

## Flint Daggers and Technological Knowledge. Production and Consumption during LN I

Jan Apel

### *Abstract in Swedish*

Debatten kring den etablerade flintdolkstypologin har under 1970, -80 och -90-talet visat att den inte enbart avspeglar en kronologisk serie. Under LN I är det tydligt att det under flera hundra år existerar åtminstone två regioner där olika typer av dolkar produceras. Ett västligt område där lancettformade dolkar utan uttalade grepp tillverkas och ett östligt område där dolkar med uttalade grepp tillverkas. Detta innebär att flera av de huvudtyper, och några av de undertyper, som Lomborg definierat kan betraktas som reella typer i den bemärkelsen att de härstammar från geografiskt och kronologiskt begränsade normativa, teknologiska traditioner. Detta antagande är svårt att styrka genom studier av statiska, arkeologiska material, men argument för en sådan tolkning presenteras i artikeln utifrån en experimentell studie där flintdolksteknologin studeras ingående.

En översiktlig undersökning av lösfunna dolkar i Skandinavien visar att de två produktionsområdena har påverkat två geografiskt skilda konsumtionsområden. Det västra produktionsområdet har avsatt dolkar i sydvästra Norge, längs den norska västkusten upp till Trondheim och sedan över sylarna till Sverige och vidare till den norrländska östkusten. Det östra produktionsområdet tycks i sin tur ha avsatt dolkar i Västergötland, Bohuslän, sydöstra Norge och i östra Mellansverige upp till Dalälven.

Jan Apel, Department of Archaeology and Ancient History, Uppsala University, St. Eriks torg 5, SE-753 10 Uppsala, Sweden. E-mail: jan.apel@arkeologi.uu.se

This paper is concerned with aspects of the production and consumption of Scandinavian flint daggers dating from the first Late Neolithic phase, LN I (2350-1950 BC). It is based on two assumptions: (i) that the flint dagger types reflect not only a chronological sequence but also regional and local traditions and (ii) that it is possible to identify and delimit the production areas in Scandinavia. To support the first assumption, a review of the research published on the subject since Lomborg (1973) is presented. This section ends with a recapitulation of the chronological relevance of the dagger typology with special reference to types produced during LN I. To support the second assumption, a *chaîne opératoire* (a chain of actions); i.e. a descrip-

tion of the production process of the daggers is established. It is based on experiments and ends with an evaluation of the degree of craftsmanship needed to complete each production stage. The purpose of this section is to argue that the degree of complexity within the dagger technology would have influenced the size of the area where the daggers were produced. Finally, the distribution of the Scandinavian daggers is discussed and the production areas are related to different areas in Scandinavia where daggers were consumed. In this context it is important to notice that daggers were also consumed within the production areas, thus the production areas are also parts of the consumption area.

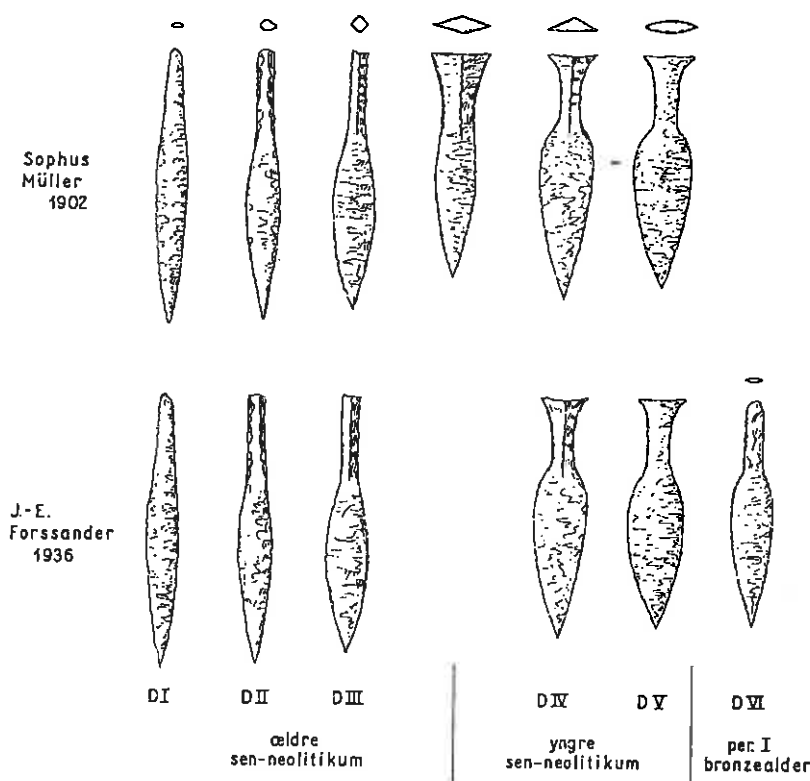


Fig. 1. Müller and Forssander's flint-dagger typologies (from Becker 1964).

## Dagger typology and Late Neolithic chronology

In 1973, *Lomborg* published a refined dagger typology, together with a presentation of the Danish flint dagger material. He was able to demonstrate, in line with older scholars (Müller 1902; Forssander 1931), that the dagger typology had chronological relevance (Lomborg 1973:158). The Danish daggers were, with some minor alterations, classified according to the older Müller-Forssander typology, which consisted of six types forming a chronological sequence (Fig. 1). Thus, types I-V represented five separate phases of the Late Neolithic, and type VI belonged to the Early Bronze Age (Lomborg 1973:158). However, the period was divided into three phases since no other Late Neolithic artefact category would support such

a detailed division. Type I defined LN A, types II and III defined LN B and types IV and V defined LN C (Lomborg 1973:158). Stratigraphic observations and find combinations supported the tripartition (Figs. 2 & 3).

Lomborg defined between two and six subtypes of each main type. Some of the subtypes had chronological value; others were regarded as local or unique forms. Within type I, four subtypes had chronological or geographical relevance. Subtype A was regarded as the earliest form. The production of subtype I B followed it. Subtypes I C and D were interpreted as contemporary subtypes from two different regions. The distribution of different grave types, stray finds and hoard finds, suggested that subtype I C was produced in northern Jutland and subtype I D on the eastern Danish isles (Lomborg 1973:39 ff.).

Lomborg argued that subtypes I A and B

ZUOBERST	VI	8	4	1	1	2	4
	V	9	5	1	2		
	IV	5	1	2			
	III	2	1	1			
	II	2					
	I	16					
		I	II	III	IV	V	VI

ZUUNTERST

Fig. 2. Stratigraphical finds of flint daggers, according to Lomborg (1973).

VI	1?				4	6
V	1?			2	5	4
IV				1	2	
III		1	9			
II	3	7	1			
I	42	3			1?	1?
	I	II	III	IV	V	VI

Fig. 3. Closed find combinations containing flint daggers according to Lomborg (1973).

were older than subtypes C and D. This was confirmed by the fact that I A was combined with I B in five closed contexts and only once combined with I C (Lomborg 1973:77 f.). This observation was strengthened by the fact that it is the parallel retouched blade on I C that separates it from I B, especially since the earlier I A daggers never have parallel retouched blades (Lomborg 1973:78). It was concluded that subtypes I A and B were the earliest dagger types and that the production of subtypes I C and D began in the later part of LN A, at the earliest (Lomborg 1973:78). Type II was regarded as a younger form than type I because it was combined with type I and type III daggers.

In addition to the Late Neolithic chronology, Lomborg also presented some interesting regional differences within Denmark during the period. After an extensive analysis of sites and artefacts, mainly graves, metal objects and flint daggers, he was able to demonstrate that the Danish Late Neolithic material could be divided into separate areas. These correspond to the two cultural zones that are detectable during the Bronze Age in southern Scandinavia (Lomborg 1968:94 ff.). Zone I consists of the northern part

of Jutland, the islands and Scania. Zone II consists of the central and southern part of Jutland and of Schleswig-Holstein in northern Germany. According to Lomborg, the daggers were produced mainly within zone I. This area had contacts with metal-producing areas such as the Wessex region on the British Isles and the Unetice culture in central Europe. Lomborg noted that there were considerable regional differences within zone I. In northern Jutland, the dominant burial forms were barrows and secondary burials in stone cists from the Jutlandic variant of the Corded-Ware culture (EGK). On the islands and in Scania, the dominant burial forms are inhumation burials below flat ground, an obvious influence from central Europe, and burials in Late Neolithic stone cists (Lomborg 1973:132).

In 1975, *Ebbesen* commented on Lomborg's results as follows: "The term 'type' is employed sometimes for a whole group of forms, sometimes for part of such group, and sometimes even for single, often unique, daggers. This impedes understanding and undermines the author's otherwise rigorous and well-documented dagger typology" (Ebbesen 1975:107).

This inconsistent typological treatment of the daggers seems to stem from the fact that Lomborg had two purposes with his dagger typology. On the one hand, he wanted to demonstrate that the typology corresponded to a chronological sequence. On the other hand, he wanted to formulate a typology that would incorporate every conceivable form. Though it was obvious to him that some of his subtypes merely reflected regional types or even single, unique daggers, one has to bear this in mind when working with the typology.

Another of Ebbesen's comments concerns Lomborg's treatment of Late Neolithic dagger hoards. Ebbesen neatly shows that hoards from LNA (type I daggers) are concentrated in northern Jutland and hoards from LNB (type II and III daggers) in the south-eastern part of the Danish isles (Ebbesen 1975:108, Fig. 1). Ebbesen claims that, by failing to discuss these patterns, Lomborg has deprived himself of an opportunity to reflect on the organisation of trade and exchange in southern Scandinavia during the Late Neolithic period. Strömberg puts forward a similar critique when, in line with Lomborg's own observations (1973:132), she argues that it is possible to identify several local regions within zone I in Denmark, and she concludes that this area cannot be regarded as uniform during the Late Neolithic (Strömberg 1975:112).

Lomborg's reply regarding the inconsistent typology is that he just followed old conventions regarding typology and that it is perfectly clear from the type descriptions whether a type has chronological or regional value (Lomborg 1975: 118). He avoids the principal discussion of the regional differences by referring to his distribution maps and concludes by saying that a discussion of the flint dagger hoards in relation to exchange and trade is published in his dissertation (Lomborg 1973:131 f.). However, it is remarkable that he does not consider the possibility that the obvious geographical differences in the distribution of the hoards with daggers during LNA and B will complicate his chronological interpretation. Especially since he stressed the regional differences inherited in the burial traditions in zone I (Lomborg 1973:132).

## A revision of the chronology

In 1978, *Segeberg* published an article in which she applies a source-critical perspective to the flint dagger typology and its chronological value. In doing so she checks the accuracy of the arguments in favour of the chronology by studying the original context; i.e. excavation reports of graves, hoards etc. She is able to demonstrate that two of the three stratigraphic observations published by Müller (1902), in which an earlier dagger type is found underneath a later type, may have been the result of stray finds in burial mounds (Segeberg 1978:179).

Segeberg also concludes that Kaelas' (1964) suspicions regarding Forssander's interpretation of the stratigraphy in the western Swedish Skogsbo cists were justified. Apparently, Forssander considered only those daggers that confirmed his chronology. As a result he gave an account of only 10 of the 17 daggers in the cists (Segeberg 1978:181). Segeberg put forward the following observations: type II daggers occur from the bottom to the top of the filling, type III daggers occur near the topsoil in connection with type II daggers, type IV daggers were found a couple of centimetres above type V daggers, and type V daggers were found at the same level as the highest, type III dagger (Segeberg 1978: 182). In other words, this context does not confirm Forssander's chronology.

Segeberg also makes a source-critical evaluation of nine of the contexts which Lomborg mentions in his thesis and concludes that only three of these have an unambiguous stratigraphy (Segeberg 1978:184). Lomborg did for instance not take into account archaeological evidence in which two separate graves with the same type of dagger are present. In such cases, the dagger typology is used to date the graves and the graves are thereby interpreted as being contemporary. Segeberg concludes that the relative chronology of the Late Neolithic period, based on the flint dagger material, is in no way resolved by the flint dagger typology (Segeberg 1978:185).

In 1979, *Madsen* used the dagger typology in a principal discussion of artefacts and their suitability for chronological studies. The main

point in this study is that a seriation made with the help of find combinations or typology that seems to display chronological sequences, may be the result of spatial differences in the material. Minor differences in the spatial distribution of an artefact type can result in more or less separate groups of combinations which need in no way be chronologically dependent (Madsen 1979:54).

Madsen concludes, in line with Ebbesen, that the hoards with type I and II daggers are unevenly distributed. He suggests that these regional differences create the clear-cut division between the two types in Lomborg's seriation diagram (Fig. 2). In addition, Madsen argues that Lomborg's stratigraphical observations regarding types I and II (Fig. 3) can be rejected with reference to the fact that in two cases they concern daggers found in stone-chamber graves and that one of the contexts has a horizontal stratigraphy (Madsen 1979:55). It is concluded that there is no reason to think that the differences between type I and II in Lomborg's diagram reflect a chronological sequence. On the contrary, they seem to stem from spatial differences. Madsen is also able to show that the daggers of these two types overlap each other chronologically, although the type II daggers together with daggers of subtype I D were introduced later than other type I daggers and were the result of a local production on the Danish isles. Madsen uses information provided in Lomborg's thesis and, with the help of a statistical analysis, he is able to predict the ways in which the differences between the types were due to chronology (Fig. 4) (Madsen 1979:55 ff.). It is worth noting that Madsen kept the tripartition of the period even if Lomborg's chronological interpretation of the dagger typology was revised.

Madsen suggests that the variation of types in the Danish flint dagger material may have been the result of different regional workshop traditions. If this were the case, it would naturally cause great problems in analysing closed hoards chronologically (Madsen 1979:57).

Rasmussen draws the obvious conclusions from Madsen's revised dagger chronology (Rasmussen 1990). She presents a new division

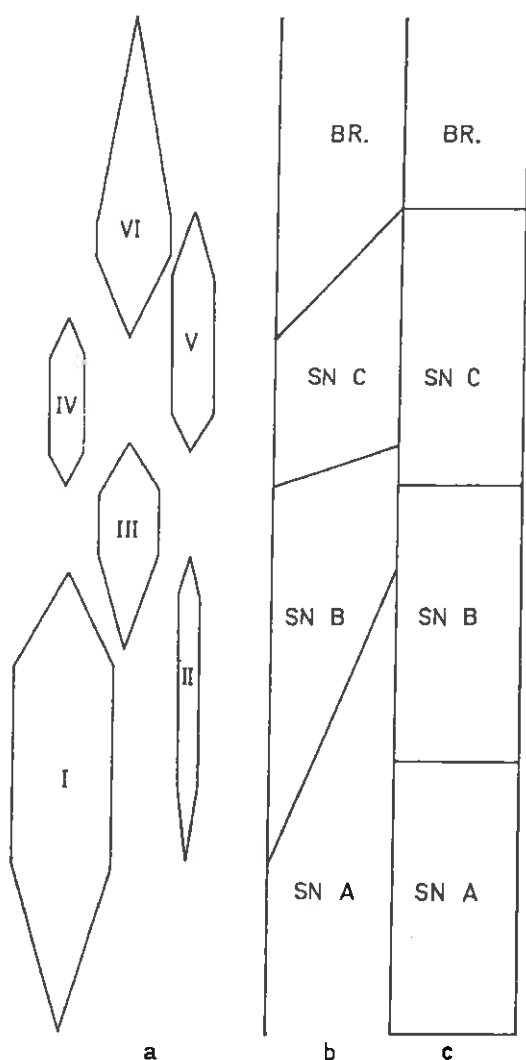


Fig. 4. The relative chronology of the flint-dagger types, based on the numbers of daggers, the regional differences and the find combinations, according to Madsen (1978).

of the Late Neolithic period, in which daggers of types I and II define an early phase and daggers of types III-V define a later phase. Daggers of subtypes I A-C are assigned to a delimited period in northern Jutland, when this part of Scandinavia was influenced by the western European Bell Beaker Cultures. The area around the Limfjord was according to Rasmussen the centre for the dagger production during the early

phase. Daggers of subtype I D and type II are seen as local variants from the islands. This area, in turn, shows signs of contact with the Unetice area during the early phase (Rasmussen 1990: 38).

The Beaker influences in Jutland are known from early Late Neolithic sites as Bell Beaker pottery on settlements and in graves in north-western Jutland. There are, for example, seven graves in which a type I dagger has been found together with Bell Beaker pottery (Rasmussen 1990:41, note 16). There are also graves in Jutland where type I daggers are combined with other, typical Bell Beaker objects, such as V-perforated conical, amber buttons and heart-shaped, bifacial arrow-heads in flint (Rasmussen 1990:35). A fragment of a wrist guard in slate of the western European Bell Beaker type was found on the early Late Neolithic settlement of Myrhøj in north-western Jutland. The site also produced fragments of type I daggers (Jensen 1972:88). Rasmussen concludes that the Danish isles, with subtype I D and type II daggers, were connected with the Unetice culture because dress pins of bone in east Danish graves have their prototypes in metal in the Unetice area (Rasmussen 1990:37). According to Rasmussen, the regional differences between western and eastern Denmark cease when the production of the type III dagger starts. This conclusion is not drawn on account of any major changes in the distribution of hoards, since the type III hoards, like the type II hoards, are concentrated to the eastern Danish isles (Lomborg 1973:50 f., Figs. 25-28). Instead, Rasmussen argues that the general distribution of daggers implies that they were more widely consumed (Rasmussen 1990). At the transition between the early and late period, the core area of the flint dagger production moved from northern Jutland to the isles. This state of affairs was strengthened when the production of the fishtailed dagger forms started (Rasmussen 1990:37).

In the late 1980's Vandkilde presented a division of the Late Neolithic into two phases that to some extent differs from Rasmussen's (Vandkilde 1989). She incorporates Lomborg's LN A and LN B into an older phase, LN I, while she keeps Lomborg's LN C (which chronologically

corresponds to the classic phase of the Unetice culture) and renames it LN II. This means that Vandkilde, as opposed to Rasmussen, considers daggers of type III to belong to the older phase. However, it is important to note that Vandkilde's division does not proceed primarily from the dagger typology. It is based on a thorough investigation of the metal hoards from the Late Neolithic and the Early Bronze Age in Scandinavia (Vandkilde 1996). Vandkilde presents a typology of the bronze axes in the hoards and is able to define the two phases in this material. A seriation diagram based on the find combinations of different artefact groups shows that an early metal horizon coincided with the later Late Neolithic period, LN II, and that two later metal horizons coincided with the first two periods of the Bronze Age. In this way the division of the Late Neolithic period is strengthened. The result is formalised by a statistical method (correspondence analysis) that confirms the seriation (Vandkilde 1996:figs. 136 ff.). The development through time in the chemical composition of the early metal objects and their alloying techniques confirms this chronology (op. cit:160 ff.).

## The relevance of the flint dagger typology

The chronological relevance of the flint dagger typology has been criticised from two different directions. Some have argued that the closed finds and stratigraphical observations that form the basis of Lomborg's chronology can be questioned (Segerberg 1978). Others accept the data but are of the opinion that the typology does not constitute a chronological sequence in which each type follows the other (Ebbesen 1975; Madsen 1979; Rasmussen 1990). This critique is based on the regional distribution of hoards containing different dagger types and on the assumption that the dagger hoards reflect the work of local or regional workshops.

If we accept this critique, it seems as if the daggers were produced in two core areas during LN I: a western area around the Limfjord in Jutland and an eastern area including the Danish islands and western Scania in Sweden. Type



Fig. 5. The distribution of Danish hoards with daggers from LN I. Type I daggers, except subtype I D (circles), subtype I D, type II and type III daggers (triangles), based on information from Lomborg (1973).

I daggers, except for subtype I D, were produced in the western area, and subtype I D, type II and type III daggers were produced in the eastern area (Fig. 5). A theoretical framework will now be presented which will shed light on the organisation of production and delimit the production area within the overall distribution of flint daggers in Scandinavia.

## Technology, and a definition of skill

In this paper, technology is regarded as a coherent system of artefacts, behaviours and knowledge that can be transmitted from generation to generation (Schiffer & Skibo 1987:595). This definition concentrates on the reproduction of technology and thereby recognises technology as integrated with other aspects of society, such as the institutions that embody the reproduction

of knowledge; i.e. apprenticeship, and how such institutions function in society. This is regarded as especially important in this paper, since flint daggers were produced over a period of 800 years.

Technological studies are often based on an analytical distinction between information acquired from a source outside the body and knowledge acquired within the body. Hodder has argued that this line of reasoning follows a western tradition which is rooted in classical philosophy (Hodder 1992:205). I suppose that he means that people in other cultures do not necessarily share such a view, and he is most certainly right in this. However, it is important to remember, as regards non-industrial societies, what Pigeot says:

"Unlike in our modern societies, no sharp distinction is made, in the acquisition of skills, between theoretical knowledge and actual practice. On the other hand, it would seem that long held views regarding the purely imitative and non-institutional educational processes in these societies need be moderated. The pertinent — even if discrete — intervention by adults and the undoubtedly educational character of many rites and ceremonies are cases in point. The organisation of youth education among traditional societies is probably more complex than previously realised" (Pigeot 1990:136).

The distinction between the modern western view and other views on this matter can be traced to the dichotomy between formal and informal ways of learning. It has been suggested that formal, institutionalised learning, for instance in the form of the western educational system, differs in a radical way from learning by doing. To support the relevance of this dichotomy, differences such as the use of language versus activity as the major vehicle of instruction and the creative versus conservative outcomes of formal versus informal teaching, have been put forward (Pelissier 1991:87 f.). Recent studies indicate that so-called informal apprenticeship systems include a proportion of theoretical learning. This has led Pelissier to suggest that the dichotomy between formal and informal learning should be avoided (Pelissier 1991:88 ff.).

The term *technological knowledge* (Schiffer & Skibo 1987) embraces the theoretical and practical knowledge that defines a technology and has three essential components: (1) *Recipes for action*, (2) *Teaching frameworks*, and (3) *Techno-science*. A *recipe for action* consists of the theoretical knowledge and all the formal rules needed to make an artefact from the acquisition of raw material through the different stages of production (Schiffer & Skibo 1987:597). According to Schiffer and Skibo, a *recipe for action* includes a list of the raw materials used, the tools and facilities employed, and a description of the sequence of specific actions carried out in the technological process. The term also embraces the rules used to solve any problem that may arise. Accordingly, a *recipe for action* will guarantee that the theoretical knowledge that is involved in a technology can be transmitted from generation to generation.

A *teaching framework* will allow the practical knowledge involved in a technology to be reproduced. This is accomplished through imitation, verbal instructions, practical demonstrations and self-teaching by trial and error. In a way, the understanding of a technology is related to the apprenticeship that guarantees its survival (Pigeot 1990:136). The teaching frameworks are not solely involved in the transmission of practical knowledge. They are also concerned with the legitimacy behind a technology. This legitimacy can be based on anything from purely rational arguments to arguments like "we have always manufactured arrow heads in this way..." These types of explanations are called "rationales" and give the master or teacher authority during class. It is also likely that "rationales" will be used in order to control the practical know-how that is the foundation of a technology (Hodder 1990:156).

The third component of a technology is, according to Schiffer and Skibo, *techno-science*. In this part of technology, the scientific foundations for the facts that a recipe for action and a teaching framework will lead to the production of the desired artefact, and this artefact will function in the way it is supposed to, are presented (Bunge 1974:30; Schiffer & Skibo 1987:597). It is not necessary to control the

techno-science in order to execute a specific technology. Thus, in non-industrial societies, the *techno-science* is often unexpressed. There is no need to understand the scientific principles behind the manufacture and use of a certain kind of arrowhead in flint for example; it is sufficient to know, through experience, that it will work. Techno-science should probably be regarded as a form of rationale that dominates the modern, western view of technology.

## Knowledge and know-how

The *chaîne opératoire* (chain of action) concept was developed in social anthropology and was introduced into archaeology by the French archaeologist Leroi-Gourhan (Schlanger 1994: 144 f.). Within this field of research, the gesture is regarded as the lowest common denominator recognisable in archaeological materials. Different gestures involved in the production of an artefact will produce different material remains that are diagnostic for that gesture. In this context a gesture is a body movement that, together with tools, raw materials and other gestures produces a flake:

"Each percussion act is "expressed" into a flake and its negative, and each debitage sequence leaves on the ground a series of products and by-products. These elements retain, to a various degree, some evidence of the succession of gestures carried out prior to their own detachment. On this basis, it becomes possible to decipher and reconstruct, with greater precision, the coherence of the knapping process, the techniques employed, and the aims of the actor" (Pigeot 1990:127 f.).

A *chaîne opératoire* analysis begins with "an in-depth 'reading' of the archaeological data" (Pelegriin 1990:116), which include the following steps: identification of the raw material, techniques and methods, and a technological definition of the production stages that are represented at a site or within the specific *chaîne opératoire* in question. This work is carried out with the help of information obtained by experiments or refitting (Pelegriin 1990:116). In order to make a chronological division of the actions and mental processes in use during the making

of a stone tool, definitions that can be used on archaeological materials are needed. Thus, during the replication of a prehistoric artefact type, logical production stages are defined which correspond to an end product or a series of complete or fragmented flakes that can be defined and thereby distinguished from other types of flakes (Geneste 1989:443; Sellet 1993:108). The lack of prehistoric informants ensures that the credibility of the experimenting flintknapper is built on his or her ability to replicate all the conceivable aspects of the prehistoric artefacts in question. The psychological factors that are involved in the making of each gesture can be analysed after the initial, in-depth reading is completed and the gestures can be defined in the archaeological material.

Pelegrin has introduced the terms *connaissance* (knowledge) and *savoir-faire* (know-how) into archaeology. The terms define two fundamental elements of a distinct neuropsychological nature involved in the execution of a gesture (Pelegrin 1990:118). These two forms of memories, which have also been referred to as *declarative* and *procedural* (Squire 1986), are involved in almost every practical action performed by humans, but the proportion of each may vary considerably between different activities. In relation to the concepts presented by Schiffer and Skibo, knowledge is an integral part of a recipe for action while know-how is an important part of the teaching framework, especially self-teaching by trial and error (Schiffer & Skibo 1987: 597). Pelegrin's terms have the advantage that they make a sharp distinction between information acquired from a source outside the body from the type of know-how that can only be

achieved by co-ordinating the muscles involved in a gesture (Table I).

Knowledge has an explicit and declarative character (Pelegrin 1990:118); it can be spread between actors (teacher and pupil) by word of mouth, signs or written language or by simple observation. In other words, knowledge is communicative. Know-how can be explained as an unconscious memory that springs from practical experience (Pelegrin 1990:118). It is intuitive, connected to body movements, and can only be learned by repetition. Where flintknapping is concerned, know-how corresponds to "...operations on the assessed adequacy of the knapping parameters invoked in the current operation. The mass and quality of the striking tool, as well as the mass and morphological characteristics of the object to be knapped, are appreciated through vision and tactile sensibility" (Pelegrin 1990:118). During flintknapping, abstract knowledge, mental templates (theoretical knowledge) and experience (know-how) are confronted with raw materials and tools. In this situation, "culture and nature are conjoined and negotiated" (Hodder 1990:155). The quality of the raw material can never be fully anticipated, the gestures made will not always correspond to the mental templates and consequently there will always be a certain amount of insecurity involved in the process, which will continuously force the flintknapper to re-assess certain situations. In order to face this challenge, he or she will need to acquire a deep level of practical know-how that will enable him or her to adapt to the actual circumstances. In this way, intuitive judgements; i.e. on the morphology of the platform remnant and the presence or absence

Table I. Key concepts used to unfold theoretical knowledge and practical know-how.

Knowledge	Know-how
- explaining	- acting
- explicit memory	- unconscious memory
- communicative	- intuitive
- theoretical memorising	- practical memorising
- is lost in case of lost memory	- is not lost in case of lost memory
- words (2-D)	- mental pictures (3-D)
	- experience

of ridges and how these will affect the next flake removal, are vital ingredients of know-how. This means that the technology will have to be adjusted to the raw material and vice versa and, as a result of this, a dialogue between the knapper and the rock will emerge. Hodder is very enthusiastic about this and conclude, "this creative linking of the general and particular is what I would call interpretation, organised by hermeneutic principles" (Hodder 1990:155).

Practical know-how cannot be communicated and can be achieved only through practice. This conclusion has consequences for the understanding of the technology and distribution of flint daggers, especially if the technology requires a deeper level of practical know-how. A technology with a low degree of know-how can be spread over large areas during short periods of time simply through communication or imitation. On the other hand, a technology which demands a deeper level of know-how will be restricted to areas and circumstances where the raw material and the time needed to apply the practical know-how involved in the production and to maintain and develop the technology are available. To teach someone how to strike a flake from a core is an activity in which the gestures involved require a larger share of knowledge than of know-how. It is quite possible for the pupil to make his or her own flakes after receiving information on the tools to be used, angles, striking directions etc. This large proportion of knowledge compared to know-how thus makes it possible for this activity to be spread over large areas in a short time. If the method allows for different raw materials, it can be spread even further. Pelegrin has referred to lithic productions such as these as *ordinary production* (Pelegrin 1989:123). Lithic industries based on simple bipolar or platform methods belong to this category.

Complex technologies, for instance the long-blade production at Grand-Pressigny in France, Spiennes in Belgium or Varna in Bulgaria, the production of Maya eccentrics in Meso-America, or the square- and bifacial production of Danish daggers in Scandinavia during the Neolithic, requires a great deal of know-how.

"The analysis of such productions - with the

assistance of experimental reconstruction's - indicates that a suitably larger flint nodule, and a little more patience, are not sufficient for the successful production of blades, axes and daggers 30 to 40 cm long. These large products require a much deeper level of know-how (one which is motor and particularly ideational for the construction of critical sequences)" (Pelegrin 1990: 123).

This means that an acquisition of the theoretical knowledge is not sufficient to produce these artefacts. They require a deeper level of practical know-how and, because of the fact that this can only be reached by practical experience, no artefacts will be produced until the flintknapper has learned to control the repertoire of gestures involved in the production. In relation to Schiffer & Skibo's terms previously discussed, one may say that, in order to make remarkable objects it is not sufficient to have access to the recipe for action, one must also take part in the teaching framework (in which practical know-how is transmitted from generation to generation). A modern example can be used to illustrate how theoretical knowledge and practical know-how interacts in a systemic context. When someone is learning how to ride a bicycle, theoretical knowledge in the form of the positions to be used, where to put hands and feet and so on, can be provided. However, information of this kind is not sufficient. Practical training will be a vital part of learning how to ride a bicycle since this act involves the co-ordination of different gestures and muscles (Hodder 1992:206).

The distribution of a technology will ultimately be dependent on the choice of different groups of people. But independently of free choice, the geographical distribution of a technology will be determined by at least three factors that in turn are related to each other: *theoretical knowledge*, *practical know-how* and *raw-material availability*. Individuals or groups can control each of these factors. The choice of whether or not to embrace a new technology is only open to those that comply with the requirements of these factors.

This conclusion provokes the idea that an advanced technology; i.e. a technology in which

specialists are in demand, will occur only in societies in which time and labour can be invested for its development and reproduction. In such a scenario, specialists will have to be supported by others and this will in turn demand a redistribution system in which economic and administrative power is organised beyond the family unit.

## Skill and flint daggers

In the previous chapter, some terms that may be used to define *techné* were presented. In order to use these terms in a discussion of the production of flint daggers, it is crucial that the raw materials and the repertoire of gestures involved in this production are identified. These data must then be organised in a way that will enable me to grade the gestures involved in each production stage according to their relative proportions of theoretical knowledge and practical know-how. The results of this investigation will be used to discuss the degree of craftsmanship involved in the production.

## Raw material

The majority of the Scandinavian flint daggers were made of high-quality Senonian flint. This type of flint occurs naturally in chalk cliffs on the Danish isles (the south-eastern part of Zealand, Møn, Lolland and Falster) and around the Limfjord in northern Jutland (Becker 1988: 46). In south-western Scania, ice transported chalk with Senonian flint has been deposited at Sallerup and Kvarnby outside Malmö and on the western part of Järavallen, an ancient shoreline outside Malmö (Becker 1988:47). Even though there are rare examples of simpler daggers produced from other raw materials, such as Danien flint, Kristianstad flint and even quartzite, the overwhelming majority of daggers were made of Senonian flint. It is therefore likely that large pieces of Senonian flint were a prerequisite for the flint dagger technology. Accordingly, this raw material was used in the experiments made to enable us to understand the production process.

## The production process

In this study, the definition of each production stage of a generic biface (Fig. 6) made up by Callahan has been used (1996). The stage definitions of a generic biface are far less complicated than a definition of dagger stages. In this article I have chosen to use these definitions because of the fact that the dagger definitions still have not been properly published (Callahan & Apel ms). In the following text I will make adjustments to the stage definitions presented in fig. 6 when needed.

The transition from one production stage to another is defined by the completion of a *mental template*; i.e. the completion of a preform with specific characteristics according to an idea that in turn is a prerequisite for continued reduction. Each of the production stages includes several different techniques and methods (Crabtree 1972:2; Madsen 1986) and, as a consequence, several different gestures will be made. Only diagnostic flakes were used to define each production stage. Diagnostic flakes are created by gestures or techniques that are unique to specific stages and flakes that are created within several stages are therefore not considered. This means that only a certain proportion of the flakes from a production sequence will be able to be assigned to a certain production stage.

In this case, stages relevant to the production of flint daggers have been formulated after production experiments conducted by Errett Callahan and documented by the author. In order to be able to use this information on prehistoric materials, a classification system that will tie the production debitage to the production stages has to be made<sup>1</sup>. In this context, there is not room to give an account of the classification system used on the experimental material. However, several gestures that in turn generate different types of diagnostic flakes have been identified during the experiments. These results are based on a dialogue between experiments and an analysis of experimental debitage and original flint daggers and preforms. If one accepts these results as valid, they can also be used in interpretations of the prehistoric making of flint daggers. The following judgements re-

Stage 1 BLANK	Obtain a blank (unmodified) piece of raw material. A blank may be a spall, nodule, irregular chunk, cobble, or any other form suitable for the end product. Action may vary from simply picking up a suitable piece to systematic flaking of a suitable spall from a core. Edges may vary from thin and sharp to thick and squared. Shape is irrelevant.
Stage 2 ROUGH OUT	Create a circumferential, roughly centered edge which is neither too sharp nor too blunt (ideally between about 55 - 75°). Work should focus on the outer zone with little or no attention being paid to the central zone, cross-section, or shape. Shape and width-thickness ratios may vary in the extreme. The edge should end up being roughly centered and bi-convex, without such concavities, convexities, steps, squared edges, or other irregularities as would hinder successful execution in the next stage.
Stage 3 PRIMARY PREFORM	Create a symmetrical, handaxe-like outline with generous, lenticular lateral cross-sections and a centered bi-convex edge. Width-thickness ratios should fall between roughly 3.00 to 4.00 while edge-angles should fall between about 40 - 60°. Focus on the middle zone without losing control of the outer zone. Principal flakes should generally just contact or overlap in the middle zone, except on thin pieces, and be without such concavities, convexities, steps, or other irregularities as would hinder successful execution in the next stage.
Stage 4 SECONDARY PREFORM	Create a symmetrical outline with flattened, lenticular cross-sections and a straight and centered, bi-convex edge. Thickness should gradually diminish during reduction, so that width-thickness ratios end up falling between roughly 4.00 to 5.00 or more. Edge angles should fall between about 25 - 45°. Focus should be on the middle zone without losing control of the outer zone. Principal flakes should generally overlap, often considerably, in the middle zone. Generalization of the final shape may start now and patterned flake removals may be implemented. The resultant piece should be without significant concavities, convexities, steps, or irregularities as would hinder successful execution in the next stage.
Stage 5 FINAL PREFORM	Create a symmetrical, more-or-less parallel-sided outline (if final shape is to be parallel-sided) of specific shape, with appropriately flattened, lenticular cross-sections, and a straight and centered, bi-convex edge. The outline and the thickness should be within one set of principal flake removals from the final product (i.e., within about 2 - 4 mm at either edge). Patterned flake removals may be employed, with flake terminations being feathered. Principal flake scars in the middle zone may or may not overlap those of the previous stage. Width-thickness ratios and edge-angles should be about the same as on the final product, which may (or may not) be greater than the secondary preform. Focus on the middle zone while giving special attention to outer zone regularity. The resultant piece should be without such concavities, convexities, steps, or irregularities as would hinder successful execution in the next stage.
Stage 6 FLAKED IMPLEMENT	Create an implement of specific, symmetrical shape, cross-sections, width-thickness ratios, thickness, and contours with a particular flake removal sequence and flake scar appearance, as appropriate to the type or anticipated function. The edge should be more or less straight but without final retouch and alignment, if needed. The focus should be upon the outer zone, with the flake scars penetrating into the middle zone as appropriate to the type or function. Fluting, if applicable, is done at this time.
Stage 7 RETOUCHED IMPLEMENT	Create a finished implement, with edges and hafting elements being retouched as appropriate to the type or anticipated function. Focus on the outer zone only so as to create a sharp, very straight and centered edge, not prepared in anticipation of another set of flake removals but from function. Execute basal hafting or finishing elements such as notching, shouldering, stitching, etc. Lateral notching sequence, if applicable, are applied at this time. Basal abrasion may also be done now, as appropriate.

Fig. 6. Definitions of the stages involved in the production of a generic biface, according to Callahan (1996).

garding the degree of craftsmanship are based mainly on Callahan's vast experience of making flint daggers, but also to a certain extent of my own limited experience in making bifacial flint tools.

## To estimate craftsmanship

For two summers and during a three weeks flintknapping course, one could say that I was acting as an apprentice to Callahan. During these periods, Callahan produced several flint daggers and in the meantime explained the ideas, goals, techniques and methods involved in the production; i.e. the recipes for action required to complete each production stage and in the end a complete dagger. Before I describe the skill involved in each production stage, it is important to know that the skill needed to make bifaces will depend on the size of the biface. A large dagger will demand a much higher level of skill than a small or average dagger will, all other aspects being kept constant (Callahan personal information). In the following text, the stages defined by Callahan (1996) will form the contextual basis for the discussion (Fig. 6).

The purpose of the *first production stage* (blank) is to acquire a suitable piece of raw material. This stage involves a certain degree of theoretical knowledge, although a low degree of practical know-how. It is important that the nodule does not have internal cracks and that it has the correct proportions: it must be big enough and have the right thickness in relation to its width and length. After receiving verbal instruction and participating in collecting trips for possible flint dagger nodules, it was possible for me to collect suitable nodules from shores, fields and chalk mines.

The purpose of the *second stage* (rough-out stage) is to create a centred edge around the preform. Using direct percussion and both soft and hard techniques, I was able to learn this stage after a few days of practice. It is obvious that the average archaeology student can grasp this stage quickly, at least on small preforms. It may be concluded that this stage does not require any great degree of practical know-how.

During the *third stage* (primary preform

stage), the most important aim is to see that the preform receives a generous, certain lenticular cross-section. This is achieved by applying a soft, direct technique, for instance using an antler billet or soft stone hammer. If the certain lenticular cross-section is not achieved, it will be impossible to make the preform thinner without losing excess width. This must be avoided since the later stages will be concentrated upon obtaining a fairly big width/thickness ratio. The generous lenticular cross-section is therefore needed to allow flakes during later stages to reach beyond the middle zone of the biface, thereby thinning it down in the process. This stage is also relatively easy to learn.

During the *fourth stage* (secondary preform stage), a preform with symmetrical contours and with a blade that has a width/thickness ratio of between 4:1 to 5:1 is demanded. During a considerable time of my apprenticeship period, I was stuck in the transition between the third and the fourth stage. I could not thin the preform down without making it excessively smaller at the same time. In spite of the fact that, through Callahan, I had access to all the theoretical knowledge needed, in the shape of what tools to use, striking angles, positions, etc., I was not able to complete this stage. It became apparent that somehow I lacked a great deal of the practical know-how needed to cope with the process. This is a problem that all flintknappers will encounter to some degree in their learning process. It took Callahan ten years of practice working alone before he achieved this level of know-how. But then one has to consider the fact that he was forced to rediscover the recipes for action only by confronting himself with original artefacts, as he had no one to teach him. In a living technological tradition, these recipes would be transmitted verbally or simply by observation, and all those who are supposed to be learning the technology will have access to this information. In the same way I do not need to rediscover the recipes for action involved in the making of a type IV flint dagger, since this already have been done by Callahan and I have access to this information. In this way, the difference between theoretical knowledge and practical know-how is enhanced. This is due to the

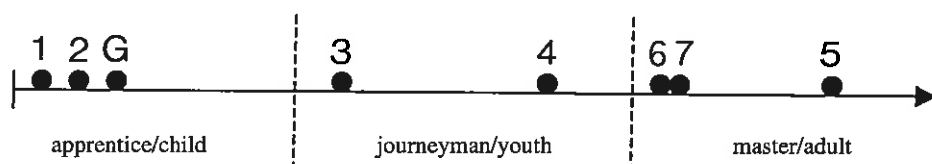


Fig. 7. The seven production stages defined by Callahan (and a grinding stage = G), graded according to the degree of practical know-how.

fact that it is frustrating to know exactly what to do, but not be able to do it. This may need a further explanation.

To successfully produce stage-four bifacial thinning flakes, the striking tool has to hit the preform on the edge (Bradley 1975). Since the edge on biface preforms has a low angle, the platform (i.e. the edge) must be prepared in a certain way, in order that it may not malfunction during the reduction. If the preparation is too extensive, it will be more difficult to release large thinning flakes, since a greater part of the energy will be spent on breaking the platform. On the other hand, if it is not strengthened enough, the platform will be crushed and, as a result, the energy will be lost and the fracture that will release the flake will stop. In order to make correct judgements regarding the degree of platform preparation needed, the flintknapper has to build on experience created through practical know-how. During flintknapping, fractures will follow convex surfaces, but if a flake reaches into a concave area, the fracture will most likely stop and create a deep scar or step in the preform. When a preform has been taken through the first production stages and displays a lenticular cross-section it is critical to know where on the preform to reduce the mass in the next removal. Wrong judgements at this stage cannot easily be repaired. The problems that arise during the fourth stage affect all those who try to learn bifacial work regardless of the fact that some pupils are more talented than others.

This is as far as my own experience with bifacial work has taken me. The following description of the difficulties inherent in different stages of flint dagger production stems from information provided by Callahan (1997). He has been working with flint and flint-like materials since the mid-fifties. During the last 40

years, he has produced thousands of bifaces of different kinds and has written many articles and a book on this subject (Callahan 1979 & 1996). Since 1980, he has made about 200 Scandinavian-type daggers in flint and obsidian. I asked him to give a verbal description of the relative difficulties involved in the different production stages that he has defined for type IV daggers (Callahan & Apel n.d.). These stages are in many aspects similar to the stages defined in fig. 6. The most important differences concern the making of the thicker handle, the grinding and the parallel-flaking present on some dagger types. It is important to notice that *both prestigious and simpler daggers of each defined type were produced during the Late Neolithic*. Callahan's description is concerned with the prestigious type IV daggers:

"...the degree of skill varies considerably from type to type and up and down the staging. Type IV is tops, type I C (with parallel unidirectionally flaked blade) next... Type I D is also very skillful...but is more attainable as it is percussion only (2 less stages)" (Callahan unpublished letter to the author dated 17 November 1997).

Callahan is of the opinion that the first three stages contain a relatively low degree of practical know-how. Thus, they can be carried out by relatively inexperienced flintknappers after receiving the proper theoretical knowledge. It is tempting to consider the idea that the early stages and the latter grinding stage were learned by youths or beginners in an apprenticeship system on their way to becoming artisans. As we have seen earlier, the fourth production stage (secondary preform stage) demands a greater deal of practical know-how. According to Callahan, this stage is much more demanding than the previous stage. This means that it was not likely that



Fig. 8. The seven production stages defined by Callahan (and a grinding stage = G) graded according to the *degree of theoretical knowledge*.

beginners were able to succeed with it. It is likely that the fourth stage was conducted by journeymen with a great deal of theoretical knowledge and practical know-how, but not yet masters. At least this is plausible if we believe that the societies in which the flint daggers were produced were socially stratified. The gap in required skill between the fourth and the fifth stage is as big as that between the primary preform stage and the secondary preform stage. Consequently, the fifth stage (final preform stage) according to Callahan, is much more demanding than the previous stage. Any mistakes that the flintknapper makes during this stage will be difficult to repair. "It's not just a matter of skill, as I said, but of perception, observation, and intelligence. Verify by looking at the originals (I keep the Hinds-gavl cast at hand as I make my daggers. It's my greatest aid). One must duplicate the angles, flake scar types, etc., as said above. Locking a 3-dimensional template in your brain isn't easy. It only comes with know how" (Callahan 1997).

The *fifth stage* (tertiary preform stage), according to Callahan, is the most difficult stage to master. During the production of certain dagger types, for example subtype I D — with a percussion flake-scar finish — this is the last stage before the final retouch. If the fifth stage is conducted without flaws, the following stages, i.e. grinding, parallel flaking and final retouch, will be completed fairly easily by comparison. The following stages, with the grinding stages as an exception, demand a certain degree of practical know-how, but they are not as demanding as the fifth stage. However, it is worth noting that it requires a large amount of strength to press the parallel flakes which cover the blades of certain dagger specimens. Therefore it is likely that grown-ups performed the body flaking stage.

In order to visualise, and in a way formalise, Callahan's information, the *degree of practical know-how* in relation to the production stages has been plotted along an axis (Fig. 7). This figure can be interpreted as the result of a work division or an apprenticeship system, based on selected individuals, for instance on certain age-based groupings. I find it likely that the flint dagger technology was institutionalised in this way, at least if the Late Neolithic societies were sedentarily organised with more or less permanent houses, cattle, farming and access to large networks for the exchange of prestigious objects. The foundations of these kinds of institutionalised organisations would be based on the control of the recipes for action, the practical know-how and the raw material. It is likely that the technology, in itself, and not only the finished object, will relate to the order of society and thereby the structure of power within the society. In this way the organisation of a complex technology is fundamental to the reproduction of the society in general.

A similar figure has been made to visualise the *degree of theoretical knowledge* involved in each production stage (Fig. 8). Owing to the obvious difficulties involved in judgements of this character, it should be stressed that the interpretation presented in fig. 8 stems from my own experience and it is likely that it differs in one way or another from the prehistoric reality. However, it is possible to tie some typological elements in the flint daggers to different recipes for action that are based mainly on theoretical knowledge. An example would be the pronounced handles on subtype I D and type II daggers from the Danish isles in relation to the non-existence of pronounced handles on the western type I subtypes. The different handle constructions cannot be explained by the fact

that some handle variations would be significantly more difficult to produce. It must instead be understood as a form of stylistic variation that probably stemmed from a need to form the handles in different ways. In this case, it is likely that the dagger typology has captured two real dagger types that were created within the frames of regional and normative technological traditions.

It can be concluded that the production of prestigious flint daggers demanded a great share of both theoretical knowledge and practical know-how. It is therefore likely that the reproduction of the flint dagger technology demanded some form of institutionalised apprenticeship system. Because of the fact that such apprenticeship is based on the acquisition of practical know-how which can be achieved only through much practical training, it follows that the dagger technology can only be reproduced over generations in areas where there is an abundance of high-quality raw material. This leads to the conclusion that the production took place in the close vicinity to the raw material; i.e. the Limfjord area in Jutland, the Danish isles and the southwestern part of Scania. Subsequently, these areas are regarded as production areas. The different dagger types and subtypes that were produced during LN I can be interpreted as the results of conscious choices that perhaps stemmed from a need to demonstrate the cultural differences in the two regions.

In the following section, the Limfjord area is considered to have been one regional production area and the Danish isles and southwestern Scania another. We shall now see how these production areas affected other areas in Scandinavia to which flint daggers were distributed and where they were consumed.

## **The consumption of Late Neolithic flint daggers in Scandinavia**

With Lomborg's typology as a starting-point, I shall now try to draw some preliminary conclusions regarding chronology and exchange routes in Scandinavia during the Late Neolithic. This reasoning will be built around the divisions and frequencies of the six dagger types in different

parts of Scandinavia (Fig. 9). These diagrams are based on information extracted from museum collections by myself and by Per Lekberg at the Department of Archaeology and Ancient History at Uppsala University and in publications (Lomborg 1973; Scheen 1979; Bondesson 1980; Larsson 1993).

## **Production areas**

On the basis of the former reasoning I propose that the production area is hypothetised to be Jutland, the Danish isles and the southwestern part of Scania. Though it is likely that simpler dagger variants were produced outside this core area, the abundance of a suitable raw material in these areas was a prerequisite, in order to maintain and reproduce the technology for longer periods. It is obvious that the frequencies of the different dagger types vary within the production area (Fig. 9). The Limfjord area in Jutland and the Danish isles differ in two important respects. The type I daggers make up 60% of the total dagger material in Jutland. On the Danish isles, the type I daggers make up 32% of the material. This tendency is further strengthened in Scania, where the type I daggers make up only 30% of the material (Fig. 9). In this context these differences mirror the occurrence of regional technological traditions.

## **Consumption areas**

In Norway, the type I daggers make up more than 40% of the total number of daggers (Fig. 9). Of Norway's 602 type I daggers, only 26 (4%) are of the subtype I D from the Danish isles (Scheen 1979, Fig. 2). This implies that the Norwegian daggers in general were derived from Jutland, an impression further strengthened if we consider the Norwegian part of the type II daggers - c. 2% which is a lower figure than that of Jutland, and considerably lower than the 17% on the Danish islands.

In 1952, Becker argued that of the 20 flint daggers found in Norrland in Sweden, 15 were made of a flint type that originated from the Limfjord area (Becker 1952:77). He suggested that these daggers were brought to Norrland

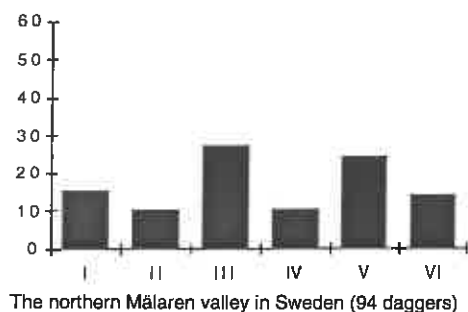
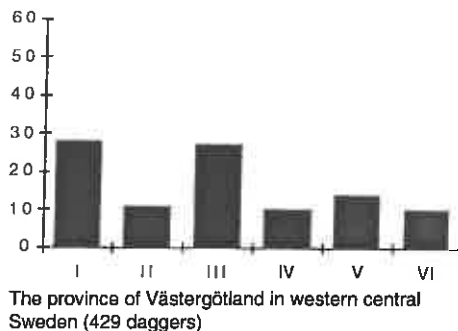
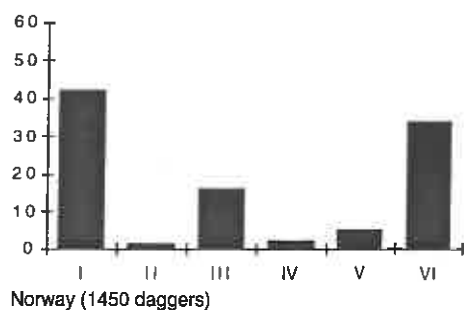
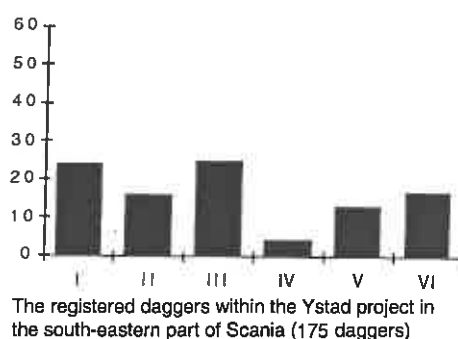
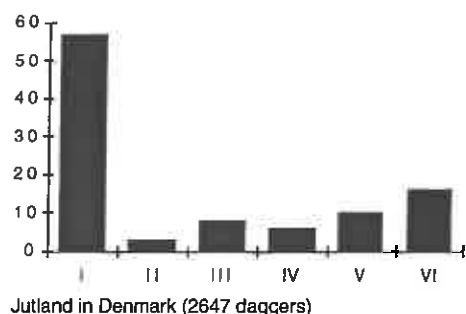
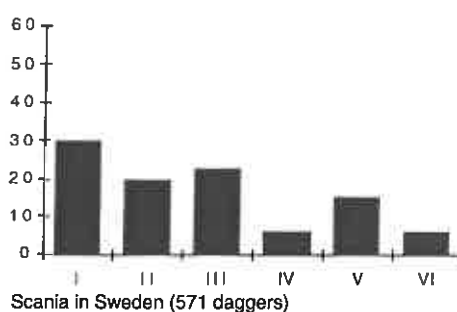
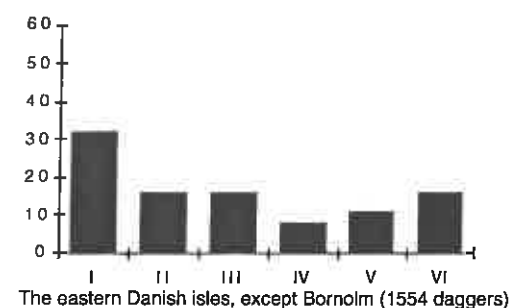


Fig. 9. The frequencies of Lomberg's six main dagger types in different regions of Scandinavia.

from Jutland over the western coast of Norway to the Trondheim area and then east over the mountains to Sweden. This interpretation can be further strengthened by the dagger typology. It is possible to tie this reasoning to the distribu-

tion of different Late Neolithic artefact types in Norway. In southeast Norway, the Late Neolithic archaeological material is dominated by simple shafthole axes in stone and in the west by the presence flint daggers. It is apparent that the

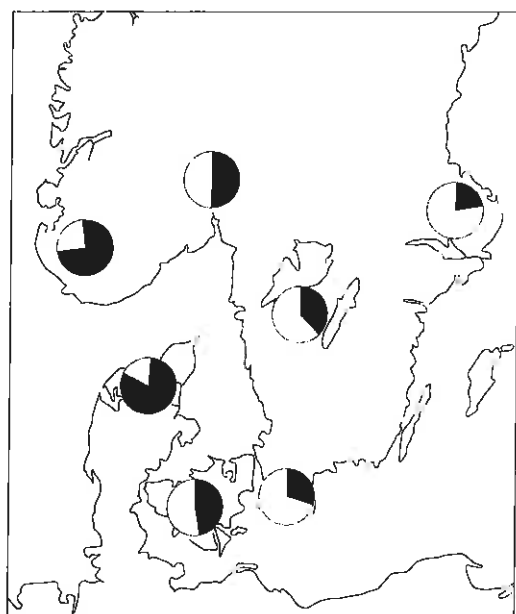


Fig. 10. The frequencies of the two dagger forms that were produced during LN I. Lancet-shaped daggers without pronounced handles; i.e. type I, except subtype I D (black), subtype I D, II and III (white).

people on the Norwegian southwest coast had contacts with Jutland and that the people in the area around the Oslo fjord had contacts with areas in Sweden. Similarities regarding, for instance, grave rituals and finds have been interpreted in terms of immigration from the south to south-western Norway (Bakka 1964:147; Prescott & Walderhaug 1995:272). As opposed to south-eastern Norway, there is scarce evidence of agriculture earlier than the Late Neolithic in Rogaland. It has been argued that the Swedish/Norwegian Battle Axe Culture dominated in south-east Norway during the Middle Neolithic and that this explains why influences from the south first affected Rogaland and western Norway (Scheen 1979:90).

In order to investigate how this relationship is reflected in the frequencies of the two dagger traditions, discussed above, Norway was divided into a western and an eastern part (Fig. 10) (Apel in press). An interpretation of the exchange routes for the flint daggers dating from LN I is presented in Fig. 11. It is based on the

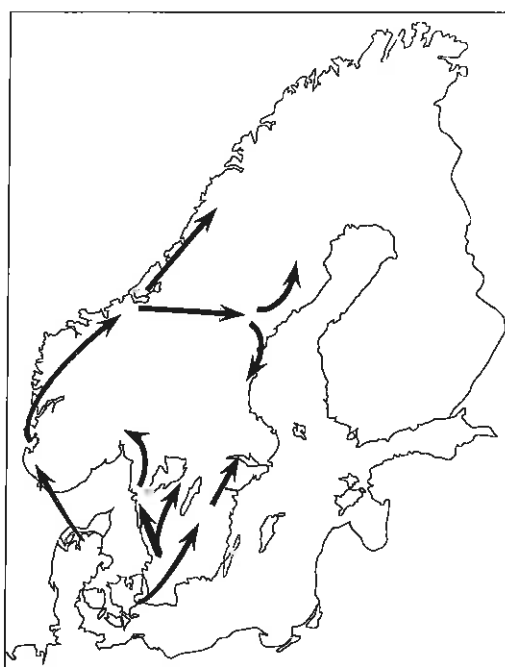


Fig. 11. Hypothetical exchange routes from the two main production areas to different parts of Scandinavia.

frequencies of daggers from the two production areas. Daggers from the Danish isles and Scania were distributed to areas in southern and central Sweden and to the southeastern parts of Norway. Daggers from Jutland were exported north to western Norway and from there to northern Sweden.

## Conclusion

In the debate concerning the Late Neolithic chronology it has been demonstrated that the established flint dagger typology does not merely reflect a chronological sequence. During LN I, there were at least two local regions with high quality flint where different dagger types were produced. Lancet-shaped daggers without pronounced handles were mainly produced around the Limfjord in the northern part of Jutland, and lancet-shaped daggers with pronounced handles were mainly produced on the Danish islands and southwestern Scania. This conclusion has been strengthened by an analysis of the flint

dagger technology and by a consideration of the distribution of different dagger types within and outside the core production area.

An experimental study of the production of type IV flint daggers indicates that the flint dagger technology is complex, as regards both theoretical knowledge and practical know-how. It is argued that, in order to reproduce the technology between generations, large amounts of raw material were required and it is also likely that an apprenticeship system, including children and youths from a certain segment of society were actively involved in this process. It is therefore plausible that the main production areas coincided with areas where high quality flint was abundant.

A preliminary investigation of stray daggers found in different parts of Scandinavia shows that the two production areas affected different consumption areas. The western production area affected western Norway and Norrland in Sweden while the eastern production area affected areas in southern and central Sweden and the south-eastern parts of Norway.

## Note

<sup>1</sup> A debitage analysis has been conducted and will be published in a book dealing with the production of type IV flint daggers (Callahan & Apel n.d.).

## References

- Apel, J. in press. Kunskap, handlag och råmaterial - en diskussion kring produktionen och konsumtionen av senneolitiska flintdolkar i Skandinavien. *Tor* 1998.
- Bakka, E. 1964. Diskussion om senneolitikum i Norden. *Tor* X.
- Becker, C. J. 1952. Die Nordschwedischen flintdepots. Ein Beitrag zur geschichte des neolithischen fernhandels in Skandinavien. *Acta Archaeologica* 23. København.
- 1988. Sydiskandinavisk flint i nordsvenske fund fra mellem- og sen-neolitisk tid. *Iskos* 7.
- Bondesson, B. 1980. *Skånska flintdolkar. En jämförelse av det skånska och det danska flintdolksmaterialet med utgångspunkt från E Lomborgs Die Flintdolche Dänemarks*. C-uppsats vid Inst för arkeologi, Lunds universitet. Stencil.
- Bradley, B. 1975. Lithic Reduction Sequences. A Glossary and Discussion. I: Swanson, E. (red.), *Lithic Technology: Making and Using Stone Tools*. The Hague: Mouton.
- Bunge, M. 1974. Technology as applied science. In: Rapp, F. (ed.), *Contributions to a philosophy of technology*. Dordrecht: D. Reidel.
- Callahan, E. 1979. *The Basics of Biface Knapping in the Eastern Fluted Point Tradition*. Archaeology of Eastern North America 7.
- 1996. *The Basics of Biface Knapping in the Eastern Fluted Point Tradition*. Lynchburg.
- 1997. Unpublished letter to the author dated 971117.
- Callahan, E. & Apel, J. n.d. Unpublished manuscript on the production of type IV Scandinavian flint daggers.
- Crabtree, D. E. 1972. *An introduction to flintworking*. Occasional Papers no. 28. Idaho State University Museum. Pocatello.
- Ebbesen, K. 1975. Comments on The Flint Daggers of Denmark. *Norwegian Archaeological Review*, vol 8, nr 2.
- Forssander, J. E. 1936. *Der ostskandinavische Norden während der ältesten metallzeit Europas*. Kungliga Humanistiska Vetenskapssamfundet i Lund.
- Geneste, J-M. 1989. Les Industries de la Grotte Vaufray: Technologie du Débitage, Economie et Circulation de la Matière Première. In: Rigaud, J. P. (ed.), *La Grotte Vaufray*. Mémoires de la Société Préhistorique Française vol. 19.
- Hodder, I. 1990. Commentary to Technology in the Humanities. *Archaeological Review from Cambridge* vol. 9:1.
- 1992. Material Practice, Symbolism and Ideology. I: Hodder, I., *Theory and Practice in Archaeology*. Routledge. London.
- Jensen, J. A. 1972. Bopladsen Myrhøj. Tre hustomter med klokkebægerkeramik. *Kuml* 1972.
- Kaelas, L. 1964. Senneolitikum i Norden. *Tor* X.
- Larsson, L. 1992. Settlement and environment during the Middle Neolithic and Late neolithic. In: Larsson, L., Callmer, J. och Stjernqvist, B. (eds.), *The Archaeology of the Cultural Landscape. Field work and research in a south swedish rural region*. Acta Archaeologica Lundensia, series in 4°. N° 19. Lund.
- Lomborg, E. 1973. *Die Flintdolche Dänemarks. Studien über Chronologie und Kulturbeziehungen des südschandinavischen Spätneolithikums*. Nordiske Fortidsminder serie B - in quatro. København.
- 1975. The Flint Daggers of Denmark. Studies in Chronology and Cultural Relations of the South

- Scandinavian Late Neolithic & Reply to Comments. *Norwegian Archaeological Review* vol 8, nr 2.
- Madsen, B. 1986. Nogle taxonomiske og nomenklatoriske bemærkninger til studiet af flintteknologi - experimentelt og arkæologisk. *Fjölur* 5 (1).
- Madsen, T. 1978. Perioder og periodovergange i neolitikum: Om forskellige fundtypers egnethed til kronologiske opdelninger. *Hikuin* 4.
- Müller, S. 1902. *Flintdolkene i den nordiske stenalder*. Nordiske Fortidsminder I. Köpenhamn.
- Pelegriñ, J. 1990. Prehistoric lithic technology: Some aspects of research. *Archaeological Review from Cambridge* 9:1.
- Pelissier, C. 1991. The Anthropology of Teaching and Learning. *Annual Review of Anthropology* 20.
- Pigeot, N. 1990. Technical and social actors. Flint-knapping specialists and apprentices at Magdalenian Etioilles. *Archaeological Review from Cambridge* 9:1.
- Prescott, C. & Walderhaug, E. 1995. The Last Frontier? Precursors of Indo-Europeanization in Northern Europe: The Norwegian Case. *The Journal of Indo-European Studies*, vol. 23, no. 3 & 4.
- Rasmussen, L. W. 1990. Dolkproduktion og -distribution i senneolitikum. *Hikuin* 16.
- Rosenberg, G. 1929. Nye Jättestuefynd. *Aarbøger for Nordisk Oldkyndighed og Historie* 1929.
- Scheen, R. 1979. *De norske flintdolke. En typologisk-kronologisk analyse*. Magisteravhandling i Nordisk arkeologi vid Universitetet i Oslo. Stencil.
- Schiffer, M. B. & Skibo, J. M. 1987. Theory and Experiment in the Study of Technological Change. *Current Anthropology* vol. 28, No 5.
- Schiffer, M. B. 1976. *Behavioral Archaeology*. Academic Press. New York.
- Schlanger, N. 1994. Mindful technology: unleashing the *chain opératoire* for an archaeology of mind. In: Renfrew, C. och Zubrow, E. B. W. (eds.), *The ancient mind. Elements of cognitive archaeology*. Cambridge University press. Cambridge.
- Segerberg, A. 1978. Den enkla skafthålsyxan av sten. Fyndförhållanden och datering. *Tor* XVII.
- Sellet, F. 1993. Chaîne opératoire; The concept and its applications. *Lithic Technology* vol. 18, no. 1&2.
- Splith, W. 1900. *Inventar der Bronzalterfunde aus Schleswig-Holstein*. Kiel.
- Squire, I. R. 1986. Mechanisms of memory. *Science* 232.
- Strömberg, M. 1975. Comments on the Flint Daggers of Denmark. *Norwegian Archaeological Review* vol 8, nr 2.
- Vandkilde, H. 1989. Det ældste metalmiljø i Danmark. In: Poulsen, J. (ed.), *Regionale forhold i Nordisk Bronzealder* 5.
- 1996. *From Stone to Bronze. the metalwork of the Late Neolithic and Earliest Bronze Age in Denmark*. Jutland Archaeological Society Publications XXXII. Aarhus.