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LONG-TERM VARIATION IN LITHIC TECHNOLOGICAL TRADITIONS AND SOCIAL INTERACTION: THE STONE AGE OF THE EASTERN BALTIC (LATVIA), 10500–2900 CALBC

Abstract

The Eastern Baltic Stone Age is characterized by several major shifts in tool technology. Our picture of cultural change is currently based on typological variation in well-preserved bone tools, ceramics, stone tools, and on diversity in lithic raw-material use. These variations have partly been interpreted as the result of external influences, and partly as internal development. However, the understanding of relations with neighbouring regions is still limited.

Recent decades have seen a growing interest in the *chaîne opératoire* approach and technological analysis, and their relevance for studying intra-site activity and development of skill, and for describing ancient technologies has been demonstrated. Technological and cultural relationships in the North European Stone Age have also been discussed within this frame. In this article, we take a new approach, employing variation in lithic technological craft traditions as proxy for investigating long-term development and variability in lines of communication.

This study addresses three chronological contexts of the Latvian Stone Age, based on technological analysis of 26 sites. In describing the overall development in stone technology during the period c 10 500–2900 calBC, the article demonstrates not only technological variations but also affirms fluctuation/change in directions of social contacts throughout the Stone Age, demonstrating variation in knowledge transmission and communication routes across large geographical areas.

Key words: *chaîne opératoire*, Eastern Baltic, Latvia, lithic technology, lithic raw material, long-term variation, technological tradition

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INTRODUCTION

This article discusses variation in communication and social interaction in the Eastern Baltic during the whole course of the Stone Age, using lithic craft traditions as proxy. We focus on the occurrence and development of lithic technological traditions in present-day Latvia, examining three cases: the first traces of settlement from the Final Palaeolithic (c 10900–9000 calBC), variation in pressure blade technology in the Mesolithic (c 9000–6500 calBC), and diversity in raw-material use and production methods for bifacial points in the Neolithic (c 4000–2900 calBC).

Within the chronological system for the region, established in the second half of the 20th century (Fig. 1), the Final Palaeolithic and Mesolithic (i.e. pre-ceramic) remains have been chronologically organized on the basis of bone/antler implement typology along with the typology of lithic tools, whereas the Neolithic (i.e. ceramic period) has been conceived in terms of a succession of pottery wares (it should be noted that the Estonian periodisation scheme has now been revised, as indicated in Fig. 1, but for the sake of coherence, we adhere in this article to the system previously applied across the whole of the Eastern Baltic). Recent research includes a stronger technological focus in the study of osseous remains (e.g. David 2006; Girininkas et al. 2016) and ceramics (e.g. Dumpe et al. 2011). Although explicit technological approaches have begun to be applied in lithic analysis in particular in Finland (Hertell & Tallavaara 2011; Kriiska et al. 2011; Manninen & Hertell 2011; Rankama & Kankaanpää 2011), nevertheless the potential of lithic technology studies for illuminating social and cultural relations remains largely untapped in the rest of the Eastern Baltic. This paper represents a first attempt at such an investigation covering the whole span of the Stone Age, using material from a range of sites across present-day Latvia (Fig. 2; Table 1).

Our studies of the lithic technology reveal the Eastern Baltic as an important region for understanding cultural change during the Mesolithic of Northern Europe, and provide new insights into the development of Final Palaeolithic and Neolithic societies. Using the French technological approach as a theoretical and methodological basis, we suggest that investigation of craft traditions significantly augments the traditional typological-morphological method. Although requiring time-intensive studies, this approach holds the advantage of focusing on the production and maintenance of everyday technology, facilitating our understanding of social interaction and communication. Study of the production concepts and raw-material economy of the lithic technology of the Latvian Stone Age provides a solid basis for comparative studies. This enables the investigation of synchronous and diachronic traits in the production of lithic material, putting forward the first interpretations of continuity and change in Eastern Baltic technological traditions.

TECHNOLOGICAL TRADITIONS AS PROXY FOR SOCIAL HISTORY

Our approach is based on a technological concept from French sociology and archaeology, emphasizing technology as a manifestation of social and cultural tradition. Within this perspective, archaeological remains are studied as part of a complete process of production and use, regarded as a sequence of actions or operations,

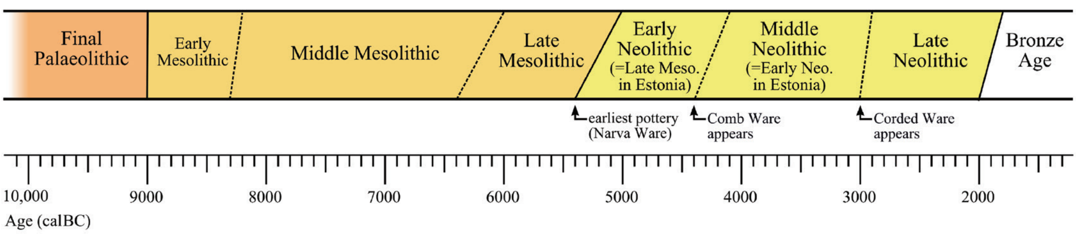

Fig. 1. Chronological scheme for the Stone Age of the Eastern Baltic (after: Girininkas 2009: Fig. 1, Tables 2, 4; Kriiska 2009: Fig. 5; Larsson & Zagorska 2006: 3, Table). Illustration: V. Bērziņš.

Site	^{14}C /yr BP	± (1σ)	Lab-index	calBC (95.4%)	Material	Period	Excavation; director, year (total area/context)	Reference
Salaspils Laukskola	-	-	-	-	-	FP	I. Zagorska 1973–74 (2700 m^2)	Zagorska 1993; 1996; 1999; 2012
Sēlpils	-	-	-	-	-	FP	E. Šnore & A. Zariņa 1963–65 (stray find)	Zagorska 2012
Ķentes pilskalns	-	-	-	-	-	FP	A. Stubavs 1954–58 (stray find)	Zagorska 2012
Ikšķiles Elkšņi	-	-	-	-	-	FP	A. Smiltnieks 1984 (survey)	Zagorska 2012
Skrīveru Lielrutuli	-	-	-	-	-	FP	E. Šturms 1929, I. Briede 1974 (stray find)	Zagorska 2012
Mūkukalns	-	-	-	-	-	FP	J. Graudonis 1959–62 (stray find)	Zagorska 2012
Zvejnieki II, lower layer	9415	80	Ua-18201	9123–8470	bone artefact	EM	F. Zagorskis & I. Zagorska 1971–73; 1975; 1977–78; 2009 (705 m^2)	Zagorska 1993; 2006; 2009; Zagorskis 2004; Bērziņš & Zagorska 2010
	9170	70	Ua-19797	8567–8271	bone artefact			
Zvejnieki II, upper layer	8240	70	Ua-3634	7465–7078	human bone	MM	F. Zagorskis & I. Zagorska 1971–73; 1975; 1977–78; 2009 (705 m^2)	Zagorska 1993; 2006; 2009; Zagorskis 2004; Bērziņš & Zagorska 2010
	8140	120	Ta-2791	7481–6714	peat			
Sise	9240	30	KIA-48973	8561–8331	wood	Early MM*	V. Bērziņš 2012 (91 m^2)	Bērziņš et al. 2016a
	8990	27	KIA-48974	8283–8022	wood			
	8873	75	Tln-3465	8246–7754	wood			
Lapiņi	9119	65	Tln-3477	8538–8241	wood	Early MM	V. Bērziņš 2012, 2014, V. Bērziņš & M. Kalniņš 2015 (172 m^2)	Bērziņš & Doniņa 2014; Bērziņš et al. 2016b
Vendzavas	8160	60	Ua-34544	7340–7048	wood charcoal	Late MM	V. Bērziņš 1996, 1998, 2000 (134 m^2)	Bērziņš 2002; Lõugas 2002
	7815	35	KIA-40957	6750–6533	wood charcoal			
Celmi	7510	80	Tln-2917	6503–6220	wood charcoal	Late MM	N. Grasis 2000–1 (130 m^2)	Grasis 2010
Pāvilostas Baznīckalns	-	-	-	-	-	Late MM	P. Stepiņš 1939 (small-scale excavation)	Mūrniece et al. 1999
Priednieki	-	-	-	-	-	MM	A. Vasks 2004 (181 m^2)	Vasks 2006
Osa	-	-	-	-	-	EN / MN	F. Zagorskis 1964, 1969 (76 m^2)	Zagorskis 1973

Site	^{14}C /yr BP	± (1σ)	Lab-index	calBC (95.4%)	Material	Period	Excavation; director, year (total area/context)	Reference
Slocene	6034	44	Ua-49274	5049-4802	wood charcoal	EN / MN	V. Bēziņš 2013 (29 m^2)	Bērziņš & Kalniņš 2014
Zvejnieki burial 252	5410	90	OxA-5988	4447–4005	human bone	MN	F. Zagorskis 1971	Zagorskis 2004
Piedāgi	5190	95	Tin-2922	4259–3776	wood charcoal	MN	E. Ziediņa 2002 (31.25 m^2)	Ziediņa 2004
Sārnate Dwelling M_{-D}	5065	75	Ua-15984	4034–3695	residue on pottery	MN	L. Vankina 1957 (154 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling T	4700	250	TA-26	4046–2778	animal bone	MN	L. Vankina 1953–5 (126 m^2)	Bērziņš 2008; Vankina 1970
Zvejnieki burial 201	4865	75	Ua-19884	3906–3381	human tooth	MN	F. Zagorskis 1970	Zagorskis 2004
Sārnate Dwelling L	4510	110	Le-814	3516–2911	wood	MN	L. Vankina 1953 (42 m^2)	Bērziņš 2008; Vankina 1970
	4639	100	Bln-769	3639–3097	wood			
Budjanka	-	-	-	-	-	MN	R. Šnore 1956, 1959 (150 m^2)	Šnore 1995
Ģipka (Pūrciems-Ģipka) Dwelling A	-	-	-	-	-	MN	I. Loze 1993, 1997–8, 2001 (82.5 m^2)	Loze 2006
Ģipka (Pūrciems-Ģipka) Dwelling B	-	-	-	-	-	MN	I. Loze 1995–6 (45 m^2)	Loze 2006
Pūrciems (Pūrciems-Ģipka), Dwelling C	-	-	-	-	-	MN	E. Šturms 1936 (6 m long profile)	Loze 2006
Pūrciems (Pūrciems-Ģipka), Dwelling D	-	-	-	-	-	MN	E. Šturms 1936 (4.5 m long profile)	Loze 2006
Pūrciems (Pūrciems-Ģipka), Dwelling E	-	-	-	-	-	MN	E. Šturms 1936 (5.5 m long profile)	Loze 2006
Kreiči	-	-	-	-	-	MN	L. Vankina 1956–7; F. Zagorskis 1958–9 (618 m^2)	Zagorskis 1963
Kreiči burial 2	-	-	-	-	-	MN	L. Vankina 1956	Zagorskis 1961
Kreiči burial 20	-	-	-	-	-	MN	L. Vankina 1957	Zagorskis 1961
Piestiņa	-	-	-	-	-	MN	F. Zagorskis 1963–4 (80 m^2)	Zagorskis 1973
Sārnate Dwelling 1	-	-	-	-	-	MN	L. Vankina 1953 (18 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 11	-	-	-	-	-	MN	L. Vankina 1959 (32 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 12	-	-	-	-	-	MN	L. Vankina 1959 (44 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 14	-	-	-	-	-	MN	L. Vankina 1959 (9 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 15	-	-	-	-	-	MN	L. Vankina 1959 (42 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 2	-	-	-	-	-	MN	L. Vankina 1953–4 (86 m^2)	Bērziņš 2008; Vankina 1970

Site	^{14}C /yr BP	± (1σ)	Lab-index	calBC (95.4%)	Material	Period	Excavation; director, year (total area/context)	Reference
Sārnate Dwelling 3	-	-	-	-	-	MN	L. Vankina 1957 (84 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 4	-	-	-	-	-	MN	L. Vankina 1957 (38 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 5	-	-	-	-	-	MN	L. Vankina 1957 (49 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 6 ZA	-	-	-	-	-	MN	L. Vankina 1957 (23 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 6 DR	-	-	-	-	-	MN	L. Vankina 1958 (15 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 8	-	-	-	-	-	MN	L. Vankina 1958 (22 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling 9	-	-	-	-	-	MN	L. Vankina 1959 (20 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling E	-	-	-	-	-	MN	E. Šturms 1939 (25 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling G	-	-	-	-	-	MN	E. Šturms 1939–40, L. Vankina 1956 (83 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling W	-	-	-	-	-	MN	L. Vankina 1953 (36 m^2)	Bērziņš 2008; Vankina 1970
Sārnate Dwelling X	-	-	-	-	-	MN	L. Vankina 1958 (100 m^2)	Bērziņš 2008; Vankina 1970
Siliņupe	-	-	-	-	-	MN	I. Zagorska 1988–9 (23 m^2)	Zagorska 2000; 2003
Zvejnieki burial 204	-	-	-	-	-	MN	F. Zagorskis 1970	Zagorskis 2004
Zvejnieki burial 207	-	-	-	-	-	MN	F. Zagorskis 1970	Zagorskis 2004
Zvejnieki burial 211	-	-	-	-	-	MN	F. Zagorskis 1970	Zagorskis 2004
Zvejnieki burial 263	-	-	-	-	-	MN	F. Zagorskis 1971	Zagorskis 2004
Zvejnieki burial 275	-	-	-	-	-	MN	F. Zagorskis 1971	Zagorskis 2004
Lejascīskas	-	-	-	-	-	MN / LN	E. Šturms 1930 (99 m^2)	Šturms 1931
Zvejnieki I	-	-	-	-	-	MN / LN	F. Zagorskis & I. Zagorska 1964–6; 1968; 1970; I. Zagorska 2005–6; M. Kalniņš & I. Zagorska 2014 (296 m^2)	Zagorska 2006; 2017

*Table 1. Stone Age sites included in this study. Conventional radiocarbon ages calibrated using the IntCal13 atmospheric curve (Reimer et al. 2013) and OxCal v4.2.4 (Bronk Ramsey 2009). For site locations, see Fig. 2. Period: FP – Final Palaeolithic, EM – Early Mesolithic, MM – Middle Mesolithic, LM – Late Mesolithic, EN – Early Neolithic, MN – Middle Neolithic, LN – Late Neolithic. * (LM–EN artefacts from adjacent river channel)*

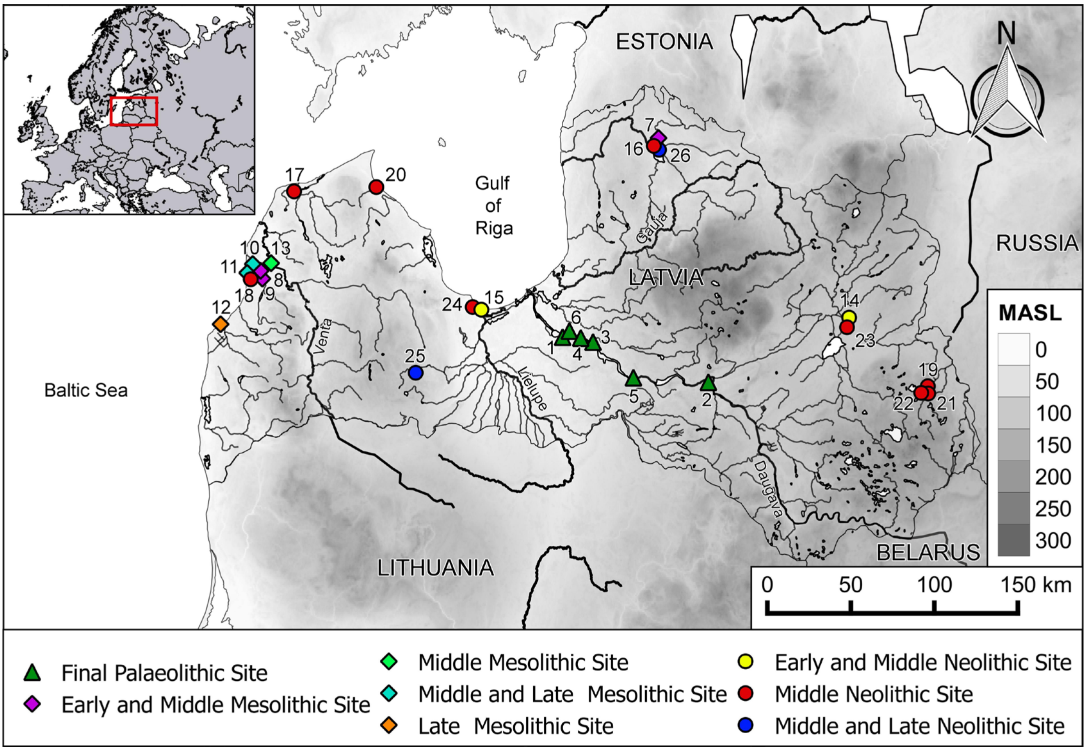

Fig. 2. Sites included in this study; 1) Salaspils Laukskola, 2) Sēlpils, 3) Ķentes pilskalns, 4) Ikšķiles Elkšņi, 5) Skrīveru Lielrutuļi, 6) Mūkukalns, 7) Zvejnieki II, 8) Vendzavas, 9) Sise, 10) Celmi, 11) Lapiņi, 12) Pāvilostas Baznīckalns, 13) Priednieki, 14) Osa, 15) Slocene, 16) Zvejnieki cemetery, 17) Piedāgi, 18) Sārnate, 19) Budjanka, 20) Pūrciems-Ģipka, 21) Kreiči cemetery, 22) Kreiči, 23) Piestiņa, 24) Siliņupe, 25) Lejascīskas, 26) Zvejnieki I. Illustration: M. Kalniņš.

i.e. *chaîne opératoire*, where the individual steps are studied as part of the whole. Central to this approach is the idea that the manner of production, i.e. how a handicraft is performed, varies between craft traditions, involving distinctive conceptual and methodological dissimilarities. Further, it is argued that such variation should be seen as a consequence of the organization of knowledge transmission through social learning, and the social processes involved in this. Mastery of a craft, such as production of lithic tools, generally presupposes theoretical knowledge as well as physical training, including practical guidance from a skilled person (Pelegrin 1990; Pigeot 1990; Sørensen 2006a; Apel 2008). This implies a close relationship between cognitive and practical knowledge, comprising common memories of operation sequences and the skill to apply tools through the proper gestures, and social and cultural practices (Pelegrin 1990; Lemonnier 1992; Leroi-Gourhan 1993[1964]: 253, 258–9; Dobres 2000). Thus, direct and sustained interaction and communication plays a crucial role in the transmission and maintenance of cultural knowledge, being essential to technology and technological tradition (Cavalli-Sforza 1986; Guglielmino et al. 1995; Henrich 2004; Tostevin 2007; Jordan 2015). Consequently, social relations are reflected in the transmission of culture-specific knowledge, and can thereby be traced in the execution of crafts such as lithic tool production, facilitating the identification of groups of archaeological assemblages with similar technology, i.e. *technological traditions* (Shennan 2001; Schlanger 2006; Sørensen 2006b; Perdaen et al. 2008; Stout et al. 2010; Weber 2012; Jordan 2015; Damlien 2016; Berg-Hansen 2017a; 2018).

This technological perspective differs from a typological-morphological approach in significant ways, the focus being on production as a dynamic process, constituting a series of culturally variable actions, rather than on individual objects as static forms. A technological perspective comprises reconstructing the production concepts, i.e. production methods and techniques as well as the mental templates the knapper uses in each step of production, whereas typology concerns describing the morphology of the finished tool. To be able to reconstruct the production concepts, characteristic attributes are identified through knapping experiments. While in lithic technology the methods for producing blanks and advanced tools reflect socially and culturally transmitted knowledge, in many cases demanding considerable skill, the morphology of tools can be easily copied by an experienced and knowledgeable knapper. This especially concerns lithic tools made by simple retouch of flakes or blades, such as many arrowhead types. Further, tool morphology can vary, even if the same methods and techniques are used in blank production. The same lithic blade or flake can serve as a blank to produce a diversity of arrowheads or burins, for instance. However, if the knapper is not familiar with the details of a specific knapping tradition, it can be hard to replicate the specific production concept and method in detail (Tostevin 2007; Apel 2008; Darmark 2012; Pelegrin 2012; Berg-Hansen 2017a). Hence, the technological approach allows a more detailed and elaborated identification of social processes and networks in archaeological assemblages.

To identify lithic craft traditions, detailed recording of technological attributes of chipped stone assemblages is necessary. As a methodological basis we use a *dynamic-technological classification* and reading, allowing a simplified *chaîne opératoire analysis,* combined with detailed attribute analysis of selected parts of the lithic assemblages (Schild 1980; Madsen 1996; Inizan et al. 1999; Eriksen 2000; Sørensen 2006a; 2006b; 2013; Damlien 2015; Berg-Hansen 2017a). On this basis, we describe the concepts, methods and techniques for production of tool blanks and tools, including raw-material procurement strategies, from the three periods of the Stone Age, facilitating a discussion of local and regional variation in craft tradition.

AT THE NORTHERN BORDER OF THE SWIDRY TRADITION – BLADE TECHNOLOGY IN A MOBILE SOCIETY

The oldest known traces of human settlement in Latvia are typologically and geologically dated to the second half of the Younger Dryas and first half of the Preboreal (c 10500–9000 calBC). Based on typological similarities in formal tools, these finds are associated with the contemporaneous Swidry tradition, known in the region from Poland to Ukraine (Zagorska 1993; 1996; 1999; 2012). Further, bone and antler finds – harpoons, a single Lyngby axe and reindeer remains – dated by radiocarbon, enclose Latvia within a wider Final Palaeolithic tradition extending from Denmark to the Eastern Baltic, where reindeer hunting plays an important role (Zagorska 2012). So far, the character of the relationship between the Latvian finds and the Swidry finds from areas further south has been studied from a typological perspective (Zaliznyak 1999a; 1999b; Šatavičius 2016; however, see Sulgostowska 1997; 2002). A technological approach comparing lithic production concepts offers new possibilities of exploring this relationship. The following discussion presents results from a technological analysis of the Final Palaeolithic Latvian blade industry, bringing additional arguments to this debate. Primarily relying on results from the Salaspils Laukskola assemblage, which is the most comprehensive find from this period in Latvia, our analysis also includes observations from five small assemblages (Fig. 2; Table 1) (for a broader presentation of this analysis see, Berg-Hansen et al. forthcoming). All these assemblages include tools or cores technologically associated with the Swidry tradition (Zagorska 1996; 1999; 2012).

The Salaspils Laukskola site, located close to the former estuary of the River Daugava, which entered the Baltic Ice Lake, comprises a total of 2170 lithic artefacts (Zagorska 1993; 1996; 1999; 2012:

Artefacts	Final Palaeolithic sites						Mesolithic sites					
	Salaspils Laukskola	Sēlpils	Ķentes pilskalns	Ikšķiles Elkšņi	Skrīveru Lielrutuli	Mūkukalns	Zvejnieki II, lower layer	Zvejnieki II, upper layer	Vendzavas	Celmi	Lapiņi	Pāvilostas Baznīckalns
Complete blades	109	0	0	3	3	1	13	20	35	25	4	7
Blade fragments	116	0	0	0	0	0	41	89	112	24	25	20
Flakes	1	0	0	0	0	0	1	0	2	0	0	0
Cores	5	2	2	0	0	1	8	30	45	17	5	0
Core fragments	6	0	0	0	0	0	7	12	10	1	2	0
Platform flakes	1	0	0	0	0	0	10	27	19	4	1	1
Blocks/nodules	1	0	0	0	0	0	0	0	0	18	0	0
Points/Microliths	41	2	4	1	1	0	1	0	1	13	2	1
Scrapers	1	0	0	2	1	2	2	1	1	0	1	0
Burins	10	0	0	0	0	0	0	0	0	0	1	0
Microburins	18	0	0	0	0	0	0	0	0	0	0	0
Sum	309	4	6	6	5	4	83	179	225	102	41	29
100% (n=)	2170	40	6	6	12	4	-	-	3285	-	208	-

Table 2. Analysed artefact types from Final Palaeolithic and Mesolithic sites (number of artefacts). In addition, an assessment has been made of the complete assemblages [cf. 100% (n=)].

80; Zagorska & Winiarska-Kabacińska 2012; Berg-Hansen 2017b) (see Table 2, for selection of artefacts included in the analysis). The analysis shows that the Laukskola lithic industry was oriented towards production of blades as blanks for tools, as no specialized production of flakes was identified. Blades were mainly produced on one-sided cores with two opposed platforms, demonstrating consistent use of a single production concept. The attribute analysis of the blades indicates use of direct percussion with medium hard (soft stone) or soft organic hammer: the blades display an acute interior angle, they are relatively regular, exhibiting a bulb and lip, and 25 per cent show detached bulb. There is great similarity in blade morphology and technological attributes within the Laukskola assemblage, signifying skilled and standardized production (Fig. 3; Table 3). This corresponds to the Swidry tradition, which is characterized by standardized blade production on dual-platform cores (Fiedorczuk 1995; 2006; Sulgostowska 1999; Dziewanowski 2006; Schild et al. 2011; Sobkowiak-Tabaka 2011; Grużdź et al. 2012; Galiński & Sulgostowska 2013; Grużdź 2018). The technological analysis confirms the same production methods and concepts.

In the Laukskola assemblage, a minimum of four different raw materials were identified, all of high-quality flint. Most of the assemblage is made from Cretaceous flint, of which the nearest known occurrences are in Lithuania, Poland and Belarus (Sulgostowska 2006; Baltrūnas et al. 2007; Johanson et al. 2015). Further, the visual assessment supports earlier observations which suggest that some artefacts are made from Chocolate flint (Sulgostowska 1997; 2002), indicating a link to the closest known source in central Poland. The *chaîne opératoire* analysis demonstrates that blade production, secondary core preparation, tool production and use were all carried out at the site. The primary preparation of cores, however, was to a large degree performed elsewhere, showing that prepared cores were brought to the site. A small amount of waste from secondary prepara-

Fig. 3. Selection of artefacts from Salaspils Laukskola (LNVM VI128); 1) one-sided dual-platform cores (id5223 and id6497), 2) blades, 3) microburins, 4) arrowheads, 5) flakes from core preparation, 6) end-scrapers from blades. Department of Archaeology, National History Museum of Latvia. Photo and illustration: I.M. Berg-Hansen.

tion of cores, including trimming flakes, demonstrates that blades were produced from different raw materials at the site (Fig. 3). This includes a low amount of waste in the probable Chocolate flint, showing blade production in this raw material.

The five small collections included in our study, Sēlpils, Kentes pilskalns, Ikšķiles Elkšņi, Skrīveru Lielrutuli and Mūkukalns, also come from the Daugava valley (Zagorska 1993; 1996; 1999; 2012). Since there is a general lack of preparation flakes or any significant number of blades, the attribute analysis of these assemblages only included the cores and arrowheads (Table 2). Our observations confirm the results from Laukskola: a lithic industry dominated by blade production on one-sided dual-platform cores made from high quality flint. The blade concept seems to be similar to Laukskola, and blades were used as blanks to make willow leaf points, scrapers and burins.

The technological analysis has demonstrated that the Latvian assemblages show significant similarities with the Swidry technological tradition. It thus confirms earlier suggestions of a connection to the Swidry find group based on tool morphology, and adds further arguments, as well as deepening our understanding of the character of this relationship.

Previous analysis of Swidry lithic technology has shown that the concept and method of blade production was highly standardized, and that long-continued practice and guidance was necessary to master this concept (Fiedorczuk 1995; Dziewanowski 2006; Migal 2007; Grużdź 2018). The production methods at Laukskola demonstrate a level of standardization and skill no less than what is generally observed in Swidry assemblages, showing reduced cores with few technical mistakes, few but precise examples of corrections, and a blade population with uniform characteristics. Previously, based on the assumed lack of waste from core preparation and primary blade production, it has been suggested that the tools and blades found at Laukskola were mainly produced elsewhere, and imported to the site (Zagorska 1996; 2012: 106; Zagorska & Winiarska-Kabacińska 2012). Further arguments for this were the exploitation of non-local flint, and a high frequency of lithic tools compared to waste material (Sulgostowska 1997; 2002). Our investigation demonstrates, however, that core preparation and blade production were performed at the site. Apart from the primary preparation of cores, all stages of blade production have been identified in the exploited flint types. Further, the presence of a number of microburins and burin spalls demonstrates that lithic tool production also took place here.

On this basis, we conclude that the people visiting Laukskola had fully mastered the Swidry method and concept of blade production. Based on the premise that social relations are reflected in transmission of culture-specific knowledge, and that this can be traced in lithic production methods (cf. paragraph above), this implies that they learned the craft and skill of blade-making through protracted training. Such training presupposes direct contact with a skilled person, thus implying the presence of social interaction, making the transmission and maintenance of the knowledge possible. Accordingly, the people at Laukskola were part of the Swidry lithic craft tradition, acquiring their technical knowledge through social interaction, facilitating the maintenance of this tradition.

The lithic raw materials exploited at Laukskola were mainly non-local, brought to the site from afar in the form of prepared cores. Further, there is evidence in the assemblage of cores removed from the site to be exploited elsewhere. Signifying a mobile adaption, this strategy can be seen as a way to secure the supply in areas where access to suitable lithic raw materials was unreliable or uncertain (Knell 2012; Damlien 2016: 399; Berg-Hansen 2017a: 168–73). This indicates that the people at Laukskola were either unfamiliar with the landscape and the resource situation in the area, or that they already knew that high-quality flint was hard to come by. The presence of several sites as mentioned above with similar technology in Latvia indicates repeated visits to the region. The artefacts made from Chocolate flint in the Laukskola assemblage signify some form of connection with the area of origin of this lithic raw material in Central Poland.

Raw-material distribution within the Swidry tradition is, on the one hand, generally suggested to have occurred as part of seasonal mobility, and on the other, as a result of exchange networks (Sulgostowska 1997; 2002). Both settlement sites and specialized workshops are documented, and extensive distribution of ready-made blades and tools is suggested as having occurred from the latter (Fiedorczuk 1995; Sulgostowska 2006; Schild et al. 2011: 213–23, 397). It is, thus, especially interesting that, contrary to earlier suggestions, both blades and tools were produced from non-local flint at Laukskola (Sulgostowska 1997; 2002). While some import of ready-made blades and tools to the site is still a possibility, a significant amount of production of blades took place at Laukskola. The production of blanks and tools at the site indicates that exploitation of these raw materials was part of everyday activity. Securing the raw-material supply by bringing them to the site, apparently over long distances, further signifies that the people at Laukskola were prepared for a period without the ability to reload. Whether access to lithic raw materials was ensured through long-distance transport by the people at Laukskola themselves, or through exchange networks, maintenance of contact with areas further south was imperative.

A TECHNOLOGICAL CROSSROADS – VARIATION IN PRESSURE BLADE TECHNOLOGY

In the Early Mesolithic, a new blade technology was introduced in the East Baltic. In the area from Estonia to north-east Poland the so-called Kunda Culture replaced the Swidry find complex. The origin of the Kunda Culture and its relationship to neighbouring find complexes has been debated (Indreko 1948; Zagorska 1993; Sulgostowska 1999; Koltsov & Zhilin 1999; Kozłowski 2009; Ostrauskas 2000; Johanson et al. 2013). Recent technological analysis of lithic blade production methods from one Early Mesolithic (9000–8300 calBC) and seven Mid-

Blade attribute	Salaspils Laukskola	Zvejnieki II, lower layer	Zvejnieki II, upper layer	Vendzavas	Celmi	Lapiņi	Pāvilostas Baznīckalns
Interior platform angle (degrees)							
Mean	77	86	88	85	87	83	87
Blade length (mm)							
Mean	53.0	35.4	30.6	28.9	27.4	32.3	31.6
Max	88.3	82.5	54.1	51.3	59.2	45.8	46.4
Min	21.2	18.9	16.1	9.9	16.6	23.9	21.3
Blade width (mm)							
Mean	15.7	10.7	9.4	10.4	10.3	11.8	13.1
Max	22.7	82.5	54.1	51.3	59.2	45.8	46.4
Min	5.6	18.9	16.1	9.9	16.6	23.9	21.3
Blade thickness (mm)							
Mean	5.3	3.7	3.4	3.7	3.6	4.6	4.3
Max	9.5	12	8.2	14	12.6	15.3	9.4
Min	2.6	1.4	1.3	1	1.6	1.7	2
Regularity (%)							
Irregular	21	20	14	25	2	29	4
Regular	68	39	55	44	67	43	64
Very regular	11	41	31	31	32	29	32
Sum	100% (n=207)	100% (n=51)	100% (n=106)	100% (n=134)	100% (n=60)	100% (n=28)	100% (n=28)
Blade curvature (%)							
Straight	85	77	65	76	55	71	73
Distal	2	17	19	11	38	24	18
Even	13	6	15	9	8	5	9
Sum	100% (n=165)	100% (n=35)	100% (n=101)	100% (n=88)	100% (n=53)	100% (n=21)	100% (n=22)

Table 3. Basic descriptive statistics of essential blade attributes from the Salaspils Laukskola assemblage and the Mesolithic sites. Selections comprise complete blades and blade fragments.

dle Mesolithic (8300–6000 calBC) sites in Latvia brings new perspectives to this debate (Fig. 2; Table 1) (for a broader presentation of this analysis, see Damlien et al. 2018a). The analysis includes lithic assemblage from the Early Mesolithic lower layer of the site Zvejnieki II (northern Latvia) and Middle Mesolithic assemblages from the upper layer of Zvejnieki II as well as the sites Lapiņi, Vendzavas, Celmi and Pāvilostas Baznīckalns (western Latvia) (see Table 2, for the selection of artefacts included in the analysis). Further, an evaluation of the lithic assemblages from the Sise and Priednieki sites (western Latvia) were included in the study.

The analysis showed that both imported Cretaceous flints and smaller frequencies of local flint of variable quality were exploited to make regular blade products from one-sided conical and sub-conical cores at the Early Mesolithic Zvejnieki II (lower layer) site. Blade production resulted in a gradual reduction of the core and a decrease in blade width. Most blades display features diagnostic of production by pressure and indirect percussion techniques (Pelegrin 2006; Sørensen 2013; Damlien 2015). However, a small selection of blades shows features that indicate production by direct percussion techniques (Table 3). This variation in knapping techniques is, however, related to various stages in the production process. A prominent feature of platform preparation was faceting the surface by removing series of small flakes that terminated in hinges towards the centre of the platform. The striking platform was formed and rejuvenated by detaching core tablets. Blade tools mainly include straight, regular blades with semi-abrupt

Blade attribute	Salaspils Laukskola	Zvejnieki II, lower layer	Zvejnieki II, upper layer	Vendzavas	Celmi	Lapiņi	Pāvilostas Baznīckalns
Twisting (%)							
No	52	84	78	95	86	81	89
Yes	48	16	22	6	14	19	11
Sum	100% (n=214)	100% (n=51)	100% (n=99)	100% (n=128)	100% (n=56)	100% (n=21)	100% (n=27)
Bulb morphology (%)							
No	6	8	7	6	7	10	0
Yes	85	90	93	91	93	90	100
Double	9	2	0	3	0	0	0
Sum	100% (n=211)	100% (n=48)	100% (n=81)	100% (n=132)	100% (n=54)	100% (n=21)	100% (n=27)
Lip formation (%)							
No	10	33	22	22	4	20	0
Yes	90	67	78	79	96	80	100
Sum	100% (n=210)	100% (n=48)	100% (n=82)	100% (n=130)	100% (n=54)	100% (n=20)	100% (n=27)
Bulbar scar (%)							
No	87	92	93	89	83	78	89
Yes	13	8	7	11	17	22	11
Sum	100% (n=223)	100% (n=48)	100% (n=81)	100% (n=132)	100% (n=54)	100% (n=18)	100% (n=27)
Conus formation (%)							
None	59	69	66	51	67	41	67
Ring crack on butt	0	4	1	1	0	0	0
Ventral proximal fissures	15	19	12	26	13	27	19
Detached bulb	25	8	20	22	20	32	15
Sum	100% (n=214)	100% (n=48)	100% (n=83)	100% (n=133)	100% (n=54)	100% (n=22)	100% (n=27)

Table 3 continued. Basic descriptive statistics of essential blade attributes from the Salaspils Laukskola assemblage and the Mesolithic sites. Selections comprise complete blades and blade fragments.

retouch along one lateral edge, i.e. inserts for slotted bone points, as well as knives, end-scrapers with a convex working edge and one tanged point of Pulli type. Slotted bone points with preserved inserts were found at the site.

A comparison of the material from all eight assemblages shows that the concept of blade production is to a large extent characterized by continuity throughout the Early and Middle Mesolithic of Latvia (Fig. 4; Table 3). As documented for the Early Mesolithic layer of Zvejnieki II, the blade production concept at the Middle Mesolithic sites involved production of blades from conical and sub-conical cores by means of pressure technique in combination with indirect and direct percussion techniques. However, specific technological elements, such as raw-material procurement and use, methods for platform rejuvenation and preparation of blade cores, as well as the morphology of the final blade tools, indicate chronological and spatial differences.

At the Middle Mesolithic sites raw materials differing in terms of quality and origin were exploited. At the western sites, local flint in the form of small, rounded nodules was utilized, whereas raw-material use at Zvejnieki II (upper layer) was dominated by flint of variable quality, probably procured from nearby moraine deposits, as well as quartz. Furthermore, spatial differences in the strategies for preparing the core platform were documented (Fig. 5). At Zvejnieki II the strategy for preparing the core platform consisted of both preparation of the platform surface by faceting, and trimming and abrasion of the platform edge. This displays a clear similarity with the preparation strategy observed

Fig. 4. A) cores and platform rejuvenations with faceted platforms, fragment of a Pulli point, blades and blade sections from the Early and Middle Mesolithic layers of Zvejnieki II (LNVM VI168), B) cores with unprepared platforms, blades, microburin and microliths from Middle Mesolithic sites in western Latvia, illustration show selected material from the following sites: Pāvilostas Baznīckalns (LNVM A10446), Vendzavas (LNVM VI315), Celmi (LNVM A13155), Lapiņi (2014 and 2015 excavations, unnumbered). Department of Archaeology, National History Museum of Latvia. Photo and illustration: I.M. Berg-Hansen & H. Damlien.

for the Early Mesolithic layer of the same site. At the western Latvia sites, however, platforms were generally unprepared, or in some cases preparation was restricted to the edge of the platform surface, with the detachment of small, thin flakes. The striking platforms appear primarily to have been rejuvenated by the detachment of large, thin platform preparation flakes, and there are few platform rejuvenations (core tablets) in the assemblages.

Tanged points of Pulli type are absent, and inserts in the form of blade fragments with semi-abrupt retouch along one lateral edge dominate on all the Middle Mesolithic sites. Interestingly, however, regional differences are documented. In western Latvia inserts occur in combination with formal microliths (simple lancets that are common in Maglemose and Komornica), occasionally produced by microburin technique. By contrast, microliths are absent in the upper layer of Zvejnieki II.

Based on the occurrence of tanged points in both Swidry and Kunda assemblages, it was, for long, assumed that the Swidry population migrated to the north-east and formed the so-called Post-Swiderian cultures (e.g. Grużdź 2018). Our technological analysis of the Kunda blade industry in Latvia supports, however, more recent studies (Sulgostowska 1999), demonstrating distinct differences between the Swidry and Kunda lithic technology and alteration in the routes of communication. The pressure blade technology in Latvia shows clear affiliation with the north-eastern technological tradition as documented for sites in today´s western Russia, indicating social interaction between the Eastern Baltic region and the adjacent regions to the east in the Early Mesolithic (Koltsov & Zhilin 1999; Sørensen et al. 2013; Damlien et al. 2018a).

Chronological and spatial variation have, however, been demonstrated in technological elements related to the pressure blade technology in Latvia. This variation does not just reflect a local trend, but signifies complex social relations with different directions of communication in the Eastern Baltic region during the Mesolithic (Damlien et al. 2018b). In today's western Russia, Estonia and most parts of Scandinavia the core platform was continually formed and rejuvenated by detachments of core tablets, and by systematically faceting the platform surface (Rankama & Kankaanpää 2011; Knutsson & Knutsson 2012; Sørensen et al. 2013; Damlien 2016; Damlien et al. 2018b). Furthermore, formal microliths are in general absent and blade inserts dominate, thereby displaying clear similarities with the pressure blade technology as documented for Zvejnieki II. By contrast, in western Latvia as well as in the western Baltic region and South Scandinavia, the core platforms were generally left unprepared and formal microliths were an incorporated element of the lithic tool tradition (Domanska & Wąs 2009; Grużdź & Płaza 2010; Sørensen 2012; Damlien et al. 2018a).

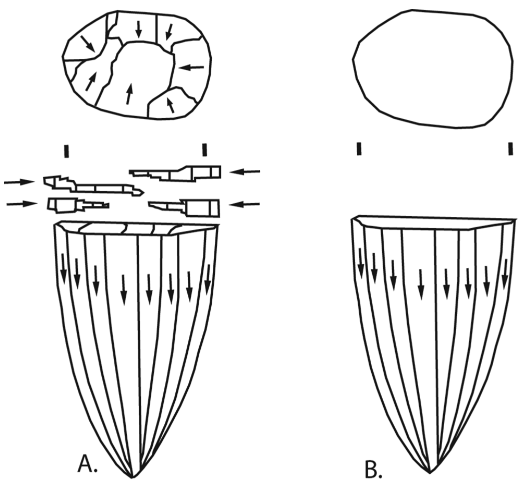

Fig. 5. Different types of core platform rejuvenation and preparation (modified after Sørensen et al. 2013: Fig. 1). A) platform preparation by systematic faceting and repeated rejuvenation; B) unprepared platforms. Illustration: H. Damlien.

Regional variation in the strategies for platform preparation has been seen as the manifestation of two different craft traditions (eastern pressure blade technology and Maglemose technocomplex 2) that co-existed in the Baltic Sea region during the Middle Mesolithic, and that overlapped in north-east Poland (Sørensen 2012; Sørensen et al. 2013; Damlien et al. 2018b). The pressure blade technology is suggested to have been transmitted between the two traditions within this shared territory and modified according to western practices, before it was transmitted westward in a new form reaching South Scandinavia in the late Middle Mesolithic (Sørensen et al. 2013).

Technological analysis from Latvia shows, however, that the strategy of leaving the platforms unprepared is an even earlier and more widely distributed phenomenon than previously thought, suggesting new explanations for its appearance (Damlien et al. 2018a). Based on knapping experiments in which blade production by pressure was applied to local flint from western Latvia, it has been suggested that a change to the use of local raw materials that required alteration of the technological concepts may explain variation in pressure blade technology (Damlien et al. 2018a). Therefore, the strategy of leaving the platforms unprepared could already have been integrated to the blade production concept when the technology spread westwards. Further technological studies are, however, needed in order to evaluate this hypothesis.

So far, we can conclude that this core platform preparation method and the presence of formal microliths of Maglemose/Komornica type at sites in western Latvia indicate more westward-oriented influences. By contrast, in eastern Latvia the eastern technological tradition appears to have been maintained even when changing to local raw materials. This indicates a shift and diversity in the direction of communication routes and social interaction in the Middle Mesolithic – thereby making the territory of present-day Latvia a technological crossroads for different craft traditions.

NEOLITHIC BIFACIAL POINTS – VARIATION IN PRODUCTION METHODS AND RAW MATERIALS

The start of the Neolithic (the Late Mesolithic in Estonia), marked by the adoption of ceramics in the Eastern Baltic region during the 6th millennium BC, seems not to have been accompanied by any significant change in lithic technology. Thus, the lithic assemblages associated with the earliest pottery – representing the Narva ceramic tradition – show that, as in the Mesolithic, blades continued to provide the blanks for projectile armatures and other tools (Zaikoski et al. 1997; Loze 2000; Kriiska 2003; Girininkas 2009).

At c 4000 calBC, Comb Ware appears in present-day Latvia: starkly differing in technology and decoration from the earlier Narva ceramics, it is seen as one expression of the broad Comb ceramic tradition that had developed in regions further to the north-east (cf. e.g. Piezonka 2015: 284–5) (Fig. 1). Comb Ware marks the start of the Middle Neolithic in Latvia, but actually constitutes one element of a 'cultural package' which also includes distinctive burial practices (Zagorska 2001) and coincides with the emergence of an extensive amber exchange network (Loze 2003). There was also a major shift in lithic technology: from this time onwards, bifaces made on flakes feature prominently in the lithic assemblages (Vankina 1970; Loze 1988; 2006; 2015; Zaikoski et al. 1997; Zagorskis 2004; Girininkas 2009). Moreover, this involved a new technique of surface treatment, namely pressure flaking.

A phenomenon of the 4th millennium BC is the development of ceramic wares, exhibiting a mix of traits from the Narva and Comb ceramic traditions, namely Piestiņa Ware in eastern and Early Sārnate Ware in western Latvia. Occurring in the west later in the Middle Neolithic is Late Sārnate Ware, which does not display Comb ceramic influence. (cf. Bērziņš 2008).

An analysis of the flaking techniques used during the Middle Neolithic contributes to our understanding of the spatio-temporal pattern of cultural traits during this period in present-day Latvia, broadening the picture obtained from ceramic studies, and offering an insight into the nature of contacts within the wider region. This study focuses on bifacial points, which constitute the largest group of bifacial artefacts made by pressure flaking. The 180 pieces studied here have been recovered from graves at two cemeteries and from nine settlement site assemblages, as well as from a number of discrete assemblages associated with separate dwellings (see Bērziņš 2008: 51–6) on the Sārnate and Ģipka-Pūrciems settlement sites (Fig. 2; Table 1).

The points can be divided into three groups based on the character and intensity of the surface treatment (Fig. 6; Table 4). Group 1 consists of points with traces of both percussion flaking and pressure flaking on the surfaces; the removals are either invasive or completely cover the surfaces (Inizan et al. 1999: 141). Group 2 has the same surface treatment as first group, but removals are only made by pressure flaking. Group 3 comprises points that display bifacial pressure flaking solely along the edges of the surfaces, with removals that are long or short in extent (Inizan et al. 1999: 141).

The production method involving percussion and pressure flaking (group 1) is more advanced than that used for the other two groups (2 and 3) (Andrefsky 2005[1998]: 12–3) and consisted of several stages, as revealed by finds of preforms (Table 4). The surface characteristics show that in the first stage the biface was thinned and a preform was obtained by percussion flaking, followed by pressure flaking to shape and complete the point.

Most of the points and preforms produced by percussion and pressure flaking were found in contexts with Comb Ware and Piestiņa Ware; just one preform from local flint has been found in an Early Sārnate Ware assemblage and two made from imported flint in Late Sārnate Ware assemblages (Table 4). On sites with Comb Ware and Piestiņa Ware, points produced by percussion and pressure flaking have been found in almost equal number to points with pressure-flaking negatives only (groups 2 and 3); on the other hand, at sites with Early and Late Sārnate Ware, points produced only by pressure flaking predominate.

Macroscopic raw-material identification was possible for 167 of the artefacts (Table 4). Three different flint raw materials were identified: Cretaceous and Carboniferous flint, which do not occur locally in natural deposits and had to be imported to the area from the south and the east, respectively (Fig. 7); and locally obtainable Silurian flint, which occurs naturally in the northern part of Latvia (Johanson et al. 2015). Pebbles of flint likewise thought to be Silurian are found on the beaches of north-western Latvia (Fig. 7).

Points made from Cretaceous flint constitute the majority (129 in total); they occur at all the analysed sites and include all surface treatment groups. Carboniferous flint was mostly used in eastern Latvia (Table 4: Piestiņa and Comb Ware sites), where the majority of points with traces of both percussion and pressure flaking are made from this flint variety. By contrast, there is just one point made from this flint type in western Latvia.

The locally available Silurian flint has been used for 18 bifacial points from three settlement sites in western Latvia, 15 of which are associated with Comb Ware. Almost the full *chaîne opératoire* of the production of these points is represented in dwellings 3 and 5 at Sārnate, and likewise at the Piedāgi site, including unprepared pebbles from Silurian flint, and flakes and biface thinning flakes obtained by percussion. The only production stage not represented at these sites is pressure flaking itself; however, the absence of pressure flakes can most probably be explained in terms of the brittleness of this flint variety, which produces relatively small flakes in the course of pressure flaking, and these could not be recovered since sieving was not practiced during excavation.

The study confirms that in present-day Latvia, as in Finland and Estonia (Jaanits 1959: 290; Manninen et al. 2003; Apel 2012), pressure-flaked bifaces appear in conjunction with Comb Ware, constituting part of the 'cultural package' associated with this ceramic tradition. This is even more apparent if we consider that in neighbouring Lithuania, to the south – outside the distribution area of Comb Ware – a microblade industry was maintained even in the Middle Neolithic (Girininkas 1990: 22–6; 2009: 146, 152).

As described above, points both with and without traces of percussion flaking were widely utilized among the users of Comb Ware, as well

Fig. 6. Different strategies of point surface treatment: point preforms (1, 2), group 1 of surface treatment (3, 4, 9), group 2 of surface treatment (5, 6) and group 3 of surface treatment (7, 8). 1, 3) Budjanka settlement (LNVM VI34:124, 88), 2, 4) Sārnate dwelling 6 (LNVM VI11422: 196, 110), 5) Zvejnieki cemetery (LNVM VI 93: 432), 6) Lejascīskas settlement (LNVM A7852: 73), 7) Piestiņa settlement (LNVM VI90: 374), 9: Kreiči settlement (VI34: 199). Department of Archaeology, National History Museum of Latvia. Photo and illustration: M. Kalniņš.

Site (Ceramic Ware)	Arrowhead preforms				Arrowheads: Extent of removals: covering or invasive – Percussion and pressure flaking				Arrowheads: Extent of removals: covering or invasive – Pressure flaking				Arrowheads: Extent of removals: long or short – Pressure flaking				Arrowheads: Indeterminate technique			Spearheads			Total
	Cr*	Ca*	Si*	U*	Cr*	Ca*	Si*	U*	Cr*	Ca*	Si*	U*	Cr*	Ca*	Si*	U*	Cr*	Ca*	U*	Cr*	Si*	U*	
Early Sārnate Ware																							
Sārnate Dwelling 2			1		1				1			1											4
Sārnate Dwelling E									1										1				2
Sārnate Dwelling M									1				1										2
Sārnate Dwelling W									2														2
Late Sārnate Ware																							
Ģipka Dwelling A					1								3							1			5
Pūrciems Dwelling C	1																						1
Pūrciems Dwelling D	1																						1
Pūrciems Dwelling E									1														1
Sārnate Dwelling G					1																		1
Sārnate Dwelling T													1										1
Sārnate Dwelling X					1																		1
Siliņupe									1														1
Comb Ware & Early/ Late Sārnate Ware																							
Lejas-cīskas					2				4				2		1								9
Slocene									2														2
Comb Ware																							
Ģipka Dwelling B					2				2				1										5
Osa	1				1				1														3
Piedāgi							2						1		2								5
Sārnate Dwelling 1																			1				1
Sārnate Dwelling 3	3		1	1	10		4	1	5		2		2		2					1			32
Sārnate Dwelling 4					1																		1

Sārnate Dwelling 5	1				4				2		1		1								1		10
Sārnate Dwelling 6 ZA					1								1										2
Sārnate Dwelling 6 DR	1				1				3			1	1	1									8
Sārnate Dwelling 8									1														1
Sārnate Dwelling 12					1							1	1										3
Sārnate Dwelling 15					1																		1
Zvejnieki 201. burial					1															1		1	3
Comb Ware & Piestiņa Ware																							
Budjanka					2	4								1				3					10
Kreiči	2	1		1	2	4		1	4	2			7	1			1			1			27
Piestiņa					2	2		1								1							6
Zvejnieki I					1				2				2							1			6
Unknown Ware																							
Kreiči 2. burial						1			1				1										3
Kreiči 20. burial													1										1
Sārnate Dwelling 9					1																		1
Sārnate Dwelling 11							1																1
Sārnate Dwelling 14													1										1
Sārnate Dwelling L									2														2
Zvejnieki 204. burial					1			1															2
Zvejnieki 207. burial	1				2				1											1			5
Zvejnieki 211. burial																				3			3
Zvejnieki 252. burial									1														1
Zvejnieki 263. burial	1																			1			2
Zvejnieki 275. burial									1														1
Total	**12**	**1**	**2**	**2**	**40**	**11**	**7**	**4**	**39**	**2**	**3**	**3**	**27**	**3**	**5**	**1**	**1**	**3**	**2**	**12**	**1**	**1**	**180**

Table 4. Distribution of points by sites according to analytical categories, arrowhead surface treatment and raw material. Sites divided into groups according ceramic types. Cr – Cretaceous flint; Ca* – Carboniferous flint; Si* – Silurian flint; U* – unknown type of flint.*

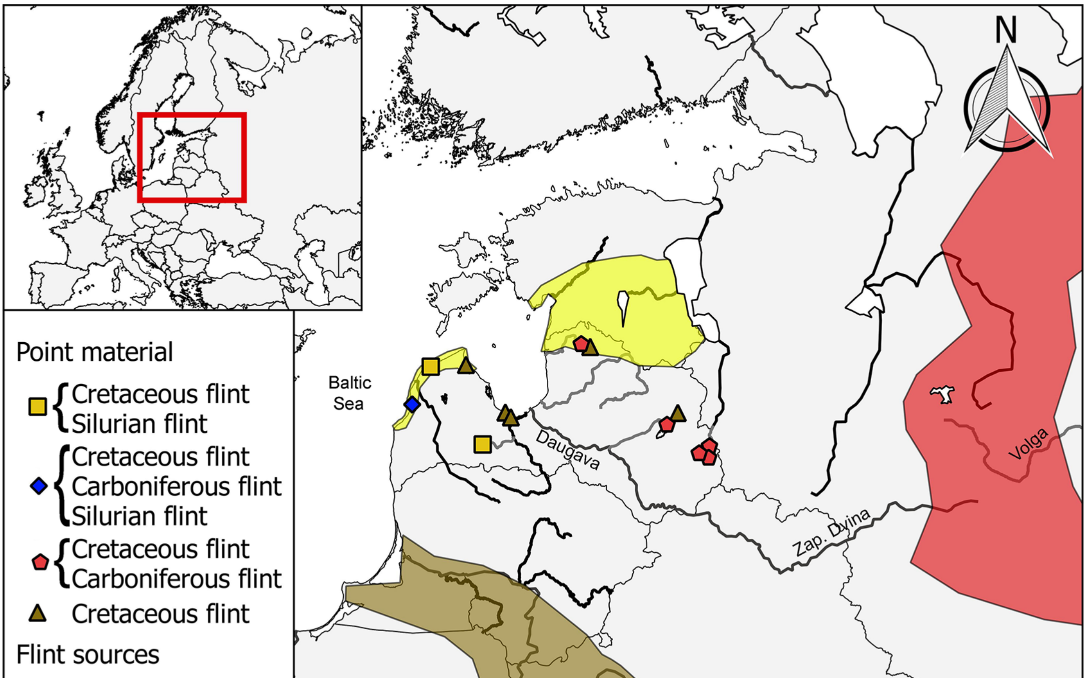

Fig. 7. Map of bifacial point material distribution on Neolithic sites and source areas of raw materials (distribution of natural deposits of flint raw material after: Baltrūnas et al. 2007; Johanson et al. 2015). Illustration: M. Kalniņš.

as Piestiņa Ware in eastern Latvia. On the other hand, the users of Early and Late Sārnate Ware, restricted to western Latvia, preferred points made by pressure flaking only. This difference in technology most likely relates to the availability of raw material and persistence of knapping traditions.

Thus, the users of Comb Ware had a very strong tradition of combined percussion and pressure flaking, as demonstrated in the production of points from Silurian flint. Most likely it was the limited access to Carboniferous and Cretaceous flint in western Latvia that stimulated them to start using local Silurian flint for biface production, but they persisted in combining percussion and pressure flaking, even though this raw material (compared with Cretaceous and Carboniferous flint) is not really appropriate for this complex production method (Andrefsky 2005[1998]: 187–93).

The lack of good-quality raw material in western Latvia seems to be one of the main reasons why the users of Early and Late Sārnate Ware preferred to produce bifacial points by pressure flaking only, as this method is simpler, reduces the risk of failure and conserves raw material (Andrefsky 2005[1998]: 12–3).

It appears the distribution of the technology involving combined percussion and pressure flaking for biface production depended on the exchange of good-quality raw material – especially Carboniferous flint, which, as shown above, was processed into bifacial points mainly by this combined method. As in present-day Estonia (Kriiska 2015), Carboniferous flint came from the northern Upper Volga area (Fig. 7), where, starting from the beginning of the Middle Neolithic, it was actively extracted and processed by the users of Comb Ceramics in particular (Zhilin 1997). The distribution of bifacial points made from Carboniferous flint – essentially restricted to Comb and Piestiņa Ware sites in eastern Latvia – suggests a situation where the inhabitants of this region, as intermediaries within the amber exchange network (Loze 2008), tended not to exchange this flint further to the west, to the coastal sites where the amber was obtained, keeping it for their own use and processing.

In this situation, continued adherence to the technological tradition of combined percussion and pressure flaking method among groups using Comb Ware in western Latvia, even when adopting a less easily workable raw material, appears to reflect the strength of social interaction with the adjacent areas where the Comb ceramic 'cultural package' dominated at this time.

CONCLUSIONS

The presented studies of lithic technology from three different periods of the Stone Age document long-term variation in social contact and communication involving transmission of technological knowledge within the Eastern Baltic.

The first case, from the Final Palaeolithic, indicates contacts and communication across large areas in the Eastern Baltic region and beyond, involving transmission of Swiderian technological knowledge as well as raw-material transport, all within the frame of a highly mobile society. In spite of a more challenging lithic raw-material situation in Latvia compared to central parts of the Swidry area to the south, there are no signs of any adaptation of the lithic technology to local conditions. Further, the lithic raw-material strategy is characterized by provisioning of flint originating from the same area, confirming southerly lines of communication. Based on this, combined with the presence of the Swidry lithic technological tradition on several sites in the Daugava valley, including the Laukskola site, we perceive this area as an integrated part of the Swidry region.

The second case demonstrates variable development in the area during the Mesolithic. Pressure blade technology is introduced in the Early Mesolithic, marking a break in the technological tradition from the Final Palaeolithic. Rather, the technology displays significant similarities with the eastern pressure blade tradition. Along with the use of imported flint, this points towards an eastern affiliation during the Early Mesolithic. In the Middle Mesolithic, this technological tradition is maintained in eastern Latvia, despite a change to local raw materials. Concurrently, changes in elements of the technology in western Latvia suggest an adaptation to the properties of the local raw materials. This demonstrates a complex relationship between maintaining tradition and adjusting the technological practice to local raw materials. Furthermore, the technological changes in this area point towards a western affiliation, indicating that the territory of present-day Latvia was a crossroads for different craft traditions.

The third case, investigating the variation in methods for production of bifacial points in the Middle Neolithic, likewise highlights the issue of technological tradition versus adjustment to local material. Although the lithic technology of the Middle Neolithic differs radically from that of the Mesolithic, similar factors appear to be at work. Thus, intensive social interaction between regions is reflected in the maintenance of a shared technology, even when changing to a material with different properties, as in the use of the combined percussion-and-pressure method for biface production in the Comb Ware milieu in western Latvia; conversely, the preference among non-Comb groups for the pressure-only method suggests their ties with the region of origin of the technology were weaker – and consequently, adaptation to the local material prevailed.

Our study demonstrates the potential for using lithic technology as a point of departure to investigate social interaction and communication in the past. Because the stone technology in the form of production waste and blanks for tools is preserved in all environments, as opposed to organic materials, it is suitable for comparative studies across large areas and in a long-term perspective. This approach also points to future possibilities for engaging other material groups in the exploration of these matters.

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REFERENCES

Unpublished sources

Berg-Hansen, I.M. 2017b. Report from technological analyses of lithic assemblages from Latvian Final Palaeolithic, with emphasis on the Salaspils Laukskola site, TechTrans project 2016–2017. Research report, University of Latvia (Rīga) and Museum of Cultural History (University of Oslo).

Sørensen, M. 2013. Dynamical technological classification of Scandinavian lithic blade industries, Nordic Blade Technology Network, March 2013. Unpublished manuscript.

Literature

Andrefsky, W.J. 2005[1998]. *Lithics – Macroscopic Approaches to Analysis*. Cambridge: Cambridge University Press.

Apel, J. 2008. Knowledge, know-how and raw material – The production of Late Neolithic flint daggers in Scandinavia. *Journal of Archaeological Method and Theory* 15 (1): 91–111.

Apel, J. 2012. Tracing pressure-flaked arrowheads in Europe. In C. Prescott & H. Glørstad (eds.) *Becoming European. The transformation of third millennium Northern and Western Europe*: 156–64. Oxford: Oxbow Books.

Baltrūnas, V., Karmaza, B., Kulbickas, D. & Ostrauskas, T. 2007. Egzotinė titnago bei titnago pakaitalų žaliava Lietuvos akmens ir žalvario amžiaus gyvenvietėse. *Lietuvos archeologija* 31: 109–22.

Berg-Hansen, I.M. 2017a. *Den Sosiale Teknologien – Teknologi og tradisjon i Nord-Europa ved slutten av istida, 10 900–8500 f.Kr.* Oslo: IAKH, University of Oslo.

Berg-Hansen, I.M. 2018. Continuity and change in Late Glacial and Postglacial social networks; Knowledge transmission and blade production methods in Ahrensburgian and Early Mesolithic North West Europe. In K. Knutsson, H. Knutsson, J. Apel & H. Glørstad (eds.) *The Technology of Early Settlement in Northern Europe – Transmission of knowledge and culture. Vol. 2*: 63–98. Sheffield: Equinox.

Berg-Hansen, I.M., Damlien, H., & Zagorska, I. forthcoming. *The northern fringe of the Swiderian technological tradition – Salaspils Laukskola revisited.* Submitted manuscript.

Bērziņš, V. 2002. Mezolīta apmetne Užavas Vendzavās. *Ventspils Muzeja Raksti* 2: 29–43.

Bērziņš, V. 2008. *Sārnate: Living by a Coastal Lake during the East Baltic Neolithic.* Acta Universitatis Ouluensis, B Humaniora, 86.

Bērziņš, V. & Doniņa, I. 2014. Izrakumi Lapiņu mezolīta apmetnē un kuršu ugunskapos 2012. gadā. *Arheologu pētījumi Latvijā 2012. un 2013. gadā*: 9–13.

Bērziņš, V. & Kalniņš, M. 2014. Arheoloģiskie izrakumi Slocenes I neolīta apmetnē 2013. gadā. *Arheologu pētījumi Latvijā 2012. un 2013. gadā*: 14–8.

Bērziņš, V. & Zagorska, I. 2010. Mezolīta apmetņu pētījumi Burtnieku ezera apkaimē. *Arheologu pētījumi Latvijā 2008. un 2009. gadā*: 12–4.

Bērziņš, V., Lübke, H., Berga, L., Ceriņa, A., Kalniņa, L., Meadows, J., Muižniece, S., Paegle, S., Rudzīte M. & Zagorska, I. 2016a. Recurrent Mesolithic–Neolithic occupation at Sise (western Latvia) and shoreline displacement in the Baltic Sea Basin. *The Holocene* 26 (8): 1319–25.

Bērziņš, V., Doniņa, I. & Kalniņš, M. 2016b. Fosfātu kartēšana un izrakumi Lapiņu mezolīta apmetnē un kuršu ugunskapos. *Arheologu pētījumi Latvijā 2014. un 2015. gadā*: 9–15.

Bronk Ramsey, C. 2009. Bayesian analysis of radiocarbon dates. *Radiocarbon* 51 (1): 337–60.

Cavalli-Sforza, L.L. 1986. Cultural Evolution. *American Zoologist* 26 (3): 845–55.

Damlien, H. 2015. Striking a Difference? The effect of knapping techniques on blade attributes. *Journal of Archaeological Science* 63: 122–35.

Damlien, H. 2016. *Between Tradition and Adaption. Long-term trajectories of lithic toolmaking in South Norway during the postglacial colonization and its aftermath (c.*

9500–7500 cal. BC). Stavanger: Museum of Archaeology, University of Stavanger.

Damlien, H., Berg-Hansen, I.M., Zagorska, I., Kalniņš, M., Nielsen, S.V., Koxvold, L.U., Bērziņš, V. & Schülke, A. 2018a. A technological crossroads. Exploring diversity in the pressure blade technology in Mesolithic Latvia. *Oxford Journal of Archaeology* 37 (3): 229–46.

Damlien, H., Kjällquist, M. & Knutsson, K. 2018b. The pioneer settlement of Scandinavia and its aftermath: New evidence from Western Scandinavia. In K. Knutsson, H. Knutsson, J. Apel & H. Glørstad (eds.) *The Technology of Early Settlement in Northern Europe – Transmission of knowledge and culture. Vol. 2*: 99–137. Sheffield: Equinox.

Darmark, K. 2012. Surface pressure flaking in Eurasia: Mapping the innovation, diffusion and evolution of a technological element in the production of projectile points. In P.M. Desrosiers (ed.) *The Emergence of Pressure blade Making: From origin to modern experimentation*: 261–84. New York: Springer.

David, É. 2006. Technical behaviours in the Mesolithic (9th–8th millennium cal. BC). The contribution of the bone industry from domestic and funerary contexts. In L. Larsson & I. Zagorska (eds.) *Back to the Origin. New research in the Mesolithic–Neolithic Zvejnieki cemetery and environment, northern Latvia*: 235–52. Acta Archaeologica Lundensia, Series in 8º, No. 52.

Dobres, M.-A. 2000. *Technology and Social Agency. Outlining a practice framework for archaeology.* Oxford: Blackwell.

Domanska, L. & Wąs, M. 2009. Dąbrowa Biskupia 71: a specialised camp from the Maglemose culture. In S. Mccartan, R. Schulting, G. Warren & P.C. Woodman (eds.) *Mesolithic Horizons: Papers presented at the seventh international conference on the Mesolithic in Europe, Belfast 2005*: 261–9. Oxford: Oxbow Books.

Dumpe, B., Bērziņš, V. & Stilborg, O. 2011. A dialogue across the Baltic on Narva and Ertebølle pottery. In S. Hartz, F. Lüth & T. Terberger (eds.) *Early Pottery in the Baltic – Dating, origin and social context. International workshop at Schleswig from 20th to 21st October 2006*: 409–41. Bericht der Römisch-Germanischen Kommission. Band 89.

Dziewanowski, M. 2006. Flint assemblage Dręstwo 37. A preliminary analysis of predetermined Swiderian debitage. In A. Wiśniewski, T. Płonka & J.M. Burdukiewicz (eds.) *The Stone: Technique and technology*: 149–66. Wrocław: Uniwersytet Wrocławski, Stowarzyszenie Krzemieniarskie SKAM.

Eriksen, B.V. 2000. 'Chaîne opératoire' – den operative proces og kunsten at tænke som en flinthugger. In B.V. Eriksen (ed.) *Flintstudier. En håndbog i systematiske analyser af flintinventarer*: 75–100. Aarhus: Aarhus universitetsforlag.

Fiedorczuk, J. 1995. Production, selection and 'export' of blanks in the Final Palaeolithic Masovian complex. A case study of the blade workshops from Rydno IV/57 in Southern Poland. *Archaeologia Polona* 33: 59–69.

Fiedorczuk, J. 2006. *Final Paleolithic Camp Organization as Seen from the Perspective of Lithic Artifacts Refitting*. Warsawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Galiński, T. & Sulgostowska, Z. 2013. Younger Dryas tanged point key sites in Western Pomerania. *Archaeologia Baltica* 13: 43–57.

Girininkas, A. 1990. Srednij i pozdnij neolit. *Lietuvos Archeologija* 7: 6–111.

Girininkas, A. 2009. *Lietuvos Archeologija* I. Vilnius: Versus aureus.

Girininkas, A., Rimkus, T., Slah, G., Daugnora, L., Stančikaitė, M. & Zabiela, G. 2016. Lyngby type artefacts of Lithuania in the context of the Stone Age in Europe: Multidisciplinary study. *Arheoloģija un etnogrāfija* 29: 13–45.

Grasis, N. 2010. A Mesolithic dwelling: Interpreting evidence from the Užavas Celmi site in Latvia. *Archaeologia Baltica* 13: 58–68.

Grużdź, W. 2018. An examination of theories on lithic reduction methods in Swiderian technology. In K. Knutsson, H. Knutsson, J. Apel & H. Glørstad (eds.) *The Technology of Early Settlement in Northern Europe – Transmission of knowledge and culture. Vol.* 2: 47–61. Sheffield: Equinox.

Grużdź, W., Pyżewicz, K., Migal, W. & Przeździecki, M. 2012. Multi-aspect analysis of flint materials from Suchodółka, Site 3, the Świętokrzyskie Voivodeship. *Światowit* IX (L), fasc. B: 245–58.

Gruźdź, W. & Płaza, D.K. 2010. Experimental study of pomeranian flint (Kugleflint) from Mesolithic excavation site in Jastrzębia Góra 4. *Materiały Zachodniopomorskie* IV/V (2007/2008): 5–19.

Guglielmino, C.R., Viganotti, C., Hewlett, B. & Cavalli-Sforza, L.L. 1995. Cultural variation in Africa: Role of mechanisms of transmission and adaptation. *Proceedings of the National Academy of Sciences* 92 (16): 7585–9.

Henrich, J. 2004. Demography and cultural evolution: How adaptive cultural processes can produce maladaptive losses – the Tasmanian case. *American Antiquity* 69: 197–214.

Hertell, E. & Tallavaara, M. 2011. Hunter-gather mobility and the organisation of core technology in the Mesolithic north-eastern Europe. In T. Rankama (ed.) *Mesolithic Interfaces: Variability in lithic technologies in Eastern Fennoscandia*: 94-111. Monographs of the Archaeological Society of Finland 1.

Indreko, R. 1948. *Die mittlere Steinzeit in Estland mit einer Übersicht über die Geologie des Kunda-Sees von K. Orviku.* Stockholm: Wahlström & Widstrand.

Inizan, M.-L., Reduron-Ballinger, M., Roche, H. & Tixier, J. 1999. *Technology and Terminology of Knapped Stone (Préhistoire de la Pierre Taillée 5)*. Nanterre: Cercle de Recherches et d'Etudes Préhistoriques.

Jaanits, L. 1959. *Poseleniya epokhi neolita i rannego metalla v priust'e r. Emajgi.* Tallin: Akademiya Nauk Estonskoy SSR.

Johanson, K., Jonuks, T., Kriiska, A. & Tõrv, M. 2013. From the first people to idols and figurines: Richard Indreko as a scientist. In K. Johanson & M. Tõrv (eds.) *Man, his Time, Artefacts, and Places. Collection of articles dedicated to Richard Indreko*: 95–175. Muinasaja teadus 19.

Johanson, K., Kriiska, A., Sikk, K., Aruväli, J., Somelar, P. & Sepp, L. 2015. Local or imported? Assessing the flint preferences of the Mesolithic habitants in Estonia and northern Latvia with the help geochemical methods. In D. Borić (ed.) *Book of Abstracts: The ninth international conference on the Mesolithic in Europe 14th–18th September 2015. Belgrade / Serbia*: 85–6. Belgrade: Institute of Archaeology.

Jordan, P. 2015. *Technology as Human Social Tradition – Cultural transmission among hunter-gatherers*. Oakland: University of California Press.

Knell, E.J. 2012. Minimum analytical nodules and Late Paleoindian cody complex lithic technological organization at Hell Gap, Wyoming. *Plains Anthropologist* 57 (224): 325–51.

Knutsson, H. & Knutsson, K. 2012. The Postglacial colonization of humans, fauna and plants in northern Sweden. *Arkeologi i Norr* 13: 1–28.

Koltsov, L.V. & Zhilin, M.G. 1999. Tanged point cultures in the Upper Volga Basin. In S.K. Kozłowski, J. Gurba & L.L. Zaliznyak (eds.) *Tanged Point Cultures in Europe. Read at the international Archaeological Symposium, Lublin, September, 13–16 1993*: 346–60. Lublin: Maria Curie-Skłodowska University Press.

Kozłowski, S.K. 2009. *Thinking Mesolithic*. Oxford: Oxbow.

Kriiska, A. 2003. Novye rezul'taty issledovaniy narvskoy kul'tury v Estonii. In A.N. Mazurkevich (ed.) *Drevnosti Podvin'ya: istoricheskiy aspekt. Po materialam kruglogo stola, posvyashchennogo pamyati A.M. Miklyaeva (6–8 oktyabrya 1999 g.)*: 84–93. Sankt-Peterburg: Gosudarstvenniy Ermitazh.

Kriiska, A. 2009. The beginning of farming in the Eastern Baltic. In P.M. Dolukhanov, G.R. Sarson & A.M. Shukurov (eds.) *The East European Plain on the Eve of Agriculture*: 159–79. BAR International Series 1964.

Kriiska, A. 2015. Foreign materials and artefacts in the 4th and 3rd millennia BCE Estonian Comb Ware complex. In P. Espak, M. Läänemets & V. Sazonov (eds.) *When Gods Spoke. Researches and reflections on religious phenomena and artefacts*. *Studia in honorem Tarmo Kulmar*: 107‒24. Tartu: Tartu Ülikooli ajaloo ja arheoloogia instituut.

Kriiska, A., Hertell, E. & Manninen, M.A. 2011. Stone Age flint technology in south-western Estonia: Results from the Pärnu Bay area. In T. Rankama (ed.) *Mesolithic Interfaces: Variability in lithic technologies in Eastern Fennoscandia*: 64–93. Monographs of the Archaeological Society of Finland 1.

Larsson, L. & Zagorska, I. (eds.) 2006. *Back to the Origin. New research in the Mesolithic–Neolithic Zvejnieki cemetery and environ-*

ment, northern Latvia. Acta Archaeologica Lundensia, Series in 8°, No. 52.
Lemonnier, P. 1992. *Elements for an Anthropology of Technology.* Michigan: Museum of Anthropology, University of Michigan.
Leroi-Gourhan, A. 1993[1964]. *Gesture and Speech.* Cambridge: Massachusetts Institute of Technology, October Book.
Lõugas, L. 2002. Analysis of animal bones from the Vendzavas (2000) excavation material. *Ventspils muzeja raksti* 2: 49–51.
Loze, I.B. 1988. *Poseleniya kamennogo veka Lubanskoy niziny. Mezolit, ranniy i sredniy neolit.* Riga: Zinatne.
Loze, I.B. 2000. The Early Neolithic at the Iča settlement site. (Lake Lubana depression). *Lietuvos Archeologija* 19: 203–20.
Loze, I. 2003. Middle Neolithic amber workshops in the Lake Lubāns depression. In C.W. Beck, I.B. Loze & J.M. Todd (eds.) *Amber in Archaeology. Proceedings of the fourth international conference on amber in archaeology. Talsi 2001*: 72–89. Riga: Institute of the History of Latvia Publishers.
Loze, I.B. 2006. *Neolīta apmetnes Ziemeļkurzemes kāpās.* Rīga: Latvijas vēstures institūta apgāds.
Loze, I.B. 2008. *Lubāna ezera mitrāja neolīta dzintars un tā apstrādes darbnīcas.* Rīga: Latvijas vēstures institūta apg.
Loze, I.B. 2015. *Lubāna mitrāja apdzīvotība akmens laikmetā: Rēzeknes novada mezolīta un neolīta apmetnes.* Rēzekne: Rēzeknes Augstskola.
Madsen, B. 1996. Late Palaeolithic cultures of South Scandinavia – Tools, traditions and technology. In L. Larsson (ed.) *The Earliest Settlement of Scandinavia and its Relationship with Neighbouring Areas*: 61–73. Acta Archaeologica Lundensia, Series in 8°, No. 24.
Manninen, M.A. & Hertell, E. 2011. Few and far between – An archive survey of Finnish blade finds. In T. Rankama (ed.) *Mesolithic Interfaces: Variability in lithic technologies in Eastern Fennoscandia*: 112–41. Monographs of the Archaeological Society of Finland 1.
Manninen, M.A., Tallavaara, M. & Hertell, E. 2003. Subneolithic bifaces and flint assemblages in Finland. Outlining the history of research and future questions. In C. Samuelsson & N. Ytterberg (eds.) *Uniting Sea. Stone Age societies in the Baltic Sea region. Proceedings from the first Uniting Sea workshop at Uppsala University, Sweden, January 26–27, 2002*: 161–79. Uppsala: Department of Archaeology and Ancient History.
Migal, W. 2007. On preferential points of the Final Paleolithic in the Central European Lowland. In M. Kobusiewicz & J. Kabaciński (eds.) *Studies in the Final Paleolithic Settlement of the Great European Plain*: 185–200. Poznan: Institute of Archaeology and Ethnology, Polish Academy of Sciences.
Mūrniece, S., Kalniņa, L., Bērziņš, V. & Grasis, N. 1999. Environmental change and prehistoric human activity in Western Kurzeme, Latvia. In U. Miller, T. Hackens, V. Lang, A. Raukas & S. Hicks (eds.) *Environment and Cultural History of the Eastern Baltic Region*: 35–70. PACT 57.
Ostrauskas, T. 2000. Mesolithic Kunda culture. A glimpse from Lithuania. In V. Lang & A. Kriiska (eds.) *De temporibus antiquissimis ad honorem Lembit Jaanits*: 51–82. Muinasaja Teadus 5.
Pelegrin, J. 1990. Prehistoric lithic technology: Some aspects of research. *Archaeological Review from Cambridge* 9 (1): 116–25.
Pelegrin, J. 2006. Long blade technology in the Old World: An experimental approach and some archaeological results. In J. Apel & K. Knutsson (eds.) *Skilled Production and Social Reproduction. Aspects of traditional stone-tool technologies. Proceeding of a symposium*: 37–68. Uppsala: SAU.
Pelegrin, J. 2012. New experimental observations for the characterization of pressure blade production techniques. In P.M. Desrosiers (ed.) *The Emergence of Pressure Blade Making: From origin to modern experimentation*: 465–500. New York: Springer.
Perdaen, Y., Crombé, P. & Sergant, J. 2008. Lithic technology and the cultural identity of Early Mesolithic groups. *Current Anthropology* 49 (2): 317–27.
Piezonka, H. 2015. *Jäger, Fischer, Töpfer. Wildbeutergruppen mit früher Keramik in Nordosteuropa im 6. und 5. Jahrtausend v. Chr.* Bonn: Habelt.
Pigeot, N., 1990. Technical and social actors. Flintknapping specialists and apprentices at

Magdalenian Etiolles. *Archaeological Review from Cambridge* 9 (1): 126–41.

Rankama, T. & Kankaanpää, J. 2011. First evidence of eastern Preboreal pioneers in arctic Finland and Norway. *Quartär* 58: 183–209.

Reimer, P.J., Bard, E., Bayliss, A., Beck, J.W., Blackwell, P.G., Bronk Ramsey, C., Grootes, P.M., Guilderson, T.P., Haflidason, H., Hajdas, I., Hatt, C., Heaton, T.J., Hoffmann, D.L., Hogg, A.G., Hughen, K.A., Kaiser, K.F., Kromer, B., Manning, S.W., Niu, M., Reimer, R.W., Richards, D.A., Scott, E.M., Southon, J.R., Staff, R.A, Turney, C.S.M. & Van Der Plicht, J. 2013. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. *Radiocarbon* 55 (4): 1869–87.

Šatavičius, E. 2016. The first Palaeolithic inhabitants and the Mesolithic in Lithuanian territory. In G. Zabiela, Z. Baubonis & E. Marcinkevičiute (eds.) *A Hundred Years of Archaeological Discoveries in Lithuania*: 8–39. Vilnius: Society of the Lithuanian Archaeology.

Schild, R. 1980. Introduction to dynamic technological analysis of chipped stone assemblages. In R. Schild (ed.) *Unconventional Archaeology: New approaches and goals in Polish archaeology*: 57–87. Wrocław: Instytut Historii Kultury Materialnej (Polska Akademia Nauk), Zakład Narodowy im. Ossolińskich.

Schild, R., Królik, H., Tomaszewski, A.J. & Ciepielewska, E. 2011. *Rydno. A Stone Age red ochre quarry and socioeconomic center.* Warsaw: Institute of Archæology and Ethnology, Polish Academy of Sciences.

Schlanger, N. (ed.) 2006. *Marcel Mauss – Techniques, technology and civilisation.* New York: Durkheim Press.

Shennan, S. 2001. Demography and cultural innovation: A model and its implications for the emergence of modern human culture. *Cambridge Archaeological Journal* 11 (1): 5–16.

Šnore, R. 1995. Budjankas un Jurizdikas apmetnes Lielā Ludzas ezera piekrastē. *Latvijas Vēstures Institūta Žurnāls* 3 (16): 9–28.

Sobkowiak-Tabaka, I. 2011. *Społeczności późnego paleolitu w dorzeczu Odry*. Poznań: Instytut Archeologii i Etnologii Polskiej Akademii Nauk Oddział w Poznaniu.

Sørensen, M. 2006a. The chaîne opératoire applied to arctic archaeology. In J. Arneborg & B. Grønnow (eds.) *Proceedings of the SILA/NABO Conference on Arctic and North Atlantic Archaeology 2004*: 31–44. Copenhagen: National Museum of Denmark.

Sørensen, M. 2006b. Rethinking the lithic blade definition: towards a dynamic understanding. In J. Apel & K. Knutsson (eds.) *Skilled Production and Social Reproduction. Aspects of traditional stone-tool technologies. Proceedings of a symposium*: 277–96. Uppsala: SAU.

Sørensen, M. 2012. The arrival and development of pressure blade technology in Southern Scandinavia. In P.M. Desrosiers (ed.) *The Emergence of Pressure Blade Making: From origin to modern experimentation*: 237–60. New York: Springer.

Sørensen, M., Rankama, T., Kankaanpää, J., Knutsson, K., Knutsson, H., Melvold, S., Eriksen, B.V. & Glørstad, H. 2013. The first eastern migrations of people and knowledge into Scandinavia: Evidence from studies of Mesolithic technology, 9th–8th millennium BC. *Norwegian Archaeological Review* 46 (1): 1–38.

Stout, D., Semaw, S., Rogers, M.J. & Cauche, D. 2010. Technological variation in the earliest Oldowan from Gona, Afar, Ethiopia. *Journal of Human Evolution* 58 (6): 474–91.

Šturms, E. 1931. Ein steinzeitlicher Wohnplatz am Zebrus-See in Kurzeme. In *Congressus secundus archaeologorum Balticorum Rigae 1930*: 411–22. Latvijas Universitātes Raksti. Filoloģijas un Filozofijas fakultātes sērija I, papildinājums No. 1.

Sulgostowska, Z. 1997. The phenomenon of chocolate flint distribution on the North European Plain during the Final Palaeolithic. In R. Schild & Z. Sulgostowska (eds.) *Man and Flint, Proceedings of the VIIth International Flint Symposium, Warsawa – Ostrowiec Swietokrzyski, September 1995*: 313–7. Warsawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Sulgostowska, Z. 1999. Final Palaeolithic Masovian Cycle and Mesolithic Kunda Culture relations. In S.K. Kozłowski, J. Gurba & L.L. Zaliznyak (eds.) *Tanged Point Cultures in Europe. Read at the international Archaeological Symposium, Lublin, September, 13–16 1993*: 85–92. Lublin: Maria Curie-Skłodowska University Press.

Sulgostowska, Z. 2002. Flint raw material economy during the Late Glacial and Postglacial in the Oder-Daugava-Prypet Basin. In L.E. Fischer & B.V. Eriksen (eds.) *Lithic Raw Material Economies in Late Glacial and Early Postglacial Europe*: 7–17. BAR International Series 1093.

Sulgostowska, Z. 2006. Final Palaeolithic societies' mobility in Poland as seen from the distribution of flints. *Archaeologia Baltica* 7: 36–42.

Tostevin, G.B. 2007. Social intimacy, artefact visibility, and acculturation models of Neanderthal–modern human interaction. In P. Mellars, K. Boyle, O. Bar-Yosef & C. Stringer (eds.) *Rethinking the Human Revolution: New behavioural and biological perspectives on the origins and dispersal of modern humans*: 341–57. Cambridge: University of Cambridge.

Vankina, L. 1970. T*orfyanikovaya stoyanka Sarnate.* Riga: Zinatne.

Vasks, A. 2006. Arheoloģiskie izrakumi pie Ventas. *Arheologu pētījumi Latvijā 2004. un 2005. gadā*: 64–75.

Weber, M.-J. 2012. *From Technology to Tradition – Re-evaluating the Hamburgian-Magdalenian relationship.* Neumünster: Wachholtz.

Zagorska, I. 1993. The Mesolithic in Latvia. *Acta Archaeologica* 63: 97–117.

Zagorska, I. 1996. Late Palaeolithic in the Daugava River Valley. In L. Larsson (ed.) *The Earliest Settlement of Scandinavia and its Relationship with Neighbouring Areas*: 263–72. Acta Archaeologica Lundensia, Series in 8°, No. 24.

Zagorska, I. 1999. The earliest settlement of Latvia. In U. Miller, T. Hackens, V. Lang, A. Raukas & S. Hicks (eds.) *Environment and Cultural History of the Eastern Baltic Region*: 131–56. *PACT* 57.

Zagorska, I. 2000. Sea mammal hunting strategy in the Eastern Baltic. *Lietuvos Archeologija* 19: 275–85.

Zagorska, I. 2001. Amber graves of Zvejnieki burial ground. In A. Butrimas *(*ed.) *Baltic Amber: Proceedings of the international interdisciplinary conference: Baltic Amber in National Sciences, Archaeology and Applied Arts. 13–18 September 2001, Vilnius, Palanga, Nida*: 109–24. Vilnius: Vilnius Academy of Fine Arts.

Zagorska, I. 2003. The 'Gold Coast' of the Gulf of Riga. In C.W. Beck, I.B. Loze & J.M. Todd (eds.) *Amber in Archaeology. Proceedings of the fourth international conference on amber in archaeology. Talsi 2001*: 106–15. Riga: Institute of the History of Latvia Publishers.

Zagorska, I. 2006. The history of research on the Zvejnieki site. In L. Larsson & I. Zagorska (eds.) *Back to the Origin. New research in the Mesolithic–Neolithic Zvejnieki cemetery and environment, northern Latvia*: 5–24. Acta Archaeologica Lundensia, Series in 8º, No. 52.

Zagorska, I. 2009. People and places in the Latvian Mesolithic: A case study from the Zvejnieki archaeological complex. In S. Mccartan, R. Schulting, G. Warren & P.C. Woodman (eds.) *Mesolithic Horizons: Papers presented at the seventh international conference on the Mesolithic in Europe, Belfast 2005*: 255–60. Oxford: Oxbow Books.

Zagorska, I. 2012. *Senie ziemeļbriežu mednieki Latvijā.* Latvia: Zinātne.

Zagorska, I. 2017. *Senā Burtnieka noslēpumi. The Secrets of Ancient Lake Burtnieks,* Rīga: Zinātne.

Zagorska, I. & Winiarska-Kabacińska, M. 2012. A first glimpse of the organisation of space in the Late Palaeolithic of Latvia. *Latvijas Vēstures Institūta Žurnāls* 3 (84): 5–19.

Zagorskis, F. 1961. Kreiču neolīta kapulauks. *Arheoloģija un etnogrāfija* 3: 3–18.

Zagorskis, F. 1963. Kreiču neolīta apmetne. *Latvijas PSR Zinātņu Akadēmijas Vēstis* 4 (189): 23–35.

Zagorskis, F. 1973. Agrais neolīts Latvijas austrumdaļā. *Latvijas PSR Zinātņu Akadēmijas Vēstis* 4 (309): 56–69.

Zagorskis, F. 2004. *Zvejnieki (Northern Latvia) Stone Age Cemetery.* BAR International Series 1292.

Zaikoski, E.M., Isaenka, U.F., Kalechyc, A G., Kapycin, V.F., Kryvaltsevich, M.M., Ksyandzou, U.P., Kudrashou V.Ya., Charnyauskii, M.M. 1997. *Arheologiya Belarusi* 1 *tom. Kamenny i bronzavy vyaki.* Minsk: Belaruskaya navuka.

Zaliznyak, L. 1999a. Tanged point cultures in the western part of Eastern Europe. In S.K. Kozłowski, J. Gurba & L.L. Zaliznyak (eds.)

Tanged Point Cultures in Europe. Read at the international Archaeological Symposium, Lublin, September, 13–16 1993: 202–18. Lublin: Maria Curie-Skłodowska University Press.

Zaliznyak, L. 1999b. Terminal Palaeolithic of Ukraine, Belarus and Lithuania (Survey of cultural differentiation). *Folia Quaternaria* 70: 333–61.

Zhilin, M.G. 1997. Flint raw material from the Upper Volga and its use in the Final Palaeolithic – Neolithic. In R. Schild & Z. Sulgostowska (eds.) *Man and Flint*: 331–3. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Ziediņa, E., 2004. Arheoloģiskā apzināšana Kurzemē un Sēlijā. *Arheologu pētījumi Latvijā 2002. un 2003. gadā*, 17–18.