1. Fläche – 1, Befund 1 (Outer ditch)

Only five knapped artefacts were discovered: two chunks, one of them made of Arnhofen Plattensilex (30 mm in diameter), and the other burnt and undefined with respect to raw material (17 mm in diameter); one highly burnt chip; one small fragment of an burnt and crushed undefined tool (size: 14 × 7 × 2 mm); and one burnt and crushed fragment of a probably heart-shaped arrowhead. It has one edge, with the base and the tip damaged. One partly preserved edge and a wing bear regularly retouch on both the dorsal and ventral sides. Length of preserved part – 24 mm, width – 20 mm, thickness – 5 mm (Table 1; Fig. 4: 1).

2.1.2. Fläche – 1, Befund 2 (Middle ditch)

Six knapped artefacts were discovered in Fläche – 1, Befund 2 (Table 1)

End-scraper – 1

One end-scraper made of partly cortical flake from probably Abensberg-Lengfeld chert. The slightly rounded and curved front is prepared with semi-steep and regular retouch; the bulb and butt are damaged; dimensions: length – 36 mm, maximum width – 32 mm, maximum thickness – 9 mm (Fig. 4: 2)

Arrowheads – 4

Items discovered: one burnt small fragment of bifacial arrowhead, made of flake or blade with partly natural one side, one edge formed with regular bifacial retouch, the opposed edge is regularly retouched on one side and jagged, or with fine retouch on the reverse. Maximum length of preserved part, 11 – mm, width – 12 mm, thickness – 3 mm; one burnt fragment of a bifacial arrowhead with one edge preserved and one barb, the opposite edge and barb as well as the tip are broken, the preserved edge, barb and part of the base are regularly retouched on both sides, the tip of the preserved barb is pointed, the concave base is regularly rounded, length of preserved part – 19 mm, width – 17 mm, thickness – 5.5 mm; one slightly burnt fragment of a bifacial tool, probably an arrowhead, made of a cortical flake or blade with broken tip and barbs made of Baiersdorf Plattensilex, cortex covers one side and part of the opposite side, one edge with bifacial regular retouch is almost straight in the central part and is slightly rounded near the partly broken barb, the opposite edge is not preserved, the maximum length of the preserved part is 36 mm, maximum width – 18 mm, thickness – 6 mm (Fig. 4: 3); one burnt heart-shaped arrowhead with a broken tip made of a polished flake, the edges are symmetrical to each other, almost

Table 1. Typological composition of chipped artefacts from Altheim (excavations 2013-2020)

Artefacts	2013, 2014 Altheim I							2018	2018		2019 Altheim I			2020 Altheim I				SUM	% without chips	% of all artefacts
	Fläche 1 bef. 1 (Outer ditch)	Fläche 1 bef. 2 (Middle ditch)	Fläche 1 bef. 3 Inner ditch)	Fläche 2 bef. 1	Fläche 2 bef. 2	Fläche 2 bef 3	Fläche 2 bef 7	Altheim II	AH II, II, 1 No- Kopf. PL 1-12, F-G-H (enclosure)	AH I, VIII, 1, PL. 1, -B-C (pit-house)	Outer ditch	Middle ditch	Inner ditch	Surface, 2019	Outer ditch	Middle ditch	Pit 6			
Chunks	2	---	38	---	---	4	---	---	---	1	---	---	11	1	---	---	1	**58**	**28.43**	**16.11**
Cores	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**1**	**0.49**	**0.28**
Cortical flakes and their fragments	---	---	12	---	---	---	---	---	---	3	---	---	3	---	1	---	---	**19**	**9.31**	**5.28**
Flakes and their fragments	---	---	23	---	1	1	1	---	---	---	---	---	12	---	1	---	---	**39**	**19.11**	**10.83**
Fragments of microblades overheated	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**1**	**0.49**	**0.28**
Cortical blades and their fragments	---	---	1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	**1**	**0.49**	**0.28**
Blades and their fragments	---	---	---	---	---	---	---	1	---	---	---	---	6	---	1	---	---	**8**	**3.92**	**2.22**
Arrowheads	1	4	10	1	1	---	---	--	---	---	1	2	10	1	3	---	---	**34**	**1.67**	**9.44**
Tools without arrowheads	1	1	13	1	---	1	---	1	1	2	1	---	16	1	1	2	1	**43**	**21.08**	**11.94**
Sum without chips	**4**	**5**	**99**	**2**	**2**	**6**	**1**	**2**	**1**	**6**	**2**	**2**	**58**	**3**	**7**	**2**	**2**	**204**		**56.67**
% without chips	**1.96**	**2.45**	**48,53**	**0.98**	**0.98**	**2.94**	**0.49**	**0.98**	**0.49**	**2.94**	**0.98**	**0.98**	**28.43**	**1.47**	**3.43**	**0.98**	**0.89**			
% of all assemblage	**1.11**	**1.39**	**27,5**	**0.56**	**0.56**	**1.67**	**0.28**	**0.56**	**0.28**	**1.67**	**0.56**	**0.56**	**16.11**	**8.33**	**1.94**	**0.56**	**0.56**			
Chips	1	1	33	--	--	--	--	--	--	87	--	3	27	2	---	2	--	**156**		**43.33**
Total with chips	**5**	**6**	**132**	**2**	**2**	**6**	**1**	**2**	**1**	**93**	**2**	**5**	**85**	**5**	**7**	**4**	**2**	**360**		
% of all assemblage	**1.39**	**1.67**	**36.67**	**0.56**	**0.56**	**1.67**	**0.28**	**0.56**	**0.28**	**25.83**	**0.56**	**1.39**	**23.61**	**1.39**	**1.94**	**1.11**	**0.56**			

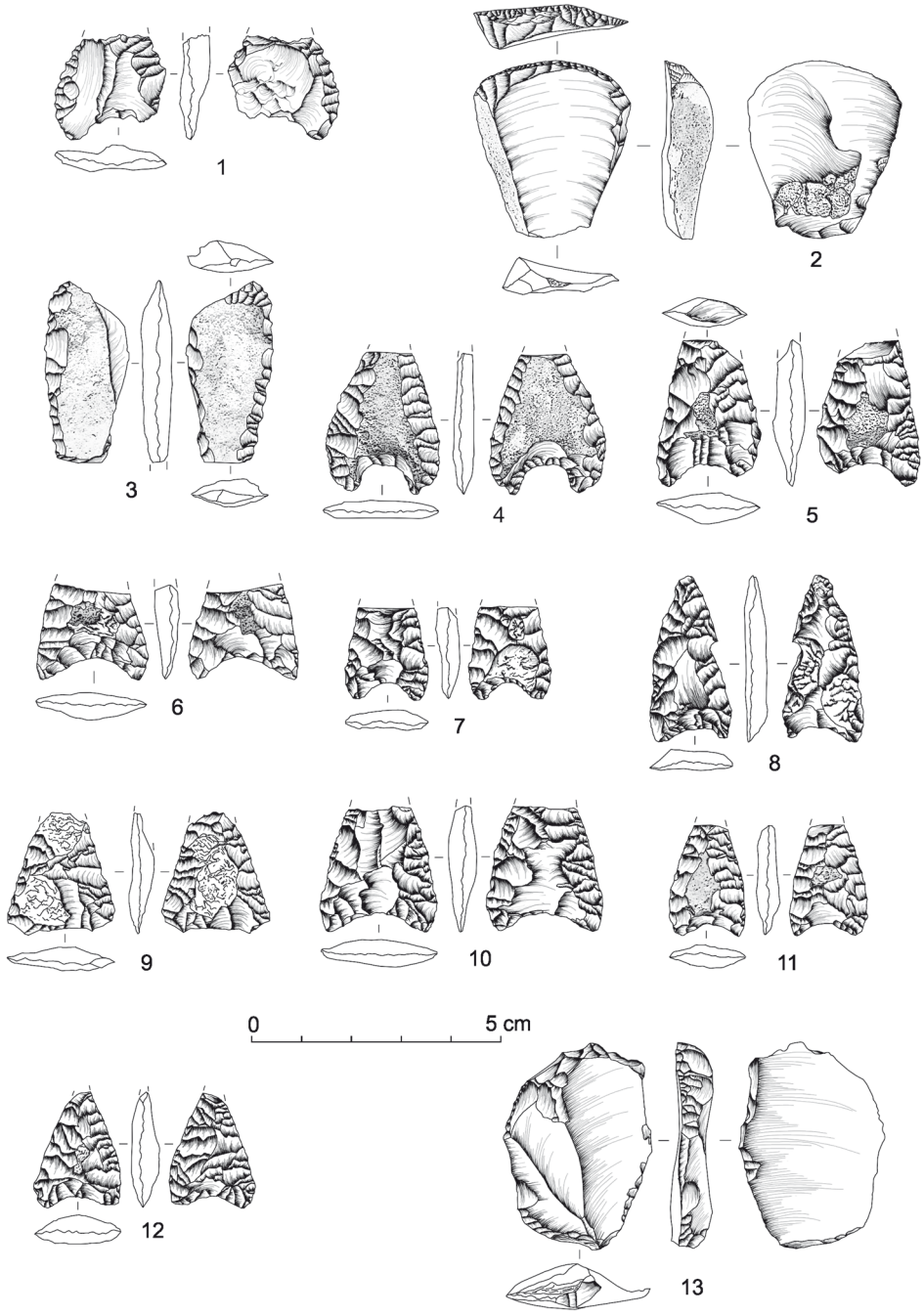

Fig. 4. Lithics from Altheim. Drawings: A. Bardetskyi

Table 2. Altheim, excavations 2013-2020. Typological and raw material composition of chipped assemblage

Category of artefact	Chert of Abensberg-Lengfeld type	Plattensilex of the Baiersdorf type	Chert of the Abensberg-Arnhofen type	Chert from Emmerthal or Hamberg	Tegernheim chert	Thalhof bounded chert	Chert from Herrnsaal	Quartzite	Jurassic chert from Alling	Flintsbach chert	Undefined	Overheated undefined	Sum	% without chips	% of all
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**			
Chunks	---	13	14	1	1	---	---	14	1	---	6	8	**58**	**28.43**	**16.11**
Fragment of core	---	---	1	---	---	---	---	---	---	---	---	---	**1**	**0.49**	**0.28**
Cortical flakes and their fragments	---	12	3	---	---	---	---	---	---	---	---	4	**19**	**9.31**	**5.28**
Flakes and their fragments	2	12	6	1	1	1	---	1	---	2	11	2	**39**	**19.12**	**10.83**
Fragments of microblades overheated	---	---	---	---	---	---	---	---	---	---	---	1	**1**	**0.49**	**0.28**
Cortical blades and their fragments	---	1	---	---	---	---	---	---	---	---	---	---	**1**	**0.49**	**0.28**
Blades and their fragments	---	1	6	---	---	---	---	---	---	---	1	---	**8**	**3.92**	**2.22**
Tools	4	13	11	1	---	1	2	---	---	4	3	4	**43**	**21.08**	**11.94**
Arrow heads	---	20	1	4	2	---	---	---	---	---	---	7	**34**	**16.67**	**9.44**
Sum of artefacts without chips	**6**	**72**	**42**	**7**	**4**	**2**	**2**	**15**	**1**	**6**	**21**	**26**	**204**		**56.67**
% of artefacts without chips	**2.94**	**35.29**	**20.59**	**3.43**	**1.96**	**0.98**	**0.98**	**7.35**	**0.49**	**2.94**	**10.29**	**12.74**			
% of all assemblage	**1.67**	**20.0**	**11.67**	**1.94**	**1.11**	**0.56**	**0.56**	**4.17**	**0.28**	**1.67**	**5.83**	**7.22**			
Cortical chips	---	75	2	---	---	---	---	---	---	---	4	2	**83**		
Overheated cortical chips	---	1	---	---	---	---	---	---	---	---	---	7	**8**		
Chips	3	36	1	1	---	---	---	2	---	---	9	10	**62**		
= Chips	**3**	**115**	**3**	**1**	**---**	**---**	**---**	**2**	**---**	**---**	**13**	**19**	**156**		**43.33**
Total	**9**	**187**	**45**	**8**	**4**	**2**	**2**	**17**	**1**	**6**	**34**	**45**	**360**		
% of all assemblage	**2.5**	**51.94**	**12.5**	**2.22**	**1.11**	**0.56**	**0.56**	**4.72**	**0.28**	**1.67**	**9.44**	**12.5**			

straight in the central part and rounded in the barb part, the tips of the barbs are sharp, the base is concave and almost rectangular in shape, the edges, barbs and base are shaped with bifacial retouch, maximum length of preserved part – 28 mm; maximum width – 23 mm; thickness – 3 mm; size of the notched base: depth – 6 mm, maximum width – 11 mm (Fig. 4: 4), small fractures on the edge between one surface of the arrowhead and the surface of break of the tip suggests an angle of impact of the arrow into a hard surface of about 60°-70°.

Chips – 1

This example is highly burnt.

2.1.3. Fläche 1 Befund 3 (Inner ditch)

The lithic assemblage discovered in Fläche 1 Befund 3 in 2013 comprises the most numeroust group of knapped artefacts. It contains 132 items (Table 1).

Chunks – 38

Chunks constitute one of largest category of lithic items. This group contains 38 pieces of raw material including seven of Baiersdorf Plattensilex (from 12 to 43 mm in diameter, average 23.5 mm), two of Arnhofen Plattensilex (29 and 36 mm in diameter), one of Emmerthal chert (22 mm in diameter), one of Tagernheim chert (29 mm in diameter), thirteen of Quartzite (from 11 to 54 mm in diameter, average 27.25 mm), one of Alling chert (41 mm in diameter), and twelve undefined in respect of raw material (six burnt).

Single platform blade cores – 1

Only one small fragment of a single platform blade core, made of Arnhofen Plattensilex, was found.

Cortical flakes and their fragments – 12

These are numerous but, in most cases, fractured. This group consists of four highly burnt and fractured items; five small fragments of artefacts made from Baiersdorf Plattensilex; and three fragments made of Arnhofen Plattensilex (one of them with one cortical edge, dimension – 21 mm; one fragment of a partly cortical item, dimension 23 mm; and one partly cortical with an edge-like butt and an almost flat bulb, length – 17, width – 16, thickness – 3 mm, one slightly burnt).

Flakes and their fragments – 23

This group contains: five flakes made from Baiersdorf Plattensilex (all preserved as small fragments), three of Arnhofen Plattensilex (one wholly preserved bears an edge-like butt and a distinct bulb, dimensions: length – 26 mm, width – 18 mm, thickness – 6 mm), one fragment made probably of Emmerthal chert, one fragment of flake made of probably Tegernheim chert (length– 22 mm); and one probably of Thalhof chert (with distinct bulb, length – 20 mm, width – 18 mm, thickness – 1.5 mm). Eleven small fragments of flakes have not been classified in terms of raw material. Only three flakes were wholly preserved.

Microblades – 1

There is only one example of a fractured and burnt microblade.

Blades – 1

Only one small distal part of a partly cortical blade, made of raw material similar to Baiersdorf Plattensilex, was discovered.

Chips – 33

Thirty-three chips were discovered in Flache 1 Befund 3. This group contains fifteen cortical chips (four of Baiersdorf Plattensilex including one slightly burnt; four undefined in respect of raw material including two strongly burnt ones), seven of Baiersdorf Plattensilex, one of Emmerthal chert, and 12 undefined with respect to raw material (nine highly burnt).

2.1.4. Arrow heads

Fragment of a highly burnt arrowhead – 1

Only one fragment of a bifacial arrowhead with broken tip and part of one barb, and concave and rounded base was discovered. It is formed by regular bifacial retouch. Maximum length of preserved part – 15 mm, width – 21 mm, thickness – 4 mm. Small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggests an angle of impact of the arrow into a hard surface of about 60°-70°.

Completely preserved arrowhead – 1

One burnt, bifacial arrowhead made of Baiersdorf Plattensilex. It has asymmetrical barbs, one slightly rounded and the opposite one small and rounded. The edges are almost straight; the base is concave and rounded. The tool is formed by regular, bifacial retouch. Maximum length of preserved part – 29 mm, length to the end of the smaller barb – 23 mm, length to the maximum concavity of the base – 25 mm, width – 21 mm, thickness – 7 mm (Fig. 4: 5).

Arrowheads with broken tips – 8

Two of them were made from Baiersdorf Plattensilex. The first one is slightly burnt. The barbs are asymmetrical, with one slightly rounded and the opposite one small and rounded. The edges are almost straight; and the base is concave and rounded. It was formed by regular, bifacial retouch, maximum length of preserved part – 29 mm, length to the end of the smaller barb – 23 mm, length to the maximum concavity of the base – 25 mm, width – 21 mm, thickness – 7 mm. It has tar on the surface of both sides. Small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggests it broke during bending.

The other arrowhead made of Baiersdorf Plattensilex with a broken tip was formed with regular retouch. Both edges are almost straight and slightly convex in the barb portions. The barbs are a little asymmetrical, one with a pointed end and the other with a slightly rounded end. The base is slightly concave and rounded. Maximum length of preserved part – 18 mm, indentation of the base – 3 mm, width – 22 mm, thickness – 6 mm (Fig. 4: 6).

Small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggest a bending break.

Four arrowheads (all are fractured) were made of Emmerthal brown chert.

One has a broken tip, symmetrical slightly rounded barbs, with both edges nearly straight, and a slightly convex base formed by regular, bifacial retouch. Length of preserved part – 19 mm, length to the maximum concavity of the base – 15.5 mm, width – 17 mm, thickness – 4 mm. It bears traces of what is probably tar on the base (Fig. 4: 7). Small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggests an angle of impact of the arrow into a hard surface of about 60°-70°.

Another item (slightly burnt) was formed by regular, bifacial retouch. The edges are slightly convex. The tip and barbs are crushed. The base is slightly concave and round. Length – 33 mm, length to the maximum concavity of the base – 31.5 mm, width – 17 mm, thickness – 4 mm (Fig. 4: 8). Small scars on the tip suggests impact into hard material.

Another arrowhead made of Emmerthal chert is bifacial, almost triangular, partly destroyed, with symmetrical, slightly rounded and partly broken barbs. The edges are straight, and the base is almost straight. The tool was formed by regular, bifacial retouch. Length of preserved part – 24 mm, width – 22 mm, maximum thickness – 5 mm. The tip was broken probably as result of striking a hard surface (Fig. 4: 9).

The last arrowhead made of this raw material has symmetrical, slightly rounded barbs. The edges are almost straight, and the base is slightly concave and rounded. The tool is formed by regular, bifacial retouch. Length of preserved part – 24 mm, length to the maximum concavity of the base – 21 mm, maximum width – 22.5 mm, maximum thickness – 6 mm (Fig. 4: 10). Small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggests an angle of impact of the arrow into a hard surface of about 60°-70°.

Two arrowheads with broken tips were made of Tegernheim chert. One made of a cortical flake is asymmetrical. Both edges are slightly convex. The base is convex and rounded. One barb is sharp, and the other is rounded. It was prepared with regular bifacial retouch. Length of preserved part – 22 mm, length to the maximum concavity of the base – 20 mm, maximum width – 15 mm, thickness – 4 mm (Fig. 4: 11). Small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggests an angle of impact of the arrow into a hard surface of about 60°-70°.

The other one has rounded barbs, a slightly convex base, and both edges are slightly convex. It was formed with regular, bifacial, retouch. The profile is a little irregular with small convexities on both sides (one of them is located in the bulb portion of the flake or blade from which the tool was made). In the central part of both sides are clearly visible ridges running according to the longitudinal tool axis. Maximum length – 23 mm, length to the maximum concavity of the base – 21 mm, width – 17.5 mm, maximum thickness – 7 mm (Fig. 4: 12).

Small scars on the tip suggests impact into a hard material.

2.1.5. Other Tools

Beside of arrowheads 13 other tools were discovered there (Table 3).

Fragments of undefined tools – 2

Both are fractured and are made of thin plates of Baiersdorf Plattensilex cortical on both sides. Size: 37 × 43 × 4 mm; 24 × 18 × 5 mm.

Flake end-scrapers – 2

One was probably made of Herrnsaal chert and has a rounded and oblique front formed with semi-steep retouch. Both edges are partly retouched on the dorsal face. Length – 41 mm, width – 30 mm, thickness – 7 mm. The other was represented by preserved as a small fragment and was probably made of Abensberg-Lengfeld chert (Fig. 4: 13).

Blades with use retouch – 4

One blade made of Baiersdorf Plattensilex has one cortical edge and the opposite edge with use retouch. The butt is natural, and the bulb is small and distinct. Length – 41 mm, width – 14 mm, thickness in the bulb portion – 7 mm, thickness in the middle part – 8.5 mm.

The proximal part of the second blade (made of Arnhofen Plattensilex), from a single platform blade-core, has one edge partly cortical. The opposite edge is formed by an irregu-

Table 3. Altheim 2013, Fläche 1 bef. 3 (inner ditch). Typological composition of tools (without arrow heads)

Category of artefacts	Chert of Abensberg-Lengfeld type	Plattensilex of the Baiersdorf type	Chert of the Abensberg-Arnhofen type	Chert from Herrnsaal	Sum
	1	**2**	**3**	**7**	
Fragments of undefined tools		2			2
Flake end-scrapers	1			1	2
End-scrapers on cortical flakes					
Backed knife			1		1
Blades wits use retouch		1	2	1	4
Retouched blades		2			2
Cortical plates of Plattensilex retouched		1			1
Cortical plates of Plattensilex with bifacial retouch and glossy polishing		1			1
Sum	**1**	**7**	**3**	**2**	**13**

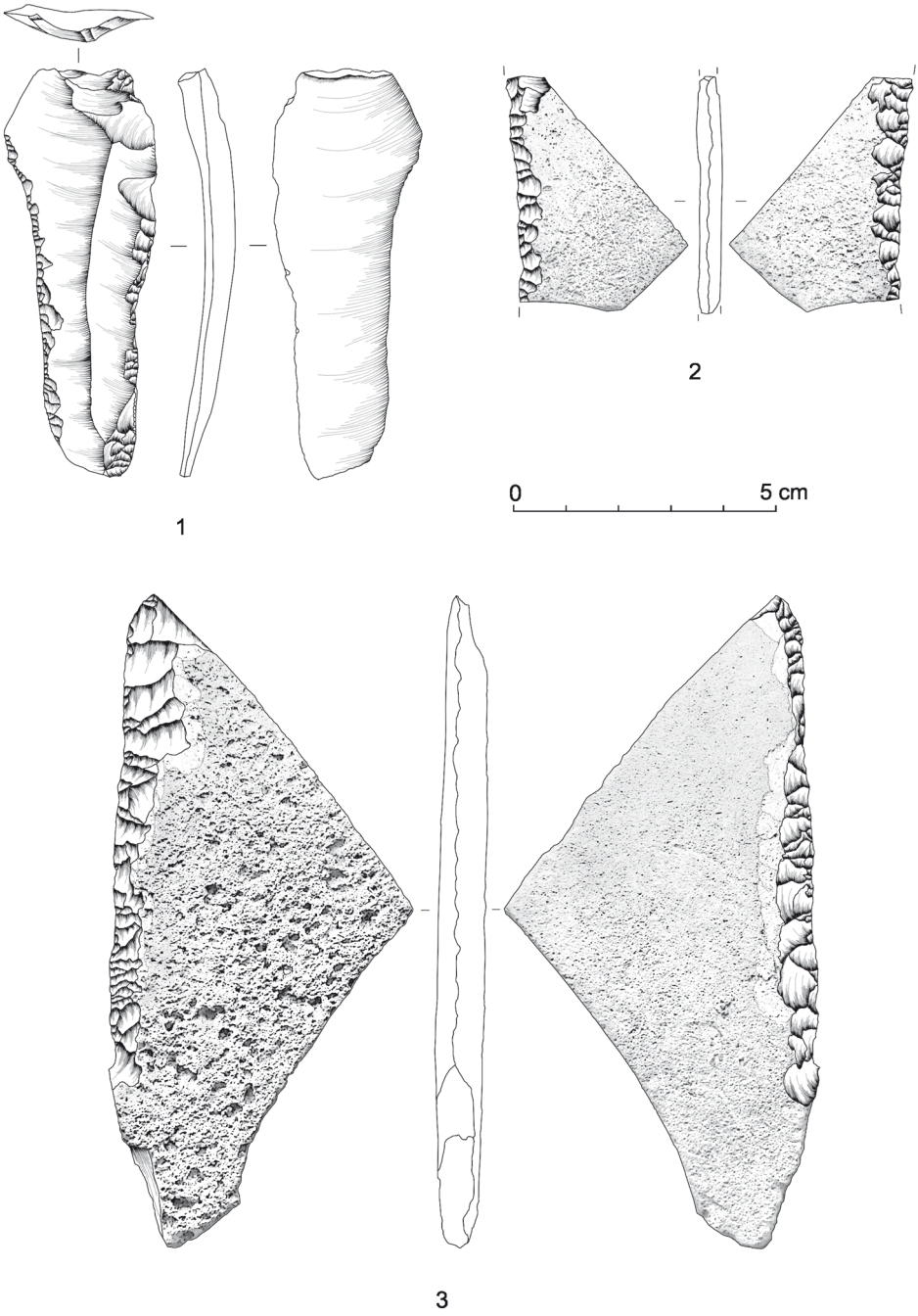

Fig. 5. Lithics from Altheim. Drawings: A. Bardetskyi

lar crack. The edges are regular and parallel. The bulb is almost flat and diffuse; the natural butt and striking platform are large. Edge angle (platform/flaking surface) is about 80°. Length of preserved part – 23 mm, width – 16 mm, thickness in the bulb portion – 5 mm, thickness in the mid portion – 4 mm.

The distal part of the third blade made of the same raw material is preserved. One edge is cortical, and the profile is straight. One edge bears use retouch. Length of preserved part – 28 mm, width – 14 mm, thickness – 4 mm.

The last blade from a single platform blade core (from Herrnsaal chert) is curved in the middle portion and bears use retouch on both edges. Edges are irregular and asymmetrical. The butt is facetted with a clear lip. The striking platform is small, located on the top of semi-conical top of the butt. The bulb is wide and diffuse with a clear ripple. Edge angle is about 80°. Length – 78 mm, maximum width – 28 mm, thickness in bulb portion – 6.5 mm, thickness in middle portion – 6 mm (Fig. 5: 1).

Retouched blades – 2

Both are made of Baiersdorf Plattensilex. One (mesial part) is slightly burnt and crushed with one edge retouched on both the ventral and dorsal sides. Length – 18 mm, width – 21 mm, thickness – 6 mm.

The mesial part of the other partly cortical blade has one edge with flat retouch on the ventral side. Length – 20 mm, width – 22 mm, thickness – 5.5 mm.

Backed knife – 1

Only one was found (made of Baiersdorf Plattensilex). It is a fragment of thin cortical on both sides plate of raw material (length 122 mm, width – 58 mm, thickness – 9 mm) with one edge retouched on both the dorsal and ventral sides (backed knife with natural back) (Fig. 5: 3).

Cortical plates of Plattensilex with retouch – 1

A fragment of thin plate of Baiersdorf Plattensilex, cortical on both sides with one edge retouched on one side. Length – 48 mm, width – 52 mm, thickness – 13 mm.

Cortical plates of Plattensilex with bifacial retouch with glossy polishing – 1

One discovered fragment was made of thin plate of Baiersdorf Plattensilex, cortical on both sides. One edge bears flat retouch on both the dorsal and ventral sides and glossy polishing. Maximum length preserved – 43 mm, width – 32 mm, thickness – 4 mm (Fig. 5: 2).

2.2. Altheim I, 2014

2.2.1. Fläche – 2, Befund 1

Two artefacts were discovered: one bifacial arrowhead made with Baiersdorf Plattensilex with asymmetrical barbs; both edges are slightly convex; the base is convex and rounded; one barb is rounded; the tip is sharp (Table 1). The tool is prepared with regular bifacial

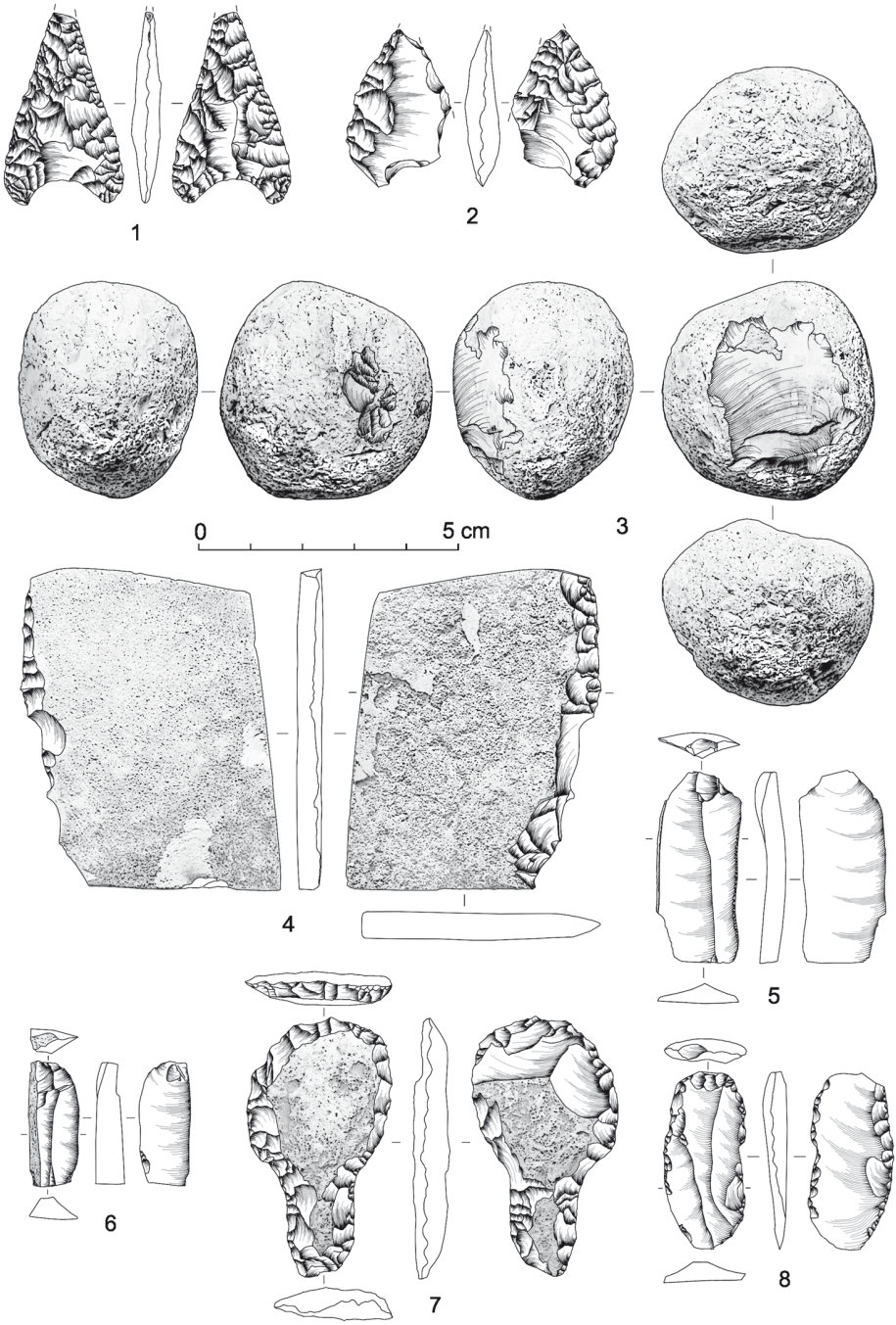

Fig. 6. Lithics from Altheim. Drawings: A. Bardetskyi

retouch. Length of preserved part – 38 mm, length to the maximum concavity of the base – 32 mm, maximum width – 22 mm, thickness – 6 mm (Fig. 6: 1). No traces of use or damage are registered; one spherical nodule of Arnhofen Plattensilex used as a hammer, max diameter 44 mm (Fig. 6: 3).

2.2.2. Fläche – 2, Befund 2

Two knapped artefacts were discovered: one fragment of flake made of quartzite and one burnt fragment of an arrowhead (Table 1; Fig. 6: 2).

2.2.3. Fläche – 2, Befund 3

Six artefacts were found: one chunk made of Abensberg-Arnhofen Plattensilex from Linsberg; one fragment of cortical chert made from Abensberg-Arnhofen Plattensilex from Linsberg; one fragment of flake made of Abensberg-Arnhofen Plattensilex from Linsberg; one fragment of flake end-scraper made of Emmerthal chert; one chunk of Abensberg-Arnhofen Plattensilex from Linsberg; one chunk of undefined raw material (Table 1).

2.2.4. Fläche – 2, Befund 7

Only one fragment of burnt flake was discovered (Table 1).

2.3. Altheim II, surface, 2018

2.3.1. AH II, II, 1 No-Kopf. PL 1-12, F-G-H enclosure

One proximal and mesial part of a regular blade from a single platform blade core, distinct, small bulb, curved in distal part, on the ventral face negatives of two regular blades; one edge bears use micro-retouch and slight gloss, while the opposite one bears slight polishing (traces of hafting?); length – 36 mm, width – 16 mm, thickness – 5 mm (Table 1).

Raw material: Baiersdorf Plattensilex?

2.4. Altheim G-2018 M-2013-1656-3_0

2.4.1. Altheim I pit-house

Ninety-three knapped artefacts made of Baiersdorf Plattensilex were found inside a pit-house (Table 1). There are subdivided as follows: one crushed chunk; three fragments of cortical flakes; one wholly cortified flake with cortical edge-like butt, diffuse bulb with

bulbar scar, straight in profile, length – 18 mm, width – 27 mm, thickness – 3 mm; 87 chips including 71 partly cortical examples; one fragment of thin plate wholly cortical on both sides with one edge with regular bifacial retouch, length – 65 mm, width – 48 mm, thickness (of the plate of raw material) – 5 mm (Fig. 6: 4**)**; one backed knife with natural back made of almost rectangular fragment of thin plate of raw material cortical on both sides, one edge with bifacial retouch and gloss, length – 61 mm, width – 48 mm, thickness (of the plate) – 5 mm.

2.5. Altheim II 2018

Two knapped artefacts were discovered (Table 1): one proximal and mesial part of a regular blade from a single platform blade core, slightly curved in profile, polyhedral butt, distinct bulb, one edge with regular use micro-retouch on the ventral face, length – 36 mm, width – 16 mm, thickness – 5 mm (raw material: undefined) (Fig. 6: 5); and one proximal and mesial part of a partly cortical blade from a single platform blade core probably made of Thalhof chert, butt natural, small distinct bulb with bulbar scar, length – 24 mm, width – 9 mm, thickness – 5 mm (Fig. 6: 6).

2.6. Altheim I 2019 surface

Five knapped artefacts were found on the surface of site Altheim I in 2019 (Table 1): one knapped artefact is made from plate of Baiersdorf Plattensilex, cortical on both sides. It is probably a typical tanged arrowhead or schematic anthropomorphic figurine formed with bifacial sharp irregular retouch (no direct analogy in Neolithic Germany). The artefact consists of two parts: a circular, slightly ellipsoidal "head" 30 mm long and 28 mm wide, and the "tang", about 20 mm long and gently merging with the "head". The maximum length of the artefact is 51 mm, maximum width – 28 mm, maximum thickness – 8 mm (Fig. 6: 7); one distal fragment of a curved blade (truncated piece with crushed front?), length – 36 mm, width – 28 mm, thickness – 1 mm (raw material undefined);

one fragment of a burnt piece of raw material, length 26 mm made of Abensberg-Arnhofen Plattensilex and two burnt chips.

2.7. Altheim I 2019 (outer ditch)

Two artefacts were discovered there (Table 1): one straight blade from a single platform blade core with use retouch on both edges, butt natural and flat, bulb flat, length – 34 mm, width – 16 mm, thickness – 5 mm (raw material undefined) (Fig. 6: 8); and one arrowhead made from Baiersdorf Plattensilex with a broken tip, one edge almost straight, opposite one slightly rounded, base slightly convex, barbs rounded, regular retouch on both sides, length – 20 mm, width – 17 mm, thickness – 4 mm (Fig. 7: 1).

2.8. Altheim I 2019 (middle ditch)

Five knapped artefacts were discovered here: one fragment of an arrowhead with a broken tip and one edge, fragment of preserved edge regularly retouched on both sides, preserved barb is rounded, base also rounded and convex, length – 27 mm, width – 17 mm, thickness – 8 mm (Fig. 7: 2); one bifacial arrowhead cortical on both sides with a broken tip, barbs asymmetrical, one of them sharp, opposite one rounded, one edge almost straight, opposite one slightly rounded in the barbs portion, base convex and rounded, regular retouch on both edges, length – 42 mm, length to the base – 39 mm, width – 16 mm, thickness – 7 mm (Fig. 7: 3); three chips.

2.9. Altheim I 2019 (inner ditch)

85 knapped artefacts were discovered there (Table 1).

Chunks – 11

Three are made from Baiersdorf Plattensilex (length: 14-25 mm), three from Abensberg-Arnhofen Plattensilex (14-35 mm), one from quartzite, and four are crushed and highly burnt.

Chips – 27

Three specimens made of probably Abensberg-Lengfeld chert, fourteen of Baiersdorf Plattensilex, two of Abensberg-Arnhofen chert (one of them is cortical), one of quartzite, one is highly burnt, and six are of undefined raw material.

Cortical flakes and their fragments – 3

This group consists of one cortical flake made of Abensberg-Arnhofen Plattensilex with an edge-like butt, straight in profile, bulb with distinct ripples and bulbar scar, length – 26 mm, width – 32 mm, thickness – 9 mm; and two fragments of cortical flakes made from Baiersdorf Plattensilex (dimensions: length – 24 mm, width – 17 mm, thickness – 5 mm; length – 20 mm, width – 36 mm, thickness – 9 mm).

Flakes and their fragments – 12

Two of them were probably made from Langfeld chert: one preserved as a small fragment and one multidirectional flake with a flat natural butt, straight in profile, curved in the distal part. length – 17 mm, width – 18 mm, thickness – 3 mm; seven examples made of Baiersdorf Plattensilex (one preserved as preserved as a small fragment) constitute the largest group of flakes found there. It contains: one multidirectional flake straight with an edge-like butt, length – 17 mm, width – 23 mm, thickness – 3 mm; one multidirectional flake probably from the edge of a bifacial tool, length – 15 mm, width – 17 mm, thickness – 9 mm; one partly cortical curved flake with an edge-like butt, length 22 mm, width – 25 mm, thickness – 3 mm; one unidirectional flake with a thin butt, length – 17 mm, width – 25 mm, thickness – 3 mm; one fragment of multidirectional flake with a natural butt and diffuse bulb, straight in profile, length – 21 mm, width – 18 mm, thickness – 4 mm; and one unidirectional flake with a polyhedral butt and flat bulb, straight in profile, length – 16 mm,

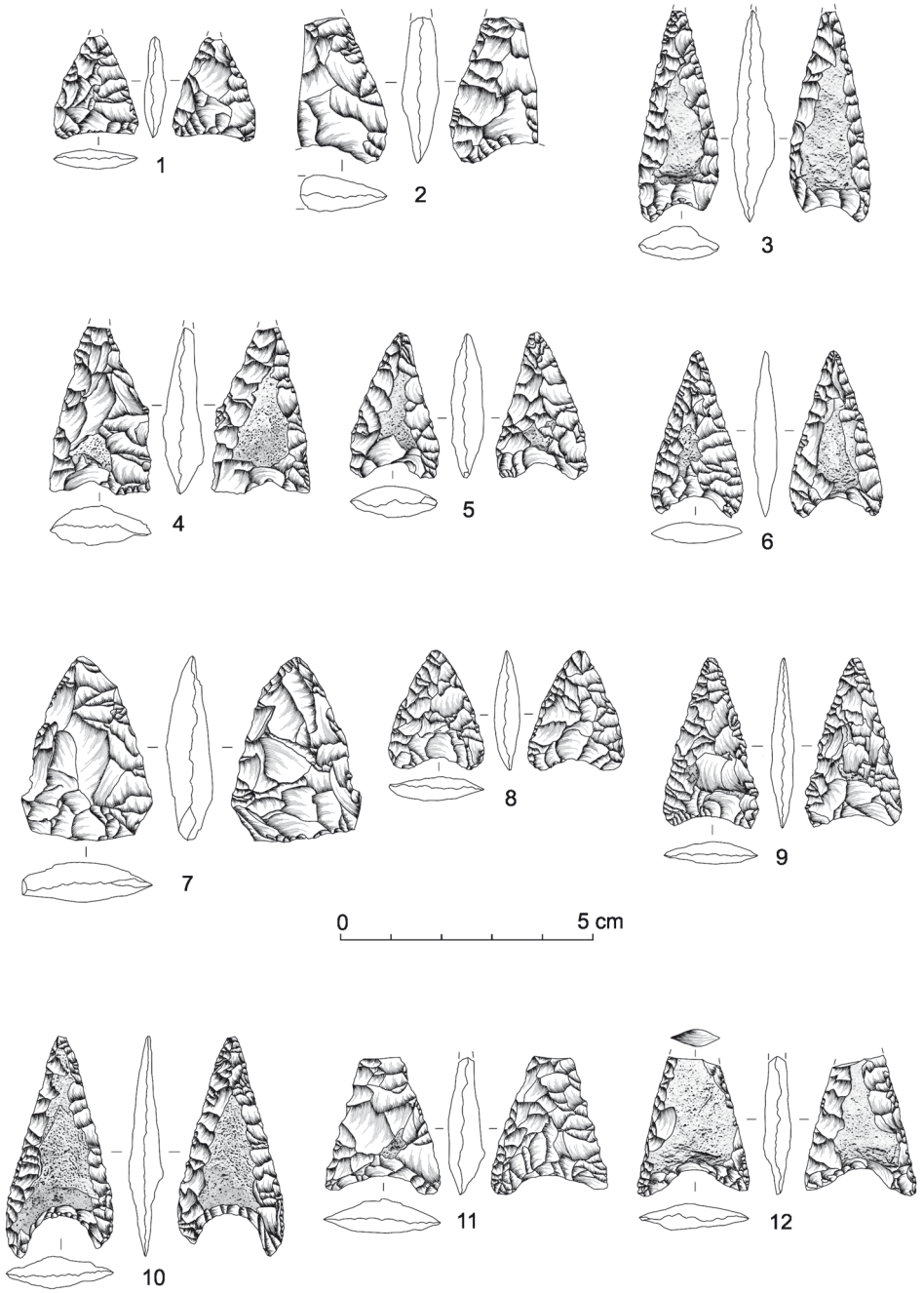

Fig. 7. Lithics from Altheim. Drawings: A. Bardetskyi

width – 28 mm, thickness – 3 mm. Also discovered were two fragments of flakes made probably from Flintsbach chert (length – 21 mm, width – 24 mm, thickness – 6 mm; and length – 53 mm, width – 38 mm, thickness – 8 mm) and one highly burnt flake (length – 23 mm, width – 28 mm, thickness 4 mm).

Blades from single platform cores and their fragments – 6

All six were made from Abensberg-Arnhofen Plattensilex (two small fragments are burnt and undefined with respect to raw material) and all are fractured. This group comprises: one mesial and distal fragment of partly cortical, slightly heated, curved blade, length – 32 mm, width – 11 mm, thickness – 7 mm; one distal fragment of blade from single platform blade core with cortical one edge, slightly burnt, length – 23 mm width – 7 mm, thickness – 3 mm; one proximal and mesial part of a blade with cortical sides and a crushed butt, length – 30 mm, width – 11 mm, thickness (of the plate of raw material) – 8 mm; and two fragments of burned blades.

Arrowheads – 10

All are made from Baiersdorf Plattensilex. Of this one is preserved as a small fragment. Also, one half-product of a bifacial arrowhead is made from a thin plate of tabular chert, both edges and base are irregular, length – 33 mm, width – 20 mm, thickness (of the plate) – 8 mm (Fig. 7: 4).

Six specimens have no signs of damage, This group consists of: one bifacial arrowhead, both sides partly cortical, one edge almost straight, opposite one slightly convex, base rounded and concave, tip sharp, both barbs slightly rounded, regular retouch on both sides, length – 29 mm, width – 18 mm, length to the base – 26 mm, thickness – 7 mm (Fig. 7: 5); one bifacial arrowhead regularly retouched on sides, edges and base, edges slightly rounded, base rounded concave, tip and barbs are sharp, no traces of use, on both sided traces of cortex, length – 33 mm, length to the base – 31 mm, width – 18 mm, thickness – 4 mm (Fig. 7: 6); one bifacial arrowhead with slightly rounded edges, straight base, rounded tip, edges, sides and base irregularly retouched, length – 37 mm, width – 26 mm, thickness – 8 mm (Fig. 7: 7); one bifacial arrowhead, tip and barbs rounded, edges slightly convex and rounded, base rounded and concave, regular retouch on the edges and sides, length – 24 mm, length to the base – 22 mm, width – 19 mm, thickness – 6 mm. No traces of damages (Fig. 7: 8); one bifacial arrow head, tip crushed and slightly rounded, one barb rounded, one sharp, both edges straight, base slightly convex, regular retouch on the edges and sides, length – 33 mm, length to the base – 32 mm, width – 19 mm, thickness – 5 mm (Fig. 7: 9); one bifacial arrowhead cortical on both sides, tip and barbs sharp, both edges almost straight slightly rounded and convex in the base portion, base rounded and significantly concave, asymmetrical sharp barbs, regular retouch on both sides and edges, length – 44 mm, length to the base – 37 mm, width – 21 mm, thickness – 7 mm (Fig. 7: 10).

Two specimens have broken tips and small fractures on the edge between one surface of the arrowhead and the surface of the break of the tip suggests an angle of impact of the arrow into a hard surface of about 60°-70°. One of them has straight edges, the base is

straight slightly rounded and convex, barbs rounded, regular retouch covers the edges, sides and base; length of preserved fragment – 30 mm, width – 22 mm, thickness – 7 mm (Fig. 7: 11). The other one is regularly retouched on both edges and faces, both sides are cortical, tip broken edges almost straight, base is rounded, barbs sharp; length of preserved part – 27 mm, length to the base – 23 mm, width – 22 mm, thickness – 6 mm (Fig. 7: 12).

Tools – 16

Tools constitute a relatively large group of knapped artefacts. Aside from ten arrowheads, 16 lithic tools were discovered in 2019 in the innermost ditch of Altheim I site (Table 4).

Fragments of undefined tools – 2

Both preserved as small fragments, made of Baiersdorf Plattensilex.

Flake end-scrapers – 6

All the flake end-scrapers are made of cortical or partly cortical flakes. They are as follows: one end-scraper made of irregular partly cortical flake from Baiersdorf Plattensilex with front semi-steep, one edge covered with semi-steep retouch on the ventral side, length – 39 mm, width – 23 mm, thickness – 17 mm (Fig. 8: 1); one end-scraper made of a curved, multidirectional, partly cortical flake, semi-steep rounded front partly covers both edges of the flake; cortex with brown coating; length 48 mm, maximum width – 28 mm, thickness

Table 4. Altheim 2019, inner ditch. Typological composition of tools

Artefacts	Platy chert of the Baiersdorf-type	Chert of the Abensberg-Arnhofen type	Thalhof bounded chert	Flintsbach chert	Overheated undefined	Sum
	2	**3**	**6**	**10**	**12**	
Fragments of undefined tools		2				2
Flake end-scrapers	1			4	1	6
Blade end-scrapers	1		1			2
Truncated blade (sickle blade)		1				1
Blade end-scrapers with retouched edge	1	1				2
Blades wits use retouch		1				1
Cortical plates of Plattensilex with bifacial retouch		1				1
Cortical plates of Plattensilex with bifacial retouch and glossy polishing						
Retouched chunk	1					1
Sum	**4**	**6**	**1**	**4**	**1**	**16**

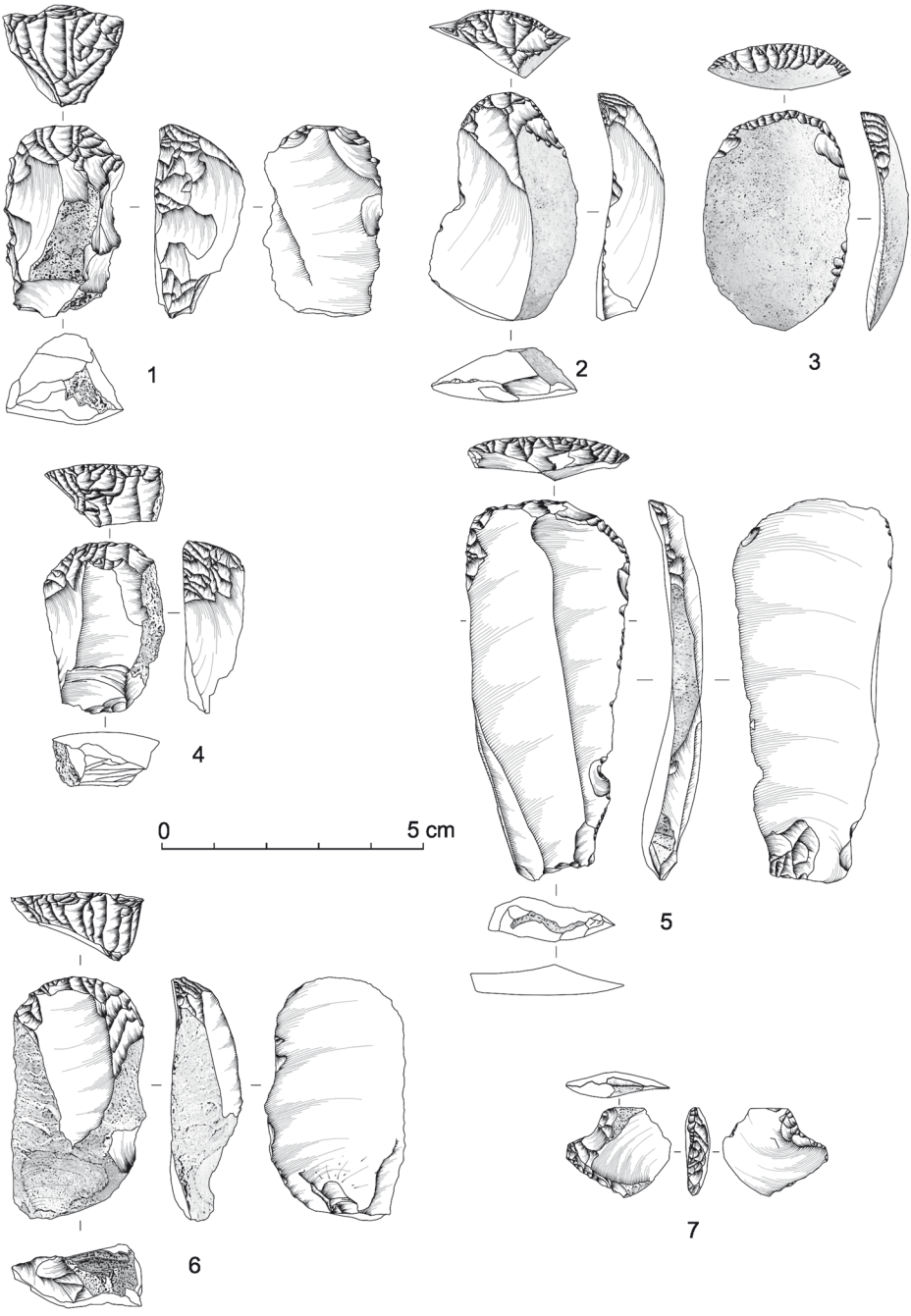

Fig. 8. Lithics from Altheim. Drawings: A. Bardetskyi

– 10 mm (Fig. 8: 2) (raw material: Alling/Thalfoh grey chert? Flintsbach chert?); one end-scraper made on large, partly cortical flake, the rounded and steep front covers one side of a flake and part of the opposite one. length – 63 mm, width – 43 mm, thickness – 20 mm (raw material: Flintsbach chert? Lengfeld chert?); one end-scraper made of wholly cortical flake with edge-like butt, bulb with bulbar scar, the front formed with semi-steep retouch; length – 42 mm, width – 28 mm, thickness – 5 mm (raw material: Flintsbach chert? Lagenfeld chert?) (Fig. 8: 3); one end-scraper made on partly cortical slightly burnt flake, front irregular, steep; length – 33 mm, width – 23 mm, thickness – 10 mm (raw material: Flinsbach chert?) (Fig. 8: 4); one fragment of a burnt end-scraper made of a cortical flake.

Blade end-scrapers – 2

The only two examples are made on blades: one end-scraper made of a regular long blade from a single-platform blade core, significantly curved in the distal portion, burned, butt edge-like, bulb distinct with bulbar scar, front semi-steep regular and slightly asymmetrical covers part of both edges, one edge with use retouch, length 73 mm, width – 27 mm, thickness – 9 mm (raw material: Arnhofen Plattensilex) (Fig. 8: 5); one nosed end-scraper on blade, length – 18 mm, width – 19 mm, thickness – 5 mm (raw material: Baiersdorf Plattensilex (Fig. 8: 7).

Blade end-scrapers with retouched edge – 2

Two specimens were discovered in the innermost ditch in 2020: one slightly burnt end-scraper made of irregular blade slightly curved in the distal part with a cortical edge, steep and regular front covers parts of the edges, one edge with flat edge-type retouch on the ventral face, polyhedral butt, distinct bulb with bulbar scars, length – 48 mm, width – 27 mm, thickness – 12 mm (raw material: Abensberg-Arnhofen Plattensilex) (Fig. 8: 6); one nosed end-scraper made probably on the cortical, distal part of a large blade, front irregular, both sides irregularly retouched on the ventral face, one edge also with flat use retouch on the dorsal face; length – 33 mm, width – 33 mm, thickness 11 mm (raw material: Alling/Thalhof grey chert?) (Fig. 9: 1).

Truncated blade – 1

Only one sickle blade, a truncated piece, made of regular blade, slightly burnt; length – 26 mm, width – 16 mm, thickness – 3 mm (raw material: Abensberg-Arnhofen Plattensilex).

Blades with use retouch – 1

One mesial fragment of regular blade from a single platform blade core has one edge with steep retouch on the ventral side, while the opposite edge has flat retouch on the ventral side and macroscopic traces of use (crushed edge); length – 37 mm, width – 20 mm, thickness – 6 mm (raw material: Abensberg-Arnhofen Plattensilex).

Cortical plates of Plattensilex with bifacial retouch – 1

One fragment of a bifacial tool partly cortical on both sides; length – 23 mm, width – 24 mm, thickness (of the plate of raw material) – 8 mm (raw material: Abensberg-Arnhofen Plattensilex).

Retouched chunk – 1

One retouched chunk partly cortical, max. length – 29 mm (raw material: Baiersdorf Plattensilex)

2.10. Altheim I 2020 (outer ditch)

Seven knapped artefacts were discovered in the fill of the outer ditch (Table 1): one fragment of cortical, straight flake made of Baiersdorf Plattensilex, length – 27 mm, width – 36 mm, thickness – 10 mm; one multidirectional flake made of Abensberg-Arnhofen

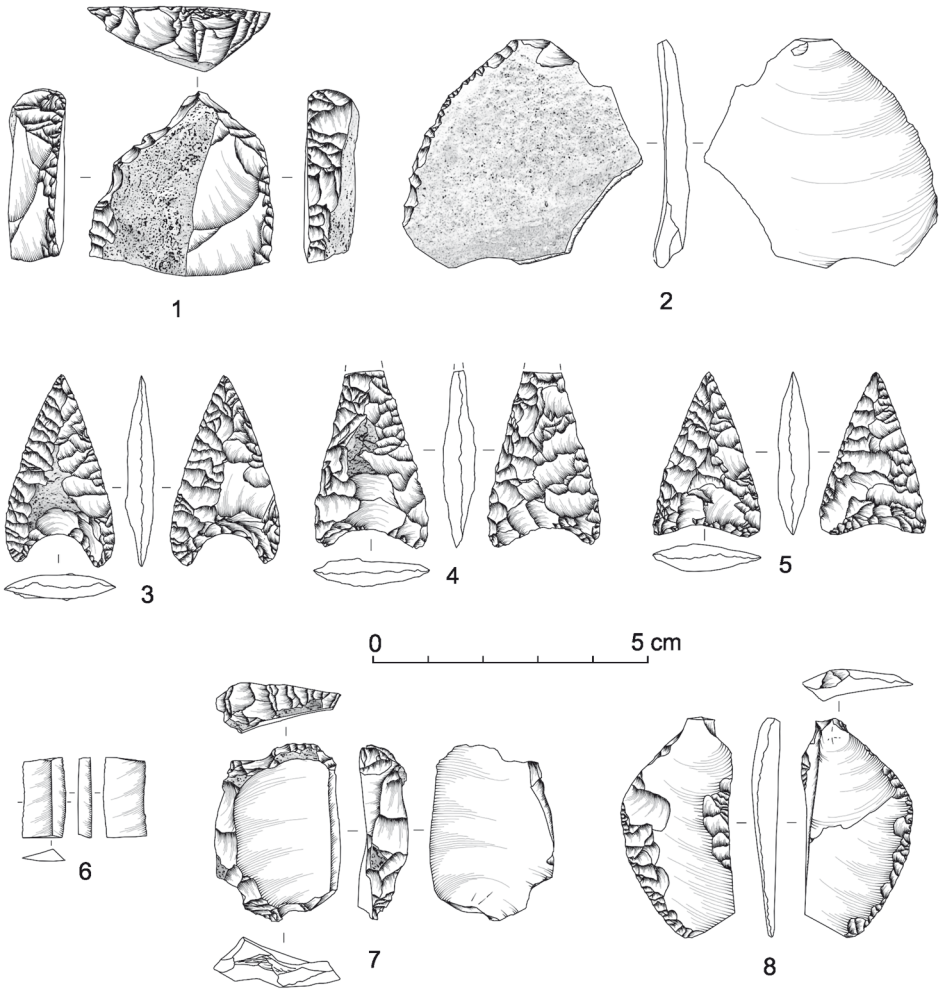

Fig. 9. Lithics from Altheim I. Drawings: A. Bardetskyi

Plattensilex with edge-like butt, flat bulb, straight in profile; length – 19 mm, width – 23 mm, thickness – 4 mm; one mesial fragment of a regular blade from a single platform blade core made probably from Abensberg-Arnhofen Plattensilex; length – 14 mm, width – 8 mm, thickness – 2 mm (Fig. 9: 6); one burnt cortical blade with a flat natural butt, curved in the distal portion, with one edge retouched on the ventral face made from Baiersdorf Plattensilex, length – 44 mm, width – 45 mm, thickness – 5 mm (Fig. 9: 2); one bifacial arrowhead with broken tip, both edges almost straight, barbs rounded, base rounded and convex, regular retouch on both edges and faces, one side slightly cortical made of Baiersdorf Plattensilex; length – 32 mm, length to the base – 29 mm, width – 21 mm; thickness – 6 mm (Fig. 9: 4); one bifacial arrowhead with slightly convex and rounded edges and convex rounded base made from Baiersdorf Plattensilex, one side partly cortical, regular retouch on both edges and sides, tip sharp, barbs are rounded; length 30 mm, length to the base – 29 mm; width – 18 mm, thickness – 6 mm (Fig. 9: 5); one bifacial arrowhead made from Abensberg-Arnhofen Plattensilex, edges almost straight, rounded and convex in a base portions, base concave and rounded, tip and barbs sharp, regular retouch on both faces, one side partly cortical; length – 35 mm, length to the base – 31 mm, width – 19 mm, thickness – 4 mm (Fig. 9: 3).

2.11. Altheim I 2020 (middle ditch)

Four lithic artefacts were discovered in the fill of the middle ditch: one end-scraper with crushed front made from partly cortical flake; length – 31 mm, width – 23 mm, thickness – 7 mm, raw material undefined (Fig. 9: 7); one flake with one edge jagged with a sharp retouch on both edges made from Abensberg-Arnhofen Plattensilex; length – 40 mm, width – 20 mm, thickness – 5 mm (Fig. 9: 8); two burnt chips.

2.12. Altheim I 2020 (middle ditch, pit 6)

One fragment of plate of raw material with negative of detached blade made from Abensberg-Arnhofen Plattensilex; length – 20 mm, width – 18 mm, thickness (of the pate) – 7 mm; one fragment of undefined tool.

3. DISCUSSION

Three hundred and sixty lithic artefacts were discovered during the 2013-2020 excavations in the Altheim Neolithic sites. These finds are made of ten raw materials, all of regional origin (Table 2): (1) Upper Jurassic chert of the Abensberg-Lengfeld-type, Lengfeld, Kelheim district, Bavaria; (2) Upper Jurassic tabular chert (Plattensilex) of the Baiersdorf-type, from Baiersdorf, Kelheim district, Franconian Alb, Bavaria; (3) tabular Upper Jurassic

chert (Plattensilex) of the Abensberg-Arnhofen type, from Linsberg near Abensberg, Kelhein district, Bavaria; (4) Upper Jurassic brown chert from Emmerthal, Emmerthal, Kelheim district, Franconian Alb, Bavaria; (5) Upper Jurassic Tegernheim chert, from Tegernheim, Regensburg district, Bavaria; (6) Jurassic, Upper Kimmeridian-Lower Tithonian/nodular banded chert, banded Thalhof chert, Regensburg district, Bavaria; (7) Upper Jurassic chert from Herrnsaal, Kelheim district, Franconian Alb; (8) Quartzite; (9) Jurassic chert from Alling(?), Regebsburg district; and (10) Flintsbach chert from Flintsbach, Deggendorf district. These raw materials were commonly used in the Neolithic and are thoroughly described in the archaeological literature (see *e.g.*, http://www.flintsource.net/; Althofer, Althofer 2011; Binsteiner 2005; 2013; Brandl *et al.* 2017; Richter 2014; Roth 2008; Underwood 2014). Due to the lack of diagnostic features, some of the artefacts were not specified in terms of raw materials (two groups: 11. Undefined; 12. Highly burnt without the possibility of assignation to a specific raw material).

Ten main typological groups of knapped artefacts were distinguished in the analyzed materials. The statistical analysis of the frequency of individual categories of knapped artefacts was performed on two levels: for the part of the inventory excluding the chips (204 artefacts) and for the whole knapped assemblage (in the further part of the analysis, the percentages without chips will be presented first, and the percentage calculated in relation to the entire inventory will be presented second). The distribution of lithic artefacts across the excavated area is irregular, as is the frequency of artefacts made of different raw materials.

Chunks (pieces of raw material which do not bear traces of flaking or with single negatives of previous detached flakes; some of them, mainly made from Plattensilex, may be parts of damaged tools) constitutes a significant part of the lithic assemblage from Altheim (58 items, 28.43% of knapped artefacts without chips; 16,11% of all the knapped assemblage). Most of them are from Plattensilex (28 items; 13 of the Baiersdorf type, and 14 of Arnhofen type), and quartzite (14 items). Emmerthal and Tegernheim cherts are represented in individual cases. The raw material of fourteen specimens were not recognized. Their maximum diameters do not exceed 100 mm, but most of them are smaller than 30 mm. Most of the chunks were discovered in part of the innermost ditch excavated in 2013.

Only one extremely exploited blade core from Arnhofen tabular chert was discovered in the innermost ditch.

Flakes constitute the largest group (excluding chips) of knapped artefacts in this assemblage of 58 items (28.43%; 16.11%) including 19 cortical specimens (9.31%; 5.28%) and 39 non-cortical specimens (19.11%; 10.83%). Most of the flakes are preserved as fragments, and estimation of their primary size is problematic (the dimensions of the largest fragments do not exceed 23 mm). Their dimensions do not exceed 26 mm, and only one flake made from Flintsbach chert is bigger than the others (53 × 38 × 8 mm). Most of them are from Baiersdorf and Arnhofen cherts, but other raw materials are also represented in this typological group. The relatively numerous flakes have not been classified in terms of raw material. Most of the flakes were discovered in the inner ditch of Altheim I.

All the blades (except one specimen) are fragmented. Except one specimen, all blades are made from tabular cherts, six of Arnfohen type, one of Baiersdorf and one of undefined raw material. Blades are regular in shape, slightly curved in profile, with a flat or polyhedral butt and a diffuse, flat or distinct bulb. Because of fragmentation of the blades, it is difficult to estimate their length. Whole specimens are 41 to 78mm long. Blade widths varied from 7 to 28 mm (average 16.22 mm), and thicknesses from 1 to 8.5 mm, usually 4 to 6 mm (average 5.08 mm). Almost all were discovered in the inner ditch of the site Altheim I. It should be added that almost all the blades bear micro-use retouch visible under 30× magnification, which suggests that they were used as tools. Almost all of the blades were discovered in the part of the innermost ditch excavated in 2019.

Tools constitute a relatively large group of the knapped assemblage from Altheim (43 specimens; 21.08%; 11.94%). Most of them were discovered in the innermost ditch. Nevertheless, tools were also discovered in other part of Altheim sites.

Tools are differentiated with respect to the raw materials used. It is particularly visible in the relatively large group of flake end-scrapers. The flake end-scrapers were made from five different ra materials: On specimen of chert of the Abensberg-Lengfeld-type, two of Baiersdorf chert, of Arnhofen chert there were three specimens of Herrnsaal chert one specimen, and four examples of Flintsbach chert. One specimen was not classified in terms of raw material. Flake end-scrapers have a slightly rounded and curved front formed with semi-steep and regular retouch. They are up to 41 mm long, 32 mm wide and 9 mm thick. In several cases, the edge(s) are partly retouched.

Four end-scrapers were made from blades. One from a regular long blade from Arnhofen Plattensilex is significantly curved in the distal portion, and it has semi-steep regular, a slightly asymmetrical front, and one edge with use retouch (dimensions: length – 73 mm, width – 27 mm, thickness – 9 mm). Another slightly burnt specimen made of the same raw material is made from an irregular blade slightly curved in the distal part. It has steep and regular front and one edge with flat edge-type retouch on the ventral face (length – 48 mm, width – 27 mm, thickness – 12 mm). One nosed blade end-scraper is from Baiersdorf chert (length – 18 mm, width – 19 mm, thickness – 5 mm). Another nosed end-scraper made from the cortical, distal part of a large blade from Thalhof chert has irregular front and both sides irregularly retouched on the ventral face, and one edge with flat use retouch on the dorsal face (dimensions: length – 33 mm, width – 33 mm, thickness – 11 mm. another blade end-scraper bears more or less visible retouch or use retouch on the edge or edges.

Two artefacts typologically refer to truncated pieces (sickle blades?). One, slightly burnt, is made of regular blade of Arnhofen chert (length – 26 mm, width – 16 mm, thickness – 3 mm. The other made of identified raw material has a crushed front (length 36 mm, width – 28 mm, thickness – 1 mm). These artefacts do not find clear counterparts on the sites of the Altheim culture or other cultures of similar chronology. Instead, they are most characteristic of the knapped assemblages of the LBK and younger Danubian cultures (*e.g.*, Dębiec *et al.* 2014, taf. 105, 6; Kadrow 1990; Mateiciucová 2008, 84, 85).

Blades with distinct use retouch and retouched blades (except two specimens) are made from tabular chert from Baiersdorf (5 specimens) and Arnhofen (4 specimens). They are regular in shape, curved, and those made of Plattensilex have one or both cortical edges. They are from 5 to 8 mm thick and from 14 to 28 mm wide. The sizes of the whole specimens made from Baiersdorf chert and Herrnsaal chert are respectively: length – 41 mm, width – 14 mm, thickness – 8.5 mm; and length – 78 mm, width – 28 mm and thickness – 6.5 mm.

Specific forms are specimens made from tabular chert described as backed knives (2 specimens), cortical plates of Plattensilex with bifacial retouch (3 specimens), and cortical plates of Plattensilex with bifacial retouch and glossy polishing (1 specimen). Their function looks unclear: they could have been multifunctional cutting tools or sickle fragments (specimens with glossy polishing).

During the excavations of 2013-2020, 34 arrowheads were discovered on the Altheim site (Table 5): 16 broken, four preserved as small fragments, and 15 whole specimens. The arrowheads are made of flakes or blades also of cortical blank. Some arrowheads made of Baiersdorf-type chert were made of plates of raw material cortical on both sides. They were made of various lithic raw materials: chert of the Baiersdorf-type, chert of the Abensberg-Arnhofen type, Upper Jurassic brown chert from Emmerthal or Hamberg, or Tegernheim chert. Six items were highly burnt. Most of them were made of Plattensilex. Tabular cherts were an especially useful raw material for making arrowheads. Thin plates of Baiersdorf and Arnhofen Plattensilex were a kind of ready-made half-product and a "starting point" for arrowheads. It is not surprising that some arrowheads from Plattensilex were made of plates of raw material cortical on both sides.

The arrowheads differ in size. The lengths of whole specimens varied from 24 to 44 mm (average 34.4 mm). The length of preserved parts of broken arrowheads is from 15 to 42 mm. They are from 12 to 26 mm in width, and from 3 to 8 mm in thickness. The concave bases are up to 6 mm deep. Most of the arrowheads are regular in shape with symmetrical edges and/or barbs, but some are also irregular. One arrowhead is almost triangular. The edges are straight, some specimens have both edges slightly concave or the edges are straight in the central part and rounded in the barbs part. They are regularly retouched on both sides, sporadically on one side. The bases of most arrowheads are concave and rounded, and also rectangular in shape and regularly retouched. Barbs are symmetrical or asymmetrical, sharp or slightly rounded. The tips are sharp, with numerous scars. The edges, barbs and base are shaped with bifacial retouch. Most of the arrowheads were discovered in the innermost ditch. All the specimens in the group of arrowheads found in 2019 are made from Beiersdorf Plattensilex (except one burnt with no assignation to a specific raw material).

Table 5. Characteristics of arrowheads

Location	Length	Length to the base	Width	Thickness	Raw material	Broken tip	Small fragment	Fig.
Excavations 2013								
Fläche 1, Befund 1	24		20	5	12		1	16
Fläche 1, Befund 2	11		12	5	12		1	
Fläche 1, Befund 2	19		17	5,5	12		1	
Fläche 1, Befund 2	36		18	6	2			22
Fläche 1, Befund 2	28		23	3	12	1		24
Fläche 1, Befund 3	15		21	4	12	1		
Fläche 1, Befund 3	29	25	21	7	2			33
Fläche 1, Befund 3	18		22	6	2	1		42
Fläche 1, Befund 3	19	15,5	17	4	4	1		66
Fläche 1, Befund 3	33	31,5	17	4	4	1		65
Fläche 1, Befund 3	24		22	5	4	1		29
Fläche 1, Befund 3	24	21	22,5	6	4	1		31
Fläche 1, Befund 3	22	20	15	4	5	1		32
Fläche 1, Befund 3	23	21	17,5	7	5	1		63
Fläche 1, Befund 3	23	20	17	5	2		1	
Fläche 2 Befund 1	38	32	22	6	2	1		607
Fläche 2 Befund 2	21		22	6	12			
Excavations 2019 and 2020								
2019 outer ditch	20		17	4	2	1		874
2019 middle ditch	27		17	8	2	1		875
2019 middle ditch	42	39	16	7	2	1		876
2019 inner ditch	33		20	8	2			888
2019 inner ditch	29	26	18	7	2			896
2019 inner ditch	33	31	18	4	2			898
2019 inner ditch	37		26	8	2			899
2019 inner ditch	24	22	19	6	2			884
2019 inner ditch	33	32	19	5	2			883
2019 inner ditch	44	37	21	7	2			891
2019 inner ditch	30		22	7	2	1		881
2019 inner ditch	27	23	22	6	2	1		898
2019 inner ditch	27	22	22	6	12			
2020 outer ditch	32	29	21	6	2	1		1246
2020 outer ditch	30	29	18	6	2			1247
2020 outer ditch	35	31	19	4	3			1249
2020 surface	51	28	8	6	2			872

4. FUNCTIONS OF TOOLS. USE-WEAR ANALYSIS

Use-wear analysis is one of the most powerful techniques for the reconstruction of functions of artefacts, and for detecting various types of damage, including breakages (Aldenderfer *et al.* 1989; Grace 1989; Hayden 1979; Hurcombe 1985; Keeley 1980; Kononenko 2011; Korobkowa 1999; Małecka-Kukawka 2001; Owen and Untrath 1985; Pelisiak 2004). Both macroscopic and microscopic observations formed the basis of the analysis. All the artefacts from Altheim were examined using an OLYMPUS SZX16 stereoscopic microscope and an OLYMPUS BX51 optical polarizing microscope using reflected light, employing both low (24X-33X) and high (175X) magnifications.

Fourteen artefacts (excluding arrowheads) were analyzed for microscopic traces of work. Use-wear analyses were performed using a microscope at 300x magnification. Formation of use-wear on lithic tools is a complex and dynamic process. On the examined tools (14 specimens) several kinds of modification were observed: surface modifications; edge scarring (microchipping); scars distributed continuously, irregular in shape, oriented toward the edge perpendicularly or slightly diagonally to the edge, edge striations (long and deep, oriented at a slight angle to the edge); and edge rounding and polishing. These traces suggest various types of working with a soft material, probably soft wood. In the case of cortical plates of Plattensilex with bifacial retouch and glossy polishing of this edge, it is possible that this tool was used for grass cutting, probably harvesting of cereals.

The lithic arrowheads discovered at Altheim in the 2013-2020 field season excavations are whole or broken. Whole specimens are extremely rare. One such artefact bears specific traces of use on the tip (Fig. 4: 8) in a form of small scars on the tip and micro crushes and cracks in the shape of micro flakes detached from the tip of the arrowhead, vertically or almost vertically to the long axis of the arrowheads. Such traces can be linked to the arrow striking a hard tree. The direction of impact of the arrow (arrowheads) was vertical or almost vertical (approx. 80°-90°) to the tree. One arrowhead bears no traces of impact (Fig. 4: 1).

Most of the arrowheads with broken tips bear diagnostic impact fractures: step terminating bending fractures or spin-off fractures (Altorfer and Altorfer 2011; Coppe and Rots 2017; Fischer *et al.* 1984; Gassin 1996; Loi, Brizzi 2011; Kalterborn 1999) specifically in the shape of small fractures on the edge between one surface of the arrowhead and the surface of break of the tip (examples 24, 28, 29, 31, 32, 33, 42, 63, 66). These suggest angles of impact of the arrows into hard surfaces at about 60°-70°. It should be also added that some arrowheads bear cracks as result of burning and/or bending. The lithic arrowheads were attached to the wooden part of the arrows. Their bond with the wooden arrows must have been stable but not very strong. After a hitting the a body, the stone part of the arrow must have stayed inside the body like a bullet.

Arrows with lithic heads were probably used in various ways, some of them also as a weapon (Bye-Jensen 2011, fig. 10). In this regard the famous Ötzi (with a lithic arrowhead recognized in his body) can be suggested as good proof of the "military" use of bows

and arrows tipped with lithic arrowheads (Fleckinger 2003, 45). Other examples come from, for example, the Iberian Peninsula (Márquez *et al.* 2008, fig. 3) and Eulau in Saxony-Anhalt (Meyer *et al.* 2009). The interpretation of some of the lithic arrowheads found in Altheim as archaeological traces of conflict (s) also finds support in the place of their discovery. The vast majority of broken specimens and specimens with characteristic fractures indicating impact into a hard material, as well as whole arrowheads, were recorded in the ditches, mainly in the inner ditch. It should be also noted that not every arrowhead that impacted hard material was necessarily broken or bearing other traces of impact.

5. CONCLUSIONS

In the 2013-2020 excavations at the Altheim site, 360 lithic artefacts were discovered. They have been analyzed on several main levels: context, raw material, typology, and use-wear and damage. The analyzed artefacts are made of several kinds of raw material sourced in the Regensburg and Kalheim regions, mainly Baiersdorf and Arnhofen patular cherts. Tabular cherts from Baiersdorf and Arnhofen were widely used by Neolithic communities which settled areas around the natural sources, but distribution of these raw materials and artefacts made of them covered an area of a radius of hundreds of kilometres from the extraction sites of Baiersdorf and Arnhofen cherts (*e.g.,* Roth 2008; Binsteiner 2005). A relatively large number of lithic artefacts discovered in Altheim are burnt, some to an extent which makes it impossible to identify the raw material used. Plates of tabular cherts were a convenient and useful type of "half-product" for the production of many tools. Plates 3-6 mm thick were used for production of arrowheads, and others for the production of a variety of tools (*e.g.,* sickles, knives, end-scrapers) as well as regular blades.

The vast majority of the lithic artefacts were discovered in the innermost ditch.

Chunks, flakes, arrow heads and other tools are the most numerous in the lithic assemblage from Altheim. Chips are also numerous. A particularly large number of them were found in the "house pit". Aside from the arrowheads, the tools are of a settlement character. They relate to the specimens discovered in the course of previous excavations at this site. The tools are made from various raw materials, but most are from Baiersdorf and Arnhofen Plattensilex. In the tools group (aside from arrowheads) blade end-scrapers (made of various raw materials), retouched blades and retouched tools made from plates of Plattensilex are most frequent. Blade end-scrapers are not numerous. Retouched plates of tabular cherts as well as sickles and knives made of these raw materials are frequently registered on sites of Altheim culture and other cultures in the IV millennium BC in the area of the Alpine Forelands (Reittinger 1968-1970; Brandl *et al.* 2017; Richter and Wild 2018).

The tools discovered in Altheim in 2013-2020 relate to the specimens discovered in previous excavations on this site. End-scrapers and retouched blades are frequent on the settlement sites located on the Alpine Forelands and dated to the Late Neolithic. A damaged

blade truncated piece is an exceptional specimen from this site. Such tools are typical and frequent on sites from the Early and Middle Neolithic. This specimen has no counterpart in the Late Neolithic sites in the Alpine Forelands.

Arrowheads constitute one of the largest group of lithic artefacts found on the Altheim site. Specimens discovered in 2013-2020 are similar in many respects (raw material, size, shape, modifications) to those discovered earlier (Richter 2014; Richter *et al*. 2016; Saile 2019). Most of the arrowheads are made of Plattensilex, but all specimens discovered in the part of the inner ditch excavated in 2018-2020 are made of Baiersdorf Plattensilex. Many of the arrowheads were burnt, and many have broken tips. All the analyzed arrowheads with broken tips bear diagnostic impact fractures: step- terminating bending fractures or spin-off fractures specifically in the shape of small fractures on the edge between one surface of the arrowhead and the surface of fracture of the tip. This suggests an angle of impact of the arrow into a hard surface of about 60°-70°. Broken and burnt arrowheads were found in the strong context of the defence structures. The context of these finds and fractures of the arrowheads resulting from being shot into hard wood suggest a connection with military conflict. It can be also suggested that most of the arrowheads discovered in the ditch were from the arrows of the attackers.

Lithic arrowheads are frequently registered (but varying in number) on other sites located in the Alpine Forelands dated to the fourth millennium BC (Binsteiner 2013). In Altheim, their high frequency compared to other categories of lithic artefacts is noticeable.

In general, the lithic material from the Altheim site relates to other knapped assemblages dated to the 4th millennium BC from the Alpine Forelands. They have numerous analogies in the field of arrowheads, other tools and raw materials used at the sites of Altheim, Cham, Pfyn and Michelsberg cultures (*e.g*., Binsteiner 2013; Kieselbach 2008; Leuzinger 2007; Meixner 2008; Modderman 1977; Underwood 2014; 2017).

References

Aldenderfer M. S., Kimball L. L. and Sievert A. 1989. Microwear Analysis in the Maya Lowlands: The Use of Function Data in a Complex-Society Setting. *Journal of Field Archaeology* 16, 47-60.

Altorfer K. and Altorfer J. 2011. *Schaffhauser Silex-Vorkommen und Nutzung. Wirtschaftsarchäologische Untersuchungen an den Silices der jungneolithischen Stationen Büttenhardt-Zelg, Schaffhausen (Herblingen)-Grüthalde und Lohn-Setzi* (= *Beiträge zur Schaffhauser Archäologie* 5). Schaffhausen: Beiträge zur Schaffhauser Archäologie.

Binsteiner A. 2005. Die Lagerstätten und der Abbau Bayerischer Jurahornstein sowie deren Distribution im Neolithikum Mittel- und Osteuropa. *Jahrbuch des Römisch-Germanischen Zentralmuseums* 52, 43-155.

Binsteiner A. 2013. Neue Forschungen zur Steinzeit im Unteren Mühlviertel. *Oberösterreichische Heimatblätter* 67/3-4, 109-129.

Brandl M., Hauzebberger Ch. and Trnka G. 2017. Analysis of a Baiersdorf sicle blades from eastern Austria. *Anthropologie* 55/1-2, 181-191.

Bye-Jensen P. 2011. Eksperimenter med flækkepilespidser. Studier af pilespidser fra grubekeramisk kultur. *KUML* 2011, 63-82.

Coppe J. and Rots V. 2017. Focus on the target. The importance of a transparent fracture terminology for understanding projectile points and projecting modes. *Journal of Archaeological Science: Reports* 12, 109-123.

Dębiec M., Pelisiak A., Becker V., Dębiec M., Makowicz-Poliszot D., Saile T., Sebők K., Posselt M. and Szczepanek A. 2014. *Zwięczyca 3. Eine bandkeramische Siedlung am Wisłok*. Rzeszów: Zimowit

Fischer A., Vemming Hansen P. and Rasmussen P. 1984. Macro and Micro Wear Traces on Lithic Projectile Points. *Journal of Danish Archaeology* 3, 19-46.

Fleckinger A. 2003. *Ötzi, the Iceman: the full facts at a glance*. Wien: Folio Verlag.

Gassin B. 1996. *Evolution socio-économique dans le Chasséen de la grotte de l'Eglise supérieure (Var). Apport de l'analyse fonctionnelle des industries lithiques*. Paris: Centre National de la Recherche Scientifique.

Grace R. 1989. *Interpreting the Function of Stone Tools. The Quantification and Computerisation of Microwear Analysis* (= *BAR International Series* 474). Oxford: Archaeopress.

Hayden B. 1979. *Lithic Use-Wear Analysis*. New York: Academic Press.

Hurcombe L. 1985. The Potential of Functional Analysis of Obsidian Tools: a Closer View. In C. Malone and S. Stoddart (eds), *Papers in Italian Archaeology IV* (= *BAR International Series* 244). Oxford: Archaeopress, 50-60.

Kadrow S. 1990 Osada neolityczna na stanowisku, nr 16 w Rzeszowie na Osiedlu Piastów. *Sprawozdania Archeologiczne* 41, 9-76.

Kalterborn P. 1999. Analysen und Experimente zu Herstellung und Gebrauch von Horgener Pfeilspitzen. *Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte* 83, 37-64.

Keeley L. H. 1980. *Experimental Determination of Stone Tools Use: a Microwear Analysis*. Chicago: University of Chicago.

Kieselbach P. 2008. *Metamorphose des Steins – Vom Rohmaterial zum Kulturgut Versorgungsaspekte und technische Prozesse der Silexverarbeitung von jungneolithischen Silexinventaren aus Südwestdeutschland*. Dissertation zur Erlangung des Grades eines Doktors der Naturwissenschaften der Geowissenschaftlichen Fakultät der Eberhard-Karls-Universität Tübingen. Tübingen.

Kononenko N. 2011. Experimental and archaeological studies of use-wear and residues on obsidian artefactsfrom Papua New Guinea. *Technical Reports of the Australian Museum, Online* 21, 1-244.

Korobkowa G. 1999. *Narzędzia w pradziejach*. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Leuzinger U. 2007. *Pfyn-Breitenloo. Die jungsteinzeitliche Pfahlbausiedlung* (= *Archäologie im Thurgau* 14). Thurgau: Departement für Erziehung und Kultur des Kantons Thurgau.

Loi C. and Brizzi V. 2011. *New approaches to the experimentation on the impact of lithic projectiles points*. Oxford: Archaeopress.

Małecka-Kukawka J. 2001. *Między formą a funkcją. Traseologia neolitycznych zabytków krzemiennych z ziemi chełmińskiej*. Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika.

Márquez B., Gibaja J. F., González J. E., Ibáñez J. J. and Palomo A. 2008. Projectile points as signs of violence in collective burials during 4th and the 3th millennia cal. BC in the North-East of the Iberian peninsula. In L. Longo and N. N. Skakun (eds), *Prehistoric Technology 40 Years Later: Functional Studies and the Russian Legacy* (= *BAR International Series 1783*). Oxford: Archaeopress, 321-326.

Mateiciucová I. 2008. *Talking stones: The Chipped Stone Industry in Lower Austria and Moravia and the Beginnings of the Neolithic in Central Europe (LBK), 5700-4900 BC*. Brno: Masarykova univerzita.

Meixner D. 2008. Grenzland. Siedlungsdynamik mittel- und jungneolithischer Kulturgruppen am Lech. In U. Gruber, G. Mahnkopf, D. Meixner, J. Pechtl and L. Steguweit (eds), *Steinzeit im Landkreis Augsburg. Jäger, Sammler, Ackerbauern* (= *Archäologie in Bayerisch-Schwaben* 2). Friedberg: Likias Verlag, 38-57.

Meyer Ch., Brandt G., Haak W., Ganslmeier R. A., Meller H. and Alt K. W. 2009. The Eulau eulogy: Bioarchaeological interpretation of lethal violence in Corded Ware multiple burials from Saxony-Anhalt, Germany. *Journal of Anthropological Archaeology* 28, 412-423.

Modderman P. J. R. 1977. *Die neolithische Besiedlung bei Hienheim, Ldkr. Kelheim. Die Ausgrabungen am Weinberg 1965 bis 1970* (= *Analecta Praehistorica Leidensia* 10). Leiden: Leiden University.

Owen L. and Unfath G. eds 1986. *Technical Aspects of Microwear Studies on Stone Tools*. Tübingen: Commission for the Palecology of Early Man of INQUA.

Pelisiak A. 2004. Functional Identification of Funnel Beaker Culture Flint Tools in the Light of Micro Wear Analysis of Artifacts from Settlement in Dobroń, site 1, and Andrzejów, site 2 (Łódź Province). *Sprawozdania Archeologiczne* 56, 289-305.

Richter Th. 2014. (K)ein Kampf um Altheim – Das Silexinventar der Grabungen 1914 und 1938 im namengebenden Erdwerk der Altheimer Kultur von Holzen, Gem. Essenbach, Lkr. Landshut. *Vorträge des 32. Niederbayerischen Archäologentages*, 59-89.

Richter Th., Saile Th. and Pelisiak A. 2016. Zu den Pfeilspitzen von Altheim. In T. Kerig, K. Nowak and G. Toth (eds), *Alles was zählt… Festschrift für Andreas Zimmerman*. Bonn: Habelt, 209-220.

Richter Th. and Wild M. 2018. Vilsbiburg – Lidl-Neubau. Eine Mineralbodensiedlung der Altheimer Kultur. In L. Husty, T. Link and J. Pechtl (eds), *Neue Materialien des Bayerischen Neolithikums 2 – Tagung im Kloster Windberg vom 18. bis 20. November 2016* (= *Würzburger Studien zur Vor- und Frühgeschichtlichen Archäologie* 3). Würzburg: Würzburg University Press, 141-153.

Reittinger J. 1968–70. Eine neolithische Feuersteinsichel aus Krummnusbaum in Niederosterreich, *Jahrbuch fur Landeskunde von Niederosterreich* N.F. 38, 1-19.

Roth G. 2008. *Geben und Nehmen. Eine wirtschaftshistorische Studie zum neolithischen Hornsteinbergbau von Abensberg-Arnhofen, Kr. Kelheim (Niederbayern)*. Dissertation zur Erlangung des Doktorgrades im Fach Ur- und Frühgeschichte an der Philosophischen Fakultät der Universität zu Köln. Köln.

Saile Th. 2019. The earthworks at Altheim: Built by many for many. In J. Müller, M. Hinz and M. Wunderlich (eds), *Megaliths – Societies – Landscapes. Early Monumentality and Social Differentiation in Neolithic Europe* (= *Frühe Monumentalität und soziale Differenzierung* 18). Bonn: Habelt, 131-151.

Saile T., Posselt M., Zirngibl B., Schoon R., Steinrücken B. and Tinapp C. 2017. Die jungneolithischen Erdwerke von Altheim. *Praehistorische Zeitschrift* 92, 66-91.

Saile T., Posselt M., Reitmaier F. and Tinapp C. 2021. Altheim gefährdet! – Zur Oberflächendynamik in Lösslandschaften. *Das archäologische Jahr in Bayern 2020*, 37-39.

Underwood D. 2014. Silexartefakte aus Pestenacker und Unfriedshausen und die jungneolithischen Silexindustrien des Alpenvorlandes. *Bericht der Bayerischen Bodendenkmalpflege* 55, 153-197, 198-267.

Underwood D. 2017. Die Verteilung der Silexartefakte in der jungneolithischen Feuchtbodensiedlung Pestenacker. *Bericht der Bayerischen Bodendenkmalpflege* 58, 55-69.

Webpage

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