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RESEARCH ARTICLE

Neolithic transverse arrowheads – a great misunderstanding

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ABSTRACT

One of the most debated subjects in archaeology is the transition between the Mesolithic and the Neolithic period. A missing piece in this debate has been the transverse arrowhead, which is a relic from the hunting and gathering society but still has its place in the new agrarian societies. What we think we know about transverse arrowheads from Southern Scandinavia is based on a more than 75 years old theory, which hypothesises that Neolithic arrowheads were manufactured from irregular or polished flakes. This article offers a critical review of research so far into transverse arrowheads in Southern Scandinavia. It does so by proposing a new typo-chronology of Neolithic arrowheads from this region, which demonstrates how the transverse arrowhead developed from the Late Mesolithic to the Middle Neolithic, and it is actually the first study with the main focus on this subject. The study is concluded with a discussion that argues the empirical basis for the typological restructuring and highlights the implications of the study for the broader debate on Neolithisation.

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Transverse arrowheads; neolithisation; flint; neolithic; transition; typo-chronology; creolisation

1. Introduction

The transition from hunter-gatherer to agricultural societies is one of the most debated topics in archeology (e.g. L. Sørensen 2014, p. 1), but for long the transverse arrowhead have been left out of the discussion. In Southern Scandinavia, we have been satisfied with the claim that Neolithic transverse arrowheads were manufactured from flakes instead of blades, as they were in the Mesolithic (e.g. Ebbesen 2011, 99ff). This aspect is basically the only thing that concerns us when we are dealing with a Neolithic arrowhead material, but why is that? I have two suggestions: Firstly, with the introduction of agriculture, archaeological interest in hunting-gathering traditions diminishes significantly due to the introduction of new technologies and the fundamental changes taking place in society. Secondly, with the introduction of especially new ceramic styles and polished flint, find groups that we are already familiar with are quickly overshadowed. One sees a similar tendency when we reach the Bronze Age, where the role played by flint is almost completely ignored, despite the fact that it still must have played an important role in the everyday economy due to the easy access of it compared to bronze (Högberg 2009). This article is an attempt to begin rectifying this neglect of certain find categories by offering new perspectives on the transverse arrowheads from the Late Mesolithic to the Middle Neolithic (4500–2800 BC).

The aim is to construct a useful and reliable dating tool in the form of a typo-chronology for the transverse arrowheads from the aforementioned time horizon to use them to tentatively date Neolithic contexts. The objective is to define some primary and secondary types for the transition to the Neolithic and for the Early and Middle Neolithic. In doing so, the following issues will be addressed:

- Is it possible to create a typo-chronology for the Neolithic transverse arrowheads? And on the basis of which criteria can such a typo-chronology be designed?
- Can the development of transverse arrowheads contribute to the Neolitisation debate in regard to processes of migration, exchange and adaptation?

By elucidating the above questions, the article strives to bring into the limelight an overlooked issue in the Neolitisation debate. At the same time, it will be an important dating tool for archaeologists working in the relevant periods.

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1.1. Research history

Overviews of types and chronologies have always been popular in archeology (Eriksen 2009a, 7ff). As for arrowheads, the most acknowledged typo-chronology for the Southern Scandinavian material is the one proposed by Peter Vang Petersen (1979, 2008b)). His typology focuses on the Mesolithic arrowheads and provides a fine chronological division of types from the beginning of the Kongemose culture (6400 BC) until the end of the Ertebølle culture (4000 BC). However, when it comes to the Neolithic transverse arrowheads, Vang Petersen's analysis becomes a bit vague (Petersen 2008b, 90).

Petersen identified five distinct Neolithic transverse arrowheads, but did not provide any indications of chronology. Petersen's types are defined as: 1) With convex sides; 2) With biconvex broadsides; 3) Extremely large; 4) From polished flakes; and 5) with polished sides. In general, he describes them as often manufactured from small flakes (type 1) and many from biconvex flakes (type 2) or flakes from polished flint axes (type 4). According to Petersen the retouche is often shaped from the dorsal surface and the polished arrows are rare (Type 5).

Petersen, however, is not the first to have attempted to construct a Neolithic typology of the transverse arrowheads. Carl Johan Becker reviewed Neolithic transverse arrowheads 40 years before Petersen's thesis (Becker 1940, 253ff). This study was most of all a comparison with the arrowheads from the Ertebølle culture, and two of Becker's Ertebølle types dominate the Neolithic material: 1) straight edge with concave sides & 2) Straight edge and convex sides. In addition, he described minor nuances, for example that the Neolithic arrowheads often are manufactured from flakes of polished axes. Furthermore, the biconvex flakes are used, and the Neolithic transverse arrowheads are larger and less elegant than the Mesolithic ones (Becker 1940, 253ff). Unlike Petersen, Becker does not distinguish the types from which type of blank the arrowhead is manufactured, be it a polished, a biconvex or a normal flake. Anders Jæger has also discussed a typology before Petersen's typology (Jæger 1976, 2ff), he suggested that the main difference from the Mesolithic to the Neolithic is that the Neolithic arrowheads often are manufactured from polished or unpolished flakes. However, later in the article he states that there is a domination of blade produced arrowheads compared to flakes, and that the polished flakes only are represented by 2% in the finds from Tornhøj II. Jæger also thinks that the Mesolithic arrowheads are more elegant because of their concave sides, while the Neolithic ones have straight or convex sides. He concludes that in the Neolithic, the transverse arrowhead is already fully developed and therefore does not change significantly over time. Jæger's arrowhead typology is designed with a focus on the arrowheads neck.

On the contrary, Klaus Ebbesen believes that neither Becker's nor Jæger's typologies are applicable, since Neolithic transverse arrowheads morphologically are very uniform (Ebbesen 2011, 99ff). Instead, he believes that a typology must be constructed on the basis of the different type of retouche. Ebbesen claims that Neolithic tranverse arrowheads are always manufactured from flakes, making them easy to distinguish from Mesolithic ones. Ebbesen states that there are no chronological, geographical or functional differences between the arrowheads, with the exception of the polished ones. According to Ebbesen, the Early Neolithic arrowheads are larger than the later ones (Ebbesen 2011, 435ff). He furthermore suggests that all the Neolithic transverse arrowheads have straight edges, the sides are either straight or slightly convex, there are only a few oversized ones, and they generally have a triangular or trapezoidal outline.

To sum up, there has been suggested six different types earlier, of which two are based on their flint blank, and one by size only. It has also been suggested that a typology should be based on the retouche or the neck of the arrowhead. There has generally been a consensus that most to all of the arrowheads were manufactured from flakes and polished flakes. Yet this too has been met with evidence that points in other directions. Finally, none of all these remarks have any chronological structure.

2. Methodology

I have reviewed and analysed 391 transverse arrowheads, from sites on Zealand and Lolland (Figure 1) with secure contexts dating to the Ålekistebro phase (4500–4000 BC), Early Neolithic Ia (ENIa: 4000–3800

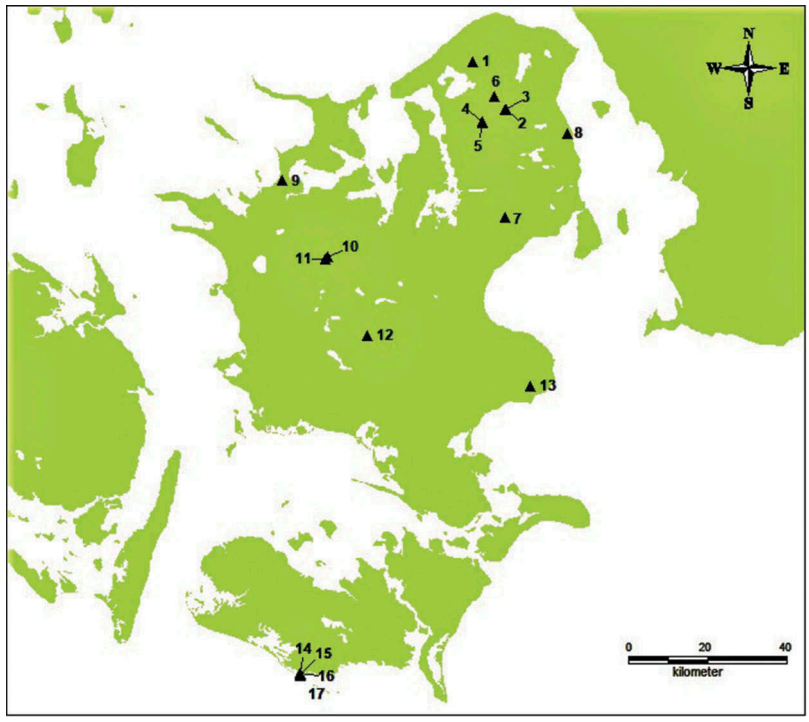

Figure 1. Map of Zealand and Lolland-Falster with the different sites. 1) Bryggergården IV, 2) Salpetermosen Syd 11, 3) Salpetermosen Syd 1, 4) Orebjerg Enge, 5) Orebjerg Agre, 6) Ullerødgård, 7) Helgeshøj, 8) Maglemosegård, 9) Dragsholm, 10) Præstelyngen, 11) Muldbjerg I, 12) Sigersted III, 13) Havnelev, 14) Sylthom II, 15) Sylthom XIV, 16) Sylthom XIII, 17) Sylthom IX. (Bredsdorffs map from Settlement and Landscape).

BC), Early Neolithic Ib (ENIb: 3800–3500 BC), Early Neolithic II (ENII: 3500–3300 BC), Middle Neolithic I (MNI: 3300–3100 BC) and Middle Neolithic V (MNV: 2900–2800 BC). Vang Petersen's flint typo-chronology (Petersen 1979, 2008b) of the Mesolithic arrowheads constitutes the basis for many observations and decisions made in this process.

The material came from the National Museum, Museum Nordsjælland, Kroppedal Museum and Museum Lolland-Falster. The material from Zealand includes 010106–59 Bryggergården IV, 010301–55 Salpetermosen Syd 11, 010301–163, Salpetermosen Syd 1, 010304–66 Orebjerg Enge, 010304–67 Orebjerg Agre, 010508–21 Ullerødgård, 020310–153 Maglemosegård, 030403–503 Dragsholm, 040112–229 Muldbjerg I, 040214–34 Sigersted III and 050602-14a Havnelev. The Mesolithic side of the transition is represented by secondary material from 030318–454 Præstelyngen. The aforementioned cover every phase from the Ålekistebro phase to the MNI. Primary material from the site 020211–71 Helgeshøj was subsequently included in my statistics and covers MNV. Unfortunately, the intermediate phases in the MN still need to be investigated due to lack of material included in this study. Primary material from Lolland has subsequently been added to the study for a regional comparison. The sites consist of 070314–58 Sylthom II, 070314–77 Sylthom XIV, 070314–80 Sylthom XIII and 070314–91 Sylthom IX.

Since this work is a geographic case study, there are of course limitations in what material that could be involved and as the number of arrowheads included in the analysis precludes this study from broader statistical validity, it is possible that complimentary studies in the future may cause the implications of this analysis to be modified.

It has previously been proposed to operate with two different regional chronological systems, respectively, east and west of Store Bælt (SH. Andersen 1979, 91ff). By focusing on Zealand, it is likely that there will be no major regional differences; furthermore, this study can be used in comparison and addition to Vang Petersen's arrowhead typo-chronology.

The period from the Late Mesolithic to the Middle Neolithic has been chosen for illuminating an unexamined perspective in the Neolithisation

debate. Furthermore, this will complement the Petersen's typo-chronology and will be the first major attempt to create a typo-chronology of transverse arrowheads in the Neolithic.

The definition of a transverse arrowhead that will be used in this work is that the piece can be manufactured from either a flint blade or flake. The piece has a sharp edge, instead of a point. The edge is formed when the piece is knapped off of the core. The neck may be shaped similarly or by the retouche. Both of the piece's sides must be shaped by retouche, otherwise the piece is considered unfinished.

The result of the first review was to maintain some of Vang Petersen's definitions (Petersen 1979, 2008b), while other definitions had to be altered partly because of the diversity of the materials, but also simply because a better definition had been reached (Figure 2). I have added an aspect to the calculation of whether a transverse arrowhead is broad- or narrow-edged: I have defined an edge as being broad when the relative edge-width (the average of the long diagonal divided by the edge-width and the median divided by the edge-width) is less than 1.75 or if the edge-width is at least 1.75 times larger than the mid-width. Since it only affects about 10% of the total material, and since these would all be classified as broad-edged based on a quick subjective review rather than a metric analysis, it justifies the change of the definition. Another important definition that required a reassessment was the calculation of the arrowhead's size; here I use the formula edge-width multiplied by the median (figs. 3 & 4).

2.1. Theoretical and methodological considerations

As in Vang Petersen's arrowhead typology (Petersen 1979, 2008b), it has been important for this work that the types and their characteristics can be defined based on objective measurements. However, it is also important that the objective measurements are essentially consistent with subjective classifications, since there are rarely resources for a larger metrical review of a whole material at the museums after completion of excavation. Most often, it will be a subjective assessment of a material that will classify the types, so it is important that the objectivity match the visual appearance.

Being exclusively subjective to a material is problematic, as it lacks consistency. Objectivity, on the other hand, will overlook some types and include others that should not be included, but if the definitions are well-considered and constructed while

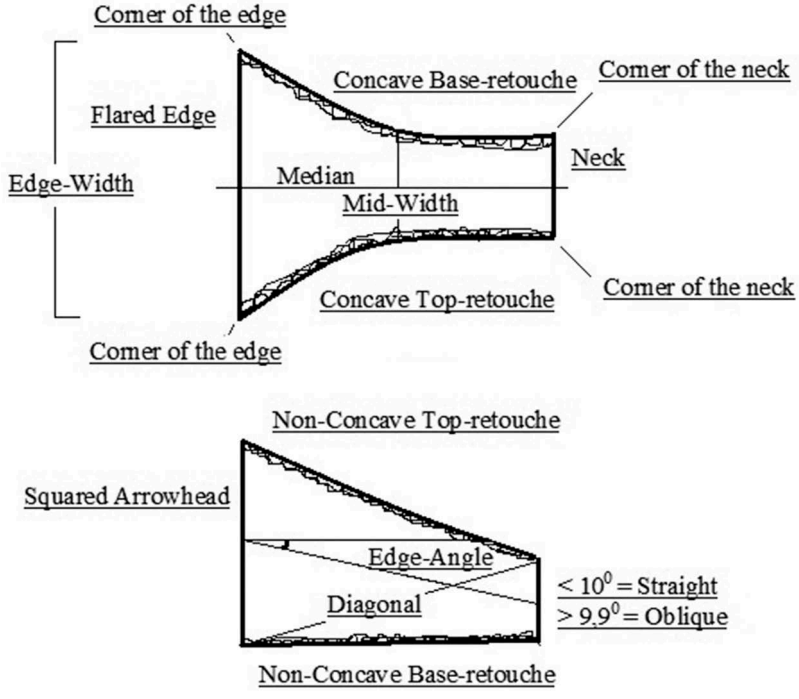

Figure 2. The definitions of the transverse arrowhead.

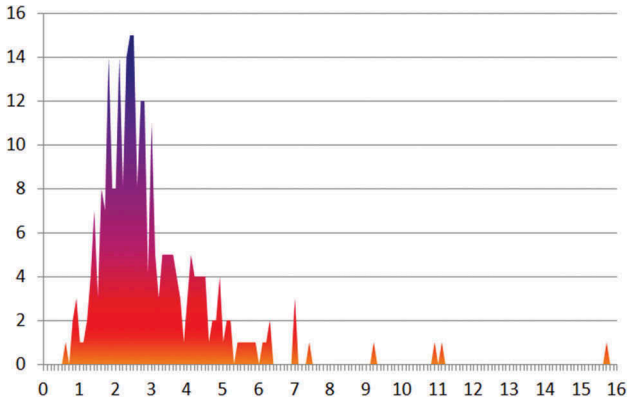

Figure 3. Graph showing the frequencies of the sizes of the arrowheads from Zealand. The sizes vary from 0.6 to 15.75 with 0.1 between each interval.

incorporating the relevant material, the overall picture of a well-represented material will still be clear (Albert 1985, 93ff; Weber 2009, 142ff; Van Gijn 2010, 35ff).

Another important consideration is how one defines whether an arrowhead is manufactured from a blade or a flake. It can be extremely difficult to assess as we are left with a relatively small product compared to the preform (Eriksen 2009b, 2009c). In addition, we see a tendency for Neolithic blades to become shorter and broader over time, making it even more difficult to assess the preform of the arrowhead (Stafford 1999, 102ff). Arrowheads, which appear to be made from a blade, can actually originate from a symmetrical but randomly knapped flake. The same applies to arrowheads that seem to be manufactured from flakes, these can also originate from a coarser and more irregular blade production. By constructing a definition for an arrowhead manufactured from a blade, for example parallel sides and longitudinal dorsal lines, it will result in many irregular blades being classified as flakes, while many flakes will be classified as blades.

Mikkel Sørensen abstains from a metric definition of a blade and instead chooses a dynamic technological definition. He states: 'A blade is a serially produced removal made with the intention of being a tool or a preform for a tool. Blades in the same industry are produced by the same technique, method and mental representations and are characterized by a similar morphology and the same set of diagnostic attributes' (M. Sørensen 2006, 289). In addition, a flake is defined as 'Waste removals (i.e. serially produced removals which are knapped off to shape cores and blanks)' or 'Removals which are not serially produced' (M. Sørensen 2006, p. 290). With these definitions, the debate becomes even more complicated. As soon as flakes are deliberately produced to be included in arrowhead production, they are no longer a waste product and should therefore be characterized as being more than just a flake. Therefore, I have settled with a subjective assessment of the preform's regularity, which is based on objective metrics, including longitudinal dorsal lines, approximate parallelism between the dorsal lines and edge, and the absence of transverse dorsal lines. However, even with such a categorisation,

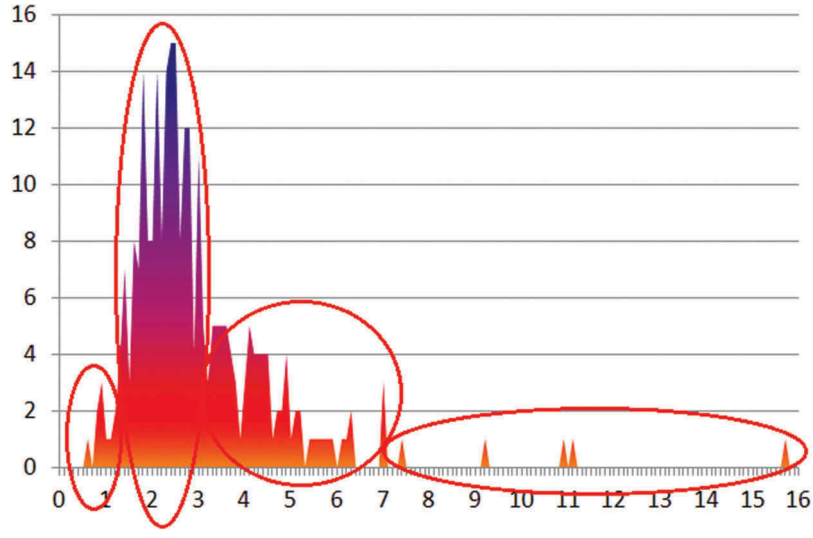

Figure 4. Interpretations of the different size groups. Small arrowheads range between 0.6 and 1.19, normal arrowheads range between 1.2 and 3.0, large arrowheads range between 3.01 and 7.09 and extremely large arrowheads range between 7.1 and 15.75.

there will still be actual blade-preforms that fall outside the category while flake-preforms fall within the category, but it is useful to provide a general overview of the material.

3. The data

To form a foundation of my typology before adding and comparing arrowheads from other parts of Southern Scandinavia, I first analysed the 296 arrowheads from Zealand, which range chronologically from the Ålekistebro phase to MNV. It was necessary to present the greatest possible nuance of the material to assess if there were chronological differences on minor details. Therefore, 15 types based on morphology with each up to three subtypes were defined (Figure 5).

Only by analyzing the arrowheads and their context's datings (Figure 6), could I assess the chronological diversification of the various types. It was clear that many of the types should be merged into fewer types, as their small different details were not of

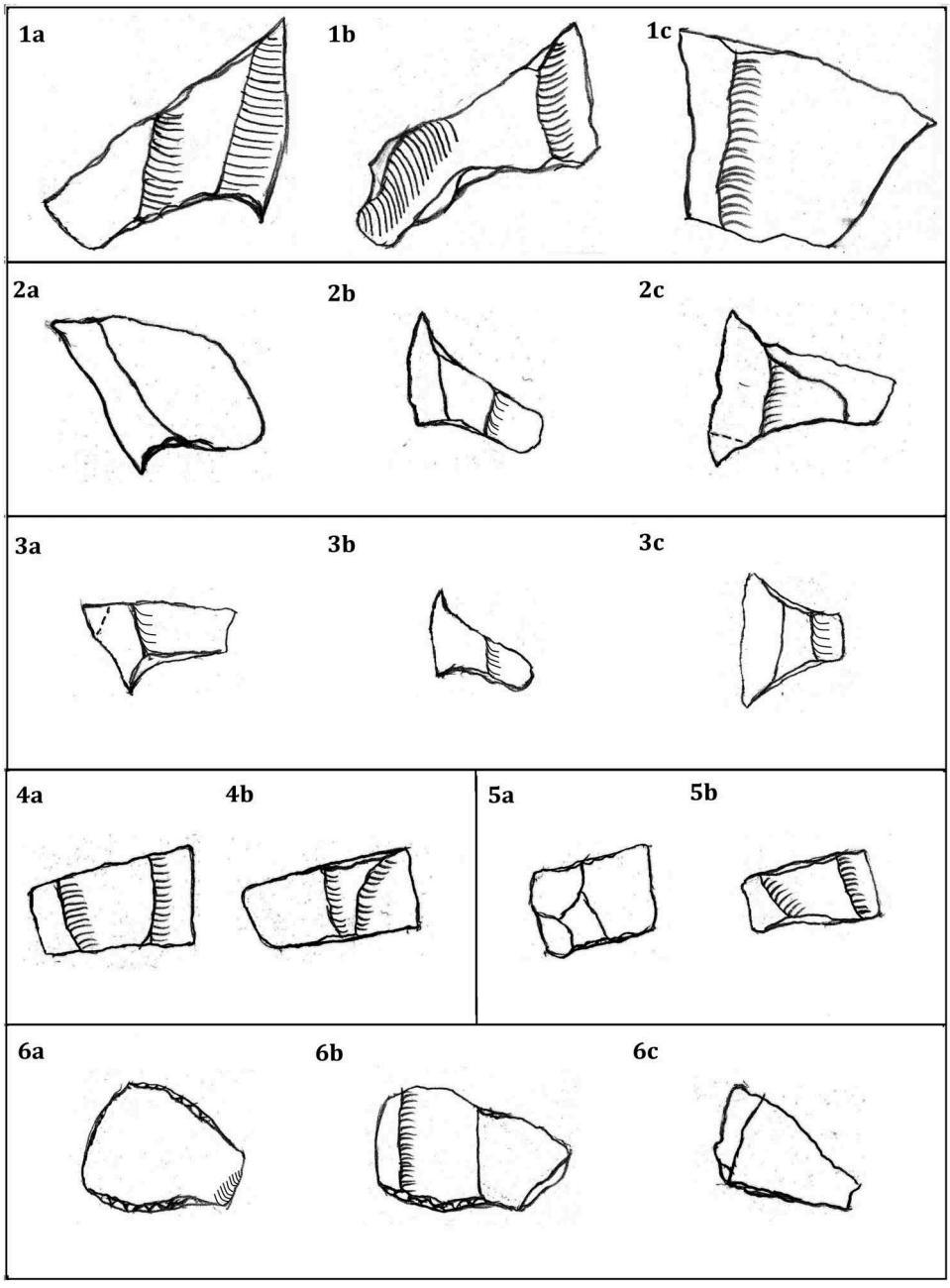

Figure 5. Morpho-typology of neolithic transverse arrowheads. Type 1a – 15a, 1:1. For descriptions see appendix A. (Illustrator: Michelle Zadstrov Pedersen).

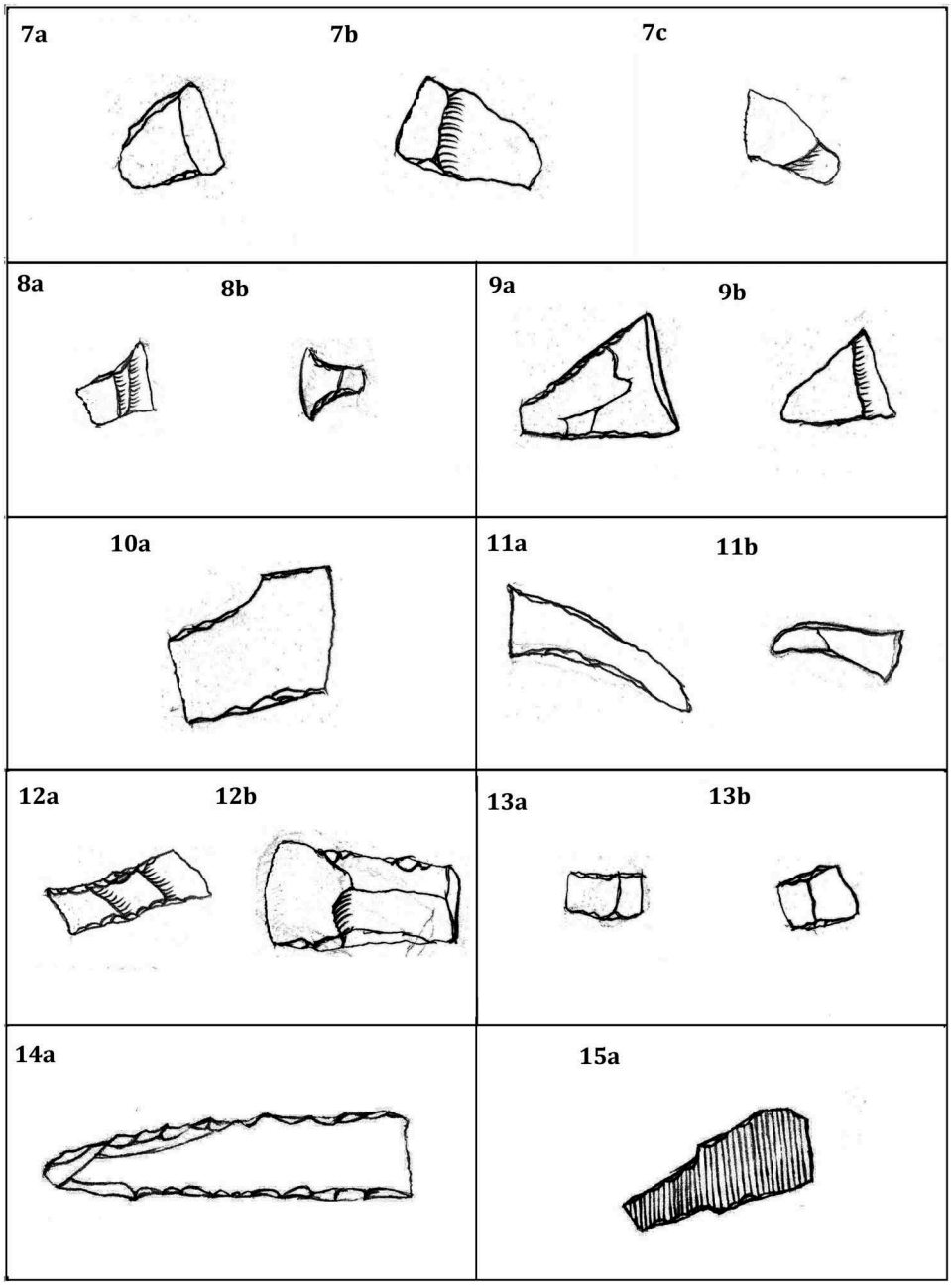

Figure 5. Continued.

chronological significance. The many types and subtypes also show a more inaccurate overview than what fewer types would, since one type might have been split into several types, which makes the type look less dominant than it actually is. In addition, an update of the types will provide a clearer overview of the typology.

Figure 7 clearly shows how certain subtypes blur the reality. For example, it appears that there is no clear dominance of a particular type in MNI, where Type 2b constitutes 25% and Type 2a constitutes less than 20%. These two types, however, differ very little morphologically, and as the figure shows, there is no chronological difference between them. As both are oblique arrowheads with wide and flared edges (Figure 8) they should be merged into one type.

4. Typo-chronology of neolithic transverse arrowheads

After a thorough review of the material, type-by-type, to figure out which subdivisions would prove

Site & Amount	Context & Dating	Blades Flakes Biconvex Polished	Broad	Straight	Flared Squared Convex	Triangular Curved Pentagonal Other	Small Normal Large Ekstreme	Dom. Type
Bryggergården IV – 11 pcs.	Floor layer from A73 (**MNI**) (Wadskjær typology)	- 100 % - -	90 %	0 %	91 % 9 % -	- - - -	- 9 % 64 % 27 %	2b -37 %
Salpetermosen Syd 11 -35 pcs.	Cultural layer A99 **ENI**(/ENII) (CeramiC)	65 % 35 % - -	88 %	70 %	86 % 5 % 3 %	- - - 5 %	3 % 82 % 15 % -	3c – 57 %
Salpetermosen Syd 1 –7 pcs.	Cultural layer A1 **ENII** (Ceramic)	14 % 71 % 14 % -	71 %	100 %	28 % 28 % 14 %	14 % 14 % - -	- 70 % 30 % -	3c – 29 %
Orebjerg Enge -41 pcs	Cultural layer A2 **ENII** (/MNI) (Ceramic)	20 % 70 % 10 %	73 %	92 %	12 % 51 % 30 %	- - 2,5 % -	- 30 % 65 % 5 %	4a – 37 %
Orebjerg Agre -5 pcs.	Cultural layer A20 **MNIb** (Ceramic)	- 80 % - 20 %	60 %	80 %	20 % - 40 %	- 20 % - -	- 40 % 60 % -	20 % hver
Ullerødgård -7 pcs.	Cultural layer A95, A901 & pit A689 **ENIb** (C14)	- 86 % 14 % -	72 %	85 %	57 % 14 % -	14 % 14 % - -	- 100 % - -	3c -43 %
Helgeshøj – 10 pcs.	Cultural layer A34 **MNV** (C14)	- 60 % 30 % 10 %	60 %	80 %	- 60 % -	10 % 10 % - 20 %	- 10 % 80 % 10 %	6a – 60 %
Maglemosegård -17 pcs.	Cultural layer **ENIa** (ENIb) (C14)	53 % 47 % - -	76 %	82 %	76 % 18 % -	- 6 % - -	6 % 82 % 12 % -	3c – 47 %
Dragsholm –9 pcs.	Grave **ENIb** (C14)	67 % 33 % - -	100 %	90 %	100 % - -	- - - -	- 67 % 33 % -	3c – 56 %
Præstelyngen – 40 pcs.	Cultural layer **Ålekistebro-phase** (C14)	90 % 7 % 3 % -	25 %	90 %	19 % 81 % -	- - - -	4 % 81 % 15 % -	5b – 81 %
Muldbjerg I – 43 pcs.	Cultural layer **ENIa** (C14)	60 % 33 % 7 % -	72 %	90 %	53 % 25 % 12 %	3 % 7 % - -	9 % 70 % 21 % -	3c – 34 %
Sigersted III – 5 pcs.	Pit A **ENIa** (C14)	20 % 40 % 40 % -	100 %	100 %	100 % - -	- - - -	- 20 % 80 % -	2c – 80 %
Havnelev – 66 pcs.	Cultural layer A31820 & A37008 **ENIb** (C14)	9 % 88 % 3 % -	77 %	80 %	71 % 10 % 6 %	- 12 % - -	- 55 % 45 % -	2c – 32 %

Figure 6. Table of the data (K. Andersen 1983, Andreasen 2002, Christensen 1964, Gron *et al*. 2016, Jepsen 2006, 2007, Juel and Kjær 2015, Jønsson 2015, Jørgensen 2015, Mathiassen 1941, Nielsen 1974, 1977, 1985, 1994, 1999, Nielsen and Nielsen 2018, Noe-Nygaard *et al*. 2005**, EB**. Petersen 1974, **2008a**, 2015**, EB**. Petersen and Egeberg 2009, Price *et al*. 2007, 2010, Rosenberg 2006, 2007, 2008, Troels-Smith 1954, 1957, 1960a, 1960b, Wadskjær 2018, Aarsleff 2013a, **2013b**, **2017**).

redundant, I can present the final typology (Figure 9).

The result of this reassessment is a much clearer overview of the types and not least on the most dominant types (Figure 10). Now, one type stands out as the most dominant type for each phase: ENI is dominated by type III; ENIa by type III-b; and in ENIb there is an almost equal representation of type III-a and type III-b. ENII is dominated by type IV-a, while V-a also is well represented. MNI is dominated by type II-a. MNV is dominated by type IV-a, as in ENII.

A single Neolithic transverse arrowhead cannot date a given context, however, there are several clear features that can be distinguished in the different phases from the Ålekistebro phase to MNI and MNV, as well as more

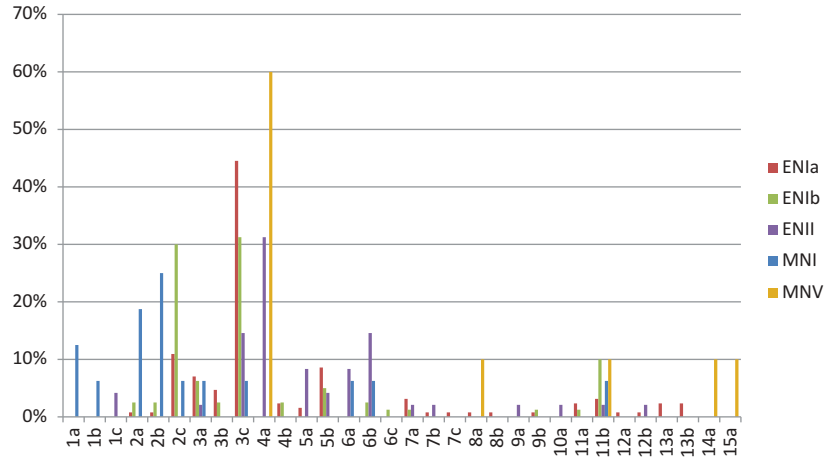

Figure 7. Diagram of the representation of each subtype through time.

Type 1	Type 2	Type 3	Chronological similarly	Morphological difference	Remarks	Result
1a	1b	1c	1a+1b	Broad/narrow	1a+1b can't be defined together without including 1c	1a→I-a 1b→I-b 1c→I-c
14a	1b	-	-	Oblique/straight	Chronological separated	14a→I-d
2a	2b	-	2a+2b	Top-retouche	2a+2b+3a+3b are chronologically and morphologically more similar than 2c+3c	2a+2b→II-a
3[a]	3b	-	3a+3b			3a+3b→II-b
2c	3c	-	-	Size		2c→III-a 3c→III-b
4a	5a	-	4a+5a	Size	4a+5a differ from 4b+5b by broad edge and dating	4a+5a→IV-a
4b	5b	-	4b+5b			4b+5b→IV-b
6a	6b	6c	6a+6b+6c	Broad/narrow Straight/oblique	Type 6 +7 are separated by size difference	6→ V-a
7a	7b	7c	7a+7b+7c			7→V-b
8a	8b	13b	8a+8b+13b	Concavity Straight/oblique	8a+8b differ from type 3+2 by size; because of chronological difference they are separated	8+13b→VI-a
13a	VI-a	-	13a+VI-a	Broad/narrow		13a→VI-b
11a	11b	-	-	Size	Too few for own type	11→VII
9a	9b	-	-	Size	Too few for own type	9→VIII
15a	-	-	-	-	Only type with shaft-retouche	15a→IX
10a	-	-	-	-	Other transverse arrowheads	10a→X-a
12a	-	-	-	-		12a→X-b
12b	IV-b	-	12b+IV-b	Thickness	Only difference is thickness	12b→IV-b

Figure 8. Table of the typology's update.

general features that gradually change over time (Wadskjær 2018).

4.1. A transverse arrowhead material can be dated to the ålekistbro phase if...

- It is certain that it is a context from around the Neolithisation and the vast majority of the transverse arrowheads are manufactured from regular blades (more than 80%).
- The narrow-edged transverse arrowhead dominates the material (more than 70%).
- The most dominant subtype is the narrow-edged squared straight transverse arrowhead (type IV-b), better known as the Ålekistebro-type (more than 70%).

There may be arrowheads manufactured from biconvex flakes, while arrowheads manufactured from polished flakes should not be found during this period. In addition, there should be a number of small transverse arrowheads represented in the material, but with a clear dominance of the arrowheads of normal size. Large transverse arrowheads can also be expected to be found in an Ålekistebro

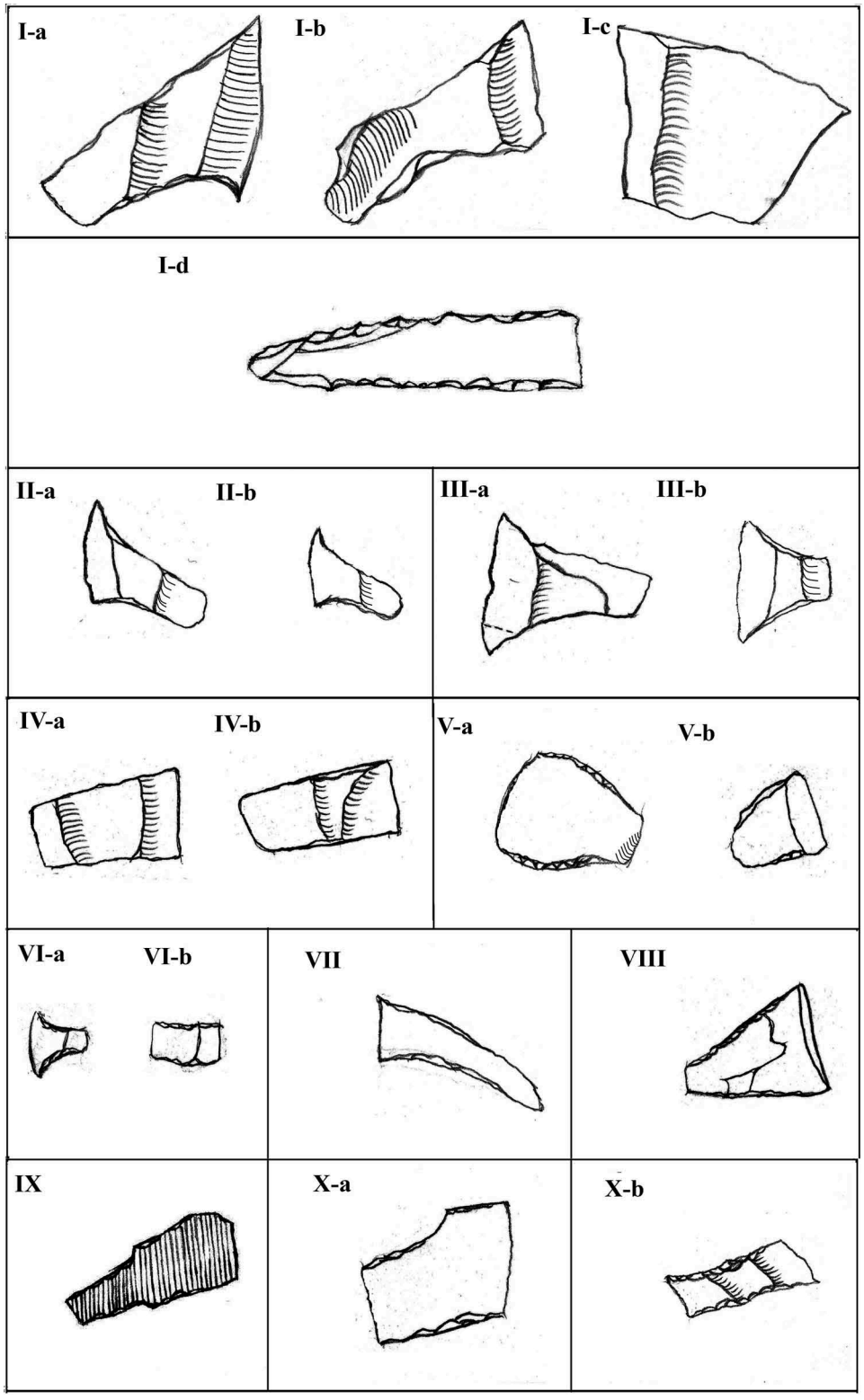

Figure 9. Updated morpho-typology of neolithic transverse arrowheads. Type I-a – X, 1:1. For descriptions see appendix B. (Illustrator: Michelle Zadstrov Pedersen).

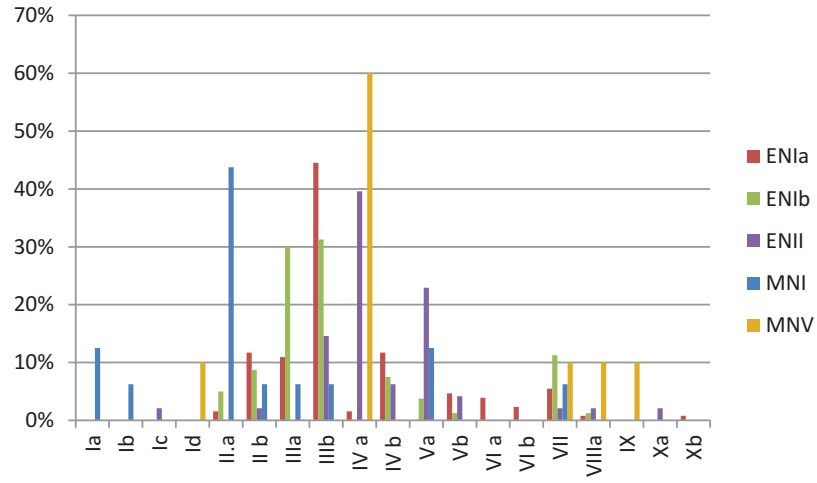

Figure 10. Revised diagram of the representation of each subtype through time.

material, while no extremely large arrowheads should be represented. The average edge-width should be below 1.1 cm, the average median should be below 1.89 cm, while the average size should be below 1.81. Finally, transverse arrowheads with wide and flared edges (type III), better known as the Stationsvej type, are also represented in this phase.

4.2. A transverse arrowhead material can be dated to enia if...

- Transverse arrowheads manufactured from regular blades make up about half of the material (about 40–65%).
- It is certain that it is a Neolithic context, and the material contains at least one small transverse arrowhead (type VI).
- It is certain that it is a Neolithic context, and transverse arrowheads with wide and flared edges are dominant (more than 50%), of which the straight one (Type III-B), better known as the Stationsvej type, alone must be the most dominant subtype (more than 30%).

Like the Ålekistebro phase, there may be arrowheads manufactured from biconvex flakes, while arrowheads manufactured from polished flakes should not be found in this period. In addition, there should be a number of small transverse arrowheads represented in the material, but with a clear dominance of the arrowheads of normal size. Large transverse arrowheads can also be expected to be found in an ENIa material, while no extremely large arrowheads should be represented. The average edge-width should be between 1.1 and 1.27 cm, the average median should be between 1.7 and 2 cm, while the average size should be between 2.1 and 2.5. Furthermore, the squared transverse arrowhead is still second best represented and accounts for about 16%. In addition, there are other types, which are not particularly well-represented.

4.3. A transverse arrowhead material can be dated to enib if...

- Transverse arrowheads of normal sizes are dominating the material (more than 50%) and at the same time no small or extremely large arrowheads are represented.
- It is certain that it is a Neolithic context and transverse arrowheads with wide and flared edges dominate (more than 50%), of which the straight ones of normal size (type III-b) and the large ones (type III-a) each constitute for more than 25%.

In ENIb, the arrowheads manufactured from blades are far less represented than earlier, except for in grave contexts. Like the earlier phases, there may be arrowheads manufactured from biconvex flakes, while arrowheads manufactured from polished flakes should not be found during this period. Large arrowheads can now constitute of 40% of the material. The average edge-width should be between 1.27 and 1.4 cm, the average median should be around 2.15 cm, while the average size should be around 3.

Furthermore, the curved transverse arrowhead is second best represented and accounts for about 11%. In addition, there are other types, which are not particularly well-represented.

4.4. A transverse arrowhead material can be dated to ENII if...

- Transverse arrowheads manufactured from regular blades are few (between 1 and 25%) and at the same time large arrowheads dominate or extremely large arrowheads are represented.
- It is certain that it is an Early Neolithic context and transverse arrowheads with wide and flared edges constitute of less than 30% of the material (types II & III).
- It is certain that it is an Early Neolithic context and the squared transverse arrowheads dominate (type IV).
- The broad-edged squared straight transverse arrowhead (type IV-a) is the most dominating type and arrowheads manufactured from blades are represented.
- The extremely large squared transverse arrowhead is represented (type I-c).
- The curved transverse arrowhead is not represented (type VII).

Like the earlier phases, there may be arrowheads manufactured from biconvex flakes, while arrowheads manufactured from polished flakes should not be found during this period. No small arrowheads should be represented. The average edge-width should be between 1.4 and 1.7 cm, the average median should be between 2.15 and 2.55 cm, while the average size should be between 3.1 and 4.5. Furthermore, the convex transverse arrowhead is second best represented and accounts for about 27%. In addition, there are other types, which are not particularly well-represented.

4.5. A transverse arrowhead material can be dated to MNI if...

- None are manufactured from biconvex flakes.
- No squared transverse arrowheads are represented (type IV).
- It is certain that it is a Neolithic context and oblique transverse arrowheads are dominating (more than 50%).
- The extremely large oblique transverse arrowhead with wide and flared edge (type I-a) or the extremely large and coarse narrow-edged oblique transverse arrowhead is represented (type I-b).

There should not be arrowheads manufactured from blades represented, but arrowheads manufactured from polished flakes may be represented. Like in ENII, no small arrowheads should be represented, however, the extremely large ones are now represented. The average edge-width should be between 1.5 and 2.1 cm, the average median should be between 2.45 and 2.75 cm, while the average size should be between 3.7 and 5.8. Furthermore, the convex transverse arrowhead is still second best represented and accounts for about 12.5%. In addition, there are other types, which are not particularly well-represented.

4.6. A transverse arrowhead material can be dated to MNV if...

- It is certain that it is a Neolithic context and no transverse arrowheads with wide and flared edges are represented (type II & III).
- The extremely large and long transverse arrowhead is represented (type I-d).
- The transverse arrowhead with shaft-retouche is represented (type IX).
- The broad-edged squared transverse arrowhead is dominating (type IV-a) and no arrowheads are manufactures from blades.
- The triangular arrowheads the most or second most dominating type (type VIII).

There should not be arrowheads manufactured from blades represented, however, now arrowheads manufactured from polished flakes may be represented and arrowheads manufactures from biconvex flakes are common. Like in ENII, no small arrowheads should be represented; on the contrary, the extremely large ones are now represented. The large arrowheads

are most represented, which means that the average edge-width should be around 1.5 cm, the average median should be around 2.9 cm, while the average size should be around 4.3. There are types, which are not particularly well-represented.

4.7. How does the transverse arrowhead develop from the ålekistbro phase to MNV?

- The transverse arrowhead develops from almost being 100% manufactured from regular blades in the Ålekistebro phase, to about 50% in ENIa, to less than 25% in ENIb and ENII, and eventually missing completely in MN (Figure 11).
- The transverse arrowhead develops from a clear dominance of narrow-edged ones in the Ålekistebro phase to a clear dominance of broad-edged ones from ENIa.
- The transverse arrowhead develops from a clear dominance of straight ones from the Ålekistebro phase to ENII to be dominated by oblique ones in MNI and again by straight arrowheads in MNV (Figure 12).
- The transverse arrowhead gradually grow in size from the Ålekistebro phase and at least until MNI, where the small arrowheads no longer are represented from ENIb and are replaced by the extremely large ones in ENII. Likewise, the dominance is changed from normal sized ones to large arrows in ENII (Figure 13).
- In the Ålekistebro phase, the preferred type is the narrow-edged squared straight transverse arrowhead, which in ENI is replaced by the straight transverse arrowhead with wide and flared edge, which again is replaced in ENII by the broad-edged squared straight transverse arrowhead, which is replaced by the oblique transverse arrowhead with wide and flared edge in MNI, which eventually is replaced by the broad-edged squared straight transverse arrowhead again (Figure 12).

In general, the Neolithic transverse arrowheads are most often manufactured from more or less irregular flakes/blades, giving the arrows a rougher appearance, with the exception of the arrows from ENIa, where they mainly are manufactured from

	^50 % blades	Few blades	No blades	Biconvex flakes	Polished flakes
Ålekistebro phase	X			X	
ENIa	X			X	
ENIb		X		X	
ENII		X		X	
MNI			X		X
MNV			X	X	X

Figure 11. Representativity table of the transverse arrowheads' prefroms.

	^50 % straight wide and flared edge	3a far most dominating	Squared most dominating	No squared	No curved	^50 % oblique
Ålekistebro phase			X			
ENIa	X	X				
ENIb	X					
ENII			X		X	
MNI				X		X
MNV			X			

Figure 12. Representativity table of various types.

	Small	^50 % normal sized	^50 % Large	Extremely large
Ålekistebro phase	X	X		
ENIa	X	X		
ENIb		X		
ENII			X	X
MNI			X	X
MNV			X	X

Figure 13. Representativity table of the sizes.

regular blades. In addition, a few ones may be manufactured from biconvex flakes and from MN also from polished flakes. The arrowheads are generally larger than in the Mesolithic and they grow in size throughout their usage. Due to the varied flake preforms from which the arrowheads were manufactured, the retouche can be knapped both from the ventral and dorsal side and with 'propeller-retouche', depending on what was most convenient according to the given preform. The most important types in the Neolithic are shown in Figure 14.

5. Regional comparison – lolland

To test whether or not my typology is applicable to other parts of southern Scandinavia, I analysed 95 transverse arrowheads from cultural layers from four different sites at Rødbyhavn in Lolland.

Syltholm II has C14-dates from the Ålekistebro phase and from all of the Early Neolithic. ENIa is well-represented by the transverse arrowhead with wide and flared edge. In addition, there were a number of arrowheads manufactured from flakes, of which in particular the broad-edged squared transverse arrowhead suggests an activity in ENII. The Ålekistebro-type was missing, but according to Søren A. Sørensen (personal

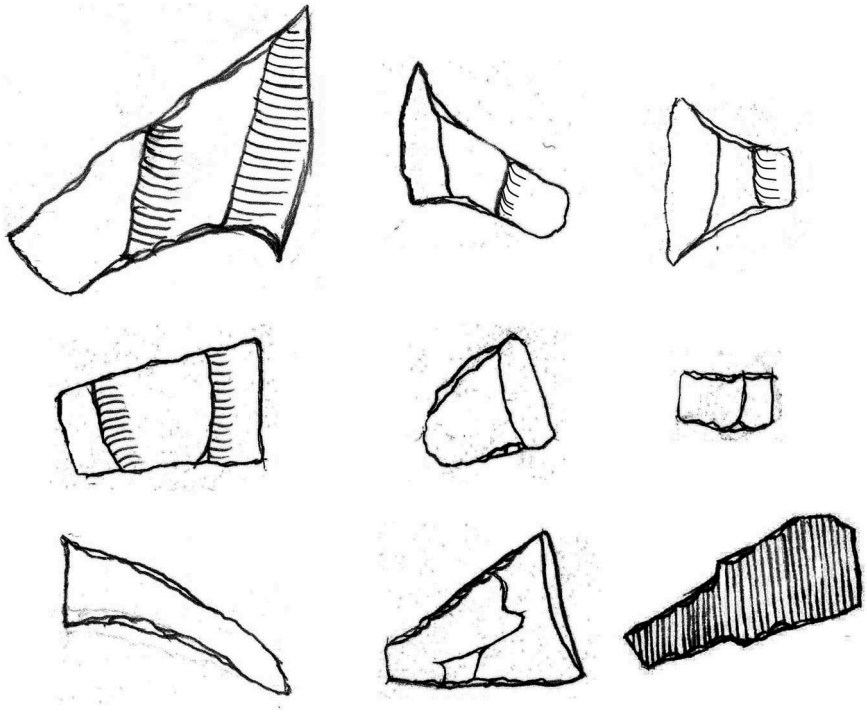

Figure 14. Most important neolithic transverse arrowhead types. Type I-IX, 1:1. For descriptions see appendix C. (Illustrator: Michelle Zadstrov Pedersen).

comment) it is rarely found outside Zealand, where instead the Stationsvej-type continues in this phase.

Sylthom IX has datings from ENIb to MNI that does not match the dating of the transverse arrowheads, and which points to a ENIa date. This is due to the fact that the arrowheads originate mainly from dry land, while the samples for the C14-dates have been taken from the slightly later phase, where the site is flooded. The other tool material from the site also points to an earlier date: the Ålekistebro phase or ENIa. Thus, there was a former cultural horizon, which has not been acknowledged on the basis of the dates from the samples.

Sylthom XIV is dated to the Ålekistebro phase and is highly dominated by straight transverse arrowheads with wide and flared edges manufactured from regular blades. This corresponds well to the dating, if one keeps in mind the statement from Sørensen mentioned earlier.

Sylthom XIII is primarily dated to the Ålekistebro phase and ENIa, but few C14-dates also spread from ENIb to MNI. The early dating is confirmed by the presence of transverse arrowheads with wide and flared edges manufactured from blades, as well as small arrowheads. It is also clear that there is a later activity (possibly MNI), which is represented by the extremely large arrowhead; type I-a. The lack of type IV and the presence of curved transverse arrowheads also correspond to a late activity in MNI instead of ENII.

My proposed typo-chronology thus seems to apply for a material from Lolland, with the exception of the Ålekistebro-material, which outside Zealand seems to be dominated by the transverse arrowheads with wide and flared edges, as in the previous and subsequent phase.

6. Can the transverse arrowhead contribute to the neolithisation debate?

In 1955, Becker wrote that 'The question is central to Danish prehistory and is still relevant' (Becker 1955, p. 167), and now almost 65 years later, I argue that the question is still relevant for Danish prehistory.

Lasse Sørensen suggests a rapid transition from Ertebølle to Funnel-beaker culture with a lack of transition types in both the ceramics and the lithic material around cal. 4000 BC, suggesting that the indigenous population has had a great deal of commitment to the practical learning processes to become confident in the new material culture and agricultural technologies (L. Sørensen 2014, p. 231ff).

However, if one solely takes in accord the transverse arrowheads, it is not quite the same conclusion (Wadskjær 2018). There is not an immediate lack of transition types; on the contrary, the transverse arrowheads seem to have a gradual development in both morphology and technology from the Ålekistebro phase in to ENII. In the first phase of the Neolithic, the arrows are still manufactured from blades like in the Ertebølle culture. Over time, more and more arrowheads are nevertheless manufactured from irregular flakes. By the second phase of the Neolithic, it is the irregular flakes that are dominant, but blades are still used in around 15–20% of the cases in the rest of the Early Neolithic. At the same time, we see that the transverse arrowhead with wide and flared edge, best known from the Stationsvej phase in the Mesolithic, is present in all the phases of the Early Neolithic, thus uniting the old and new traditions. Furthermore, this type is gradually replaced by other types that are known from earlier phases. The same applies for the size of the arrowheads. In ENIa they are still slender and elegant, as we know it from the Ertebølle culture, and slowly they grow in size and thickness. One exception is the arrowheads from Sigersted, which are mainly made from irregular and biconvex flakes, while at the same time being larger and coarser than contemporaneous arrowheads from other sites.

Great similarities in artefact types and their frequencies point to a migration from the Michelsberg culture (Troels-Smith 1954, p. 5ff; L. Sørensen 2014, p. 125ff). However, when comparing the percentage of transverse arrowheads at Michelsberg culture sites and Funnel-beaker culture sites, there is a significant difference (L. Sørensen 2014, p. 236). In the Mischelsberg culture, the transverse arrowheads make up less than 2.5% of the flint tools on all the sites listed in the graph, and most often the percentage is below 1%. While in the Funnel-beaker culture, the transverse arrowheads usually constitute more than 2.5% and even make up more than 20% at several of the sites. If one though includes the leaf-shaped arrowheads from the Michelsberg culture,

then the percentage is fairly similar from the Michelsberg culture to the Funnel-beaker culture. The transverse arrowheads could thus be this missing transition type from the hunter-gatherer society, which the native hunter-gatherers did not want to give up at the expense of the immigrants' different arrow-type.

Sigersted should probably be interpreted as a site where the first immigrants from the Mischelsberg culture settled or as a scouting expedition (L. Sørensen 2014, p. 227ff). While the other sites represent places where immigrants and natives have interfered with each other, the latter group apparently did not intend to let go of all of their old traditions and thus maintained their own arrowhead style. The transverse arrowheads stand out from the other flint tools by being based on ideals from the Ertebølle culture rather than ideals from the Mischelsberg culture, as the other flint tools seem to be in the Funnel-beaker culture in southern Scandinavia (L. Sørensen 2014, p. 231ff). With regard to Sigersted, there is also another possibility. Poul Otto Nielsen wrote about Sigersted, 'that in the field of blade technology, the Early Funnel-beaker culture does not stand back for the Ertebølle culture' (Nielsen 1985, p. 113). This means that they did have the exquisite blade technique at Sigersted, and the reason why it is not detected in the arrows (with the exception of a single piece equivalent to 20%) may be due to that the transverse arrowheads are very poorly represented.

With the exception of Sigersted, the development and frequencies of the arrowheads are almost identical, regardless of whether it is a coastal settlement or an inland settlement.

7. Conclusion

Before this study, it was generally accepted that the transverse arrowheads from the Neolithic almost exclusively were manufactured from flakes and that there were no chronological differences between them. Based on my study of 391 transverse arrowheads from sites on Zealand and Lolland, I can conclude that there are different types that dominate different phases and that other characteristics also change over time.

The Ålekistebro phase is dominated by the narrow-edged squared transverse arrowhead (Type IV-b), which is almost always manufactured from a blade: This is consistent with previous research on this point. Hereafter we have a dominance of the straight transverse arrowhead with a wide and flared edge (type III) manufactured from both blades and flakes in ENI. ENIa and ENIb differ by the fact that arrowheads in ENIa on average are smaller and more often manufactured from blades than in ENIb. In ENII the broad-edged squared transverse arrowhead dominates (type IV-a). The arrowheads grow larger, and now the extremely large arrowheads are also represented (type I). In MNI, it is the oblique transverse arrowhead with a wide and flared edge (type II) that dominates, and the extremely large arrowhead is now found more often than in earlier phases. In addition, a production of transverse arrowheads manufactured from polished flakes begins in MNI. In MNV, it is again the broad-edged squared transverse arrowhead that dominates, but now without pieces manufactured from blades. On the other hand, they are now more often manufactured from biconvex flakes. Furthermore, they appear to be trapezoidal, where they previously were rectangular. A new type is seen in this phase: the transverse arrowhead with shaft-retouche (Type IX). It has thus been possible to construct a typo-chronology for at least EN, and this seems to be applicable both for Zealand and Lolland-Falster, while a future study hopefully will explore whether the typology applies to all of Southern Scandinavia.

Last but not least, I can conclude that the development of the transverse arrowhead can contribute to the Neolithisation debate. The transverse arrowhead is one of the transition types that have not yet been recognized in archaeology. It seems to develop gradually in both morphology and technology from the Ålekistebro phase until at least ENII. It is thus a link between the indigenous people and the immigrants, and is based more on the ideals of the Ertebølle culture than the Mischelsberg culture, which the other flint tools seem to be. The transverse arrowhead can thus be an expression of cultural creolisation.

8. Perspectives

One has to keep in mind that this work has been based on a relatively limited material, and that larger analyses can adjust the conclusions. It should also be remembered that a typo-chronology never is final; when more finds appear, changes may occur and the classification system may become more detailed. In addition, I have focused on a geographically defined area, so it would be an obvious next step to analyse material from other regions in southern Scandinavia to acknowledge possible regional differences.

Furthermore, it could be interesting to complete the typo-chronology of the Neolithic by incorporating the missing phases of the transverse arrowhead's usage. Whether there have been any functional differences on the arrowheads, must also be determined by future studies.

I have shown that the transverse arrowheads gradually are developing through the Neolithisation, which may mean that other tool types did the same, but due to the lack of narrow studies of find categories, these are not acknowledged yet. A study on another find category could be important for nuancing the Neolithisation further.

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Appendix A

(1) Extremely large oblique transverse arrowhead: 1a) Extremely large oblique transverse arrowhead with wide and hanging edge, 1b) Extremely large and coarse narrow-edged oblique transverse arrowhead, 1c) Extremely large squared oblique transverse arrowhead.

(2) Large transverse arrowhead with wide and flared edge: **2a)** Large oblique transverse arrowhead with wide and hanging edge, **2b)** Large oblique transverse arrowhead with wide and upward edge, **2c)** Large straight transverse arrowhead with wide and flared edge.

(3) Transverse arrowhead with wide and flared edge: **3a)** Oblique transverse arrowhead with wide and hanging edge, **3b)** Oblique transverse arrowhead with wide and upward edge, **3c)** Straight transverse arrowhead with wide and flared edge.

(4) Large squared straight transverse arrowhead: **4a)** Large squared broad-edged straight transverse arrowhead, **4b)** Large squared narrow-edged straight transverse arrowhead.

(5) Squared straight transverse arrowhead: **5a)** Squared broad-edged straight transverse arrowhead, **5b)** Squared narrow-edged straight transverse arrowhead.

(6) Large transverse arrowhead with convex sides: **6a)** Large broad-edged straight transverse arrowhead with convex sides, **6b)** Large narrow-edged straight transverse arrowhead with convex sides, **6c)** Large broad-edged oblique transverse arrowhead with convex sides.

(7) Transverse arrowhead with convex sides: **7a)** Broad-edged straight transverse arrowhead with convex sides, **7b)** Narrow-edged straight transverse arrowhead with convex sides, **7c)** Narrow-edged oblique transverse arrowhead with convex sides.

(8) Small transverse arrowhead with wide and flared edge: **8a)** Small oblique transverse arrowhead with wide and upward edge, **8b)** Small straight transverse arrowhead with wide and flared edge.

(9) Triangular transverse arrowhead: **9a)** Large broad-edged triangular transverse arrowhead, **9b)** Broad-edged triangular straight transverse arrowhead.

(10) Pentagonal transverse arrowhead: **10a)** Large pentagonal transverse arrowhead.

(11) Curved narrow-edged transverse arrowhead: **11a)** Large curved narrow-edged transverse arrowhead, **11b)** Curved narrow-edged transverse arrowhead.

(12) Other narrow-edged transverse arrowhead: **12a)** Narrow-edged oblique transverse arrowhead with concave base-retouche, **12b)** Large and coarse narrow-edged straight transverse arrowhead.

(13) Small squared straight transverse arrowhead: **13a)** Small squared narrow-edged straight transverse arrowhead, **13b)** Small squared broad-edged straight transverse arrowhead.

(14) Extremely large straight transverse arrowhead: **14a)** Extremely large and long narrow-edged straight transverse arrowhead.

(15) Transverse arrowhead with shaft-retouche: **15a)** Large transverse arrowhead with shaft-retouche.

Appendix B

(I) Extremely large transverse arrowhead: **I-a)** Extremely large oblique transverse arrowhead with wide and flared edge, **I-b)** Extremely large and coarse narrow-edged oblique transverse arrowhead, **I-c)** Extremely large squared broad-edged oblique transverse arrowhead, **I-d)** Extremely large and long narrow-edged transverse arrowhead.

(II) Oblique transverse arrowhead with wide and flared edge: **II-a)** Large oblique transverse arrowhead with wide and flared edge, **II-b)** Normal oblique transverse arrowhead with wide and flared edge.

(III) Straight transverse arrowhead with wide and flared edge: **III-a)** Large straight transverse arrowhead with wide and flared edge, **III-b)** Normal straight transverse arrowhead with wide and flared edge.

(IV) Squared straight transverse arrowhead: **IV-a)** Broad-edged squared straight transverse arrowhead, **IV-b)** Narrow-edged squared straight transverse arrowhead.

(V) Transverse arrowhead with convex sides: **V-a)** Large transverse arrowhead with convex sides, **V-b)** Normal transverse arrowhead with convex sides.

(VI) Small transverse arrowhead: **VI-a)** Small broad-edged transverse arrowhead, **VI-b)** Small narrow-edged transverse arrowhead.

(VII) Curved narrow-edged transverse arrowhead.

(VIII) Triangular transverse arrowhead.

(IX) Transverse arrowhead with shaft-retouche.

(X) Other transverse arrowhead: **X-a)** Pentagonal transverse arrowhead, **X-b)** Narrow-edged oblique transverse arrowhead with concave base-retouche.

Appendix C

Type I: Extremely large transverse arrowhead. Aside from the fact that they may already be found in the Late Kongemose culture, they first emerge from ENII. In ENII, they are squared and broad-edged, in MNI they are either

narrow-edged or have wide and flared edges, while in MNV they are long and narrow-edged.

Type II: Oblique transverse arrowhead with wide and flared edge. A small version of the type is known from the Trylleskov phase, but it is also represented in EN and MNI. In MNI it becomes the most dominant type, especially the large version (type II-a), and it is only sparsely represented other phases of the Neolithic.

Type III: Straight transverse arrowhead with wide and flared edge (Stationsvej-type). This classic form is the most common in the Neolithic and is represented in all phases except for MNV, but it is particularly dominant in ENI. In ENIa, the majority is of normal size (type III-b) and about half are produced on regular blades, whereas in ENIb both the normal size (type III-b) and the large ones (type III-a) are almost equally dominant and with a dominance manufactured from irregular flakes/blades. This type is previously known from the Stationsvej phase, where it is almost exclusively manufactured from regular blades.

Type IV: Squared straight transverse arrowhead. This type exists in a broad- and narrow-edged version. The narrow-edged one (type IV-b/Ålekistebro-type) dominated the Ålekistebro phase, but is also represented in all phases of EN, while the broad-edged one (type IV-a) is the most dominant type in ENII and MNV. The type has not been recognised in MNI.

Type V: Tranverse arrowhead with convex sides. This type is represented both in EN and MN, but it becomes more influential from ENII to MNI. The type consists of a large and a normal version, of which the first is not known in ENIa and the latter is not known in MNI.

Type VI: Small transverse arrowhead. The small transverse arrowhead is already known from the Ertebølle culture but is also represented in ENIa, after which it disappears.

Type VII: The curved transverse arrowhead. With one concave side and the other convex, the curved transverse arrowhead is sparsely represented in both EN and MN.

Type VIII: Triangular transverse arrowhead. Besides a few pieces from EN, the type is more influential in ENII and MNV, which corresponds to a dominance of squared broad-edged transverse arrowhead (IV-a). It is thus possible that these two types are the same type, which, however, in the manufacturing process has ended up with two different visual expressions.

Type IX: Transverse arrowhead with shaft-retouche. This type is only known in MNV.