Chapter 9
The Arrival and Development of Pressure Blade Technology in Southern Scandinavia

Mikkel Sørensen

9.1 The Problem and the Research Field

In this paper, the following problem is discussed: When and why did pressure blade technology appear in Southern Scandinavia and how did the pressure blade concept evolve in this area?

This question is discussed from a technological point of view, thus the specific methods of pressure blade technology employed in prehistory within the area will be analysed, described and reconstructed. As technology today is defined not only as a science related to the technical transformation of raw materials but also to its social, cognitive and cultural aspects (e.g. Apel 2001; Audouze 1999; Leroi Gourhan 1964; Pelegrin 1990; Schiffer and Skibo 1987; Sørensen 2006c), the reasons for the arrival of the pressure blade technique and the meaning of this technology in the Maglemosian society will be discussed as well.

Pressure blade technology is, in this chapter, defined as the study of lithic production concepts in which pressure technique have been applied to produce blades, i.e. serially made detachments, from lithic cores, used as tools or preforms for tools (Sørensen 2006a: 289). The recognition of prehistoric pressure technique is based on macromorphological lithic criteria and stigmata found in experimental work and by analogy investigated and diagnosed in prehistoric lithic assemblages (Pelegrin 1984a, b, 1988, 2002, 2006; Sørensen 2006a). These criteria are extreme regularity, rare occurrence of ripples, straightness, a small bulb in combination with lip formation and, most importantly, the occurrence of small exhausted blade cores with negatives showing extreme regularity. These criteria have an overlap with blades made by indirect technique, and in many cases, single blades can therefore not be attributed with certainty; however, the careful investigation of large blade populations,

M. Sørensen, Ph.D. (✉)
Department of Archaeology, University of Copenhagen,
Njalsgade 76, Copenhagen, Denmark
e-mail: miksr@hum.ku.dk

P. Desrosiers (ed.), *The Emergence of Pressure Blade Making: From Origin to Modern Experimentation*, DOI 10.1007/978-1-4614-2003-3_9,

including blade cores, regarding the combination of the criteria can allow a reliable verification.

The Maglemose Culture, in this text termed the Maglemosian, can be defined as a complex of artefacts and technologies produced by hunter-gatherer groups in the Early Mesolithic and Early Holocene periods (9500–6500 B.C.). The Maglemosian complex is defined in Southern Scandinavia, Northern Germany and, in its early stages, in Eastern England and Western France. Towards the Baltic, assemblages with typical Maglemosian industries are known; however, these regions have traditionally been defined with other culture groups such as the Komornica Culture. The most important typological archaeological signifier of the complex is its microlithization of armature points as seen in the lithic assemblages. Bone point morphologies, lithic technology and bone technology are today also considered important for the definition of this complex. Early Holocene Southern Scandinavia was, due to the huge ice sheets of Northern Scandinavia, a period with a low seawater level characterized by vast low lands; for example a land bridge existed between Southern Scandinavia and the British Isles. The Maglemosian hunter-gatherer groups are generally interpreted to have employed this landscape depending largely on inland hunting and fishing.

The Maglemosian of Southern Scandinavia has been subject to a long and vast research history. It comprises a broad range of materials including an outstandingly well-preserved organic material due to the fact that most of the early excavated sites were found in anaerobic conditions (moors). During the early years of research, much effort was made to excavate, publish, define and date the archaeological material (Johansen 1919; Sarauw 1903). The Early Mesolithic, called the Mullerup Culture at that time, was the oldest known Mesolithic Stone Age culture in Northern Europe. Thus, the Maglemosian was filling out the chronological gap in Europe between the Ertebølle Culture in the North and the Upper Paleolithic found in the French cave sites until Late Paleolithic sites were documented in Northern Germany during the 1930s (see Fig. 9.1).

Later, research efforts merely addressed the typology and the chronology of the period, especially dealing with morphological analysis and seriation of microliths (Becker 1952; Petersen 1966, 1973; Skaarup 1979). The Maglemosian was divided into six phases from 0 to 5 mainly due to the seriation of microliths. This relative chronological ordering of the material has been criticized and scrutinized by several researchers since it was established. Critical points are that the microlith morphologies can reflect functional aspects as well as stylistic ones, and that solely defining a cultural chronology on the frequency of one artefact type is insufficient (e.g. Henriksen 1980; Sørensen 2006b). The latter argument is crucial when applying the chronology to smaller assemblages where the number of microliths is low, as only doubtful relative ages can be achieved in such situations.

During the last decade, new research methodologies have been employed in studying the Maglemosian artefact materials (David 2006; Sørensen 2006a, b; Toft 2006). As a result, a new chronological ordering has been put forward based on changes in the Maglemosian lithic blade industry (Sørensen 2006a, b). This chronology is now often preferred due to its broader application on the lithic material; however, the chronology based on microliths is generally still considered valid when the amounts of microliths are sufficient.

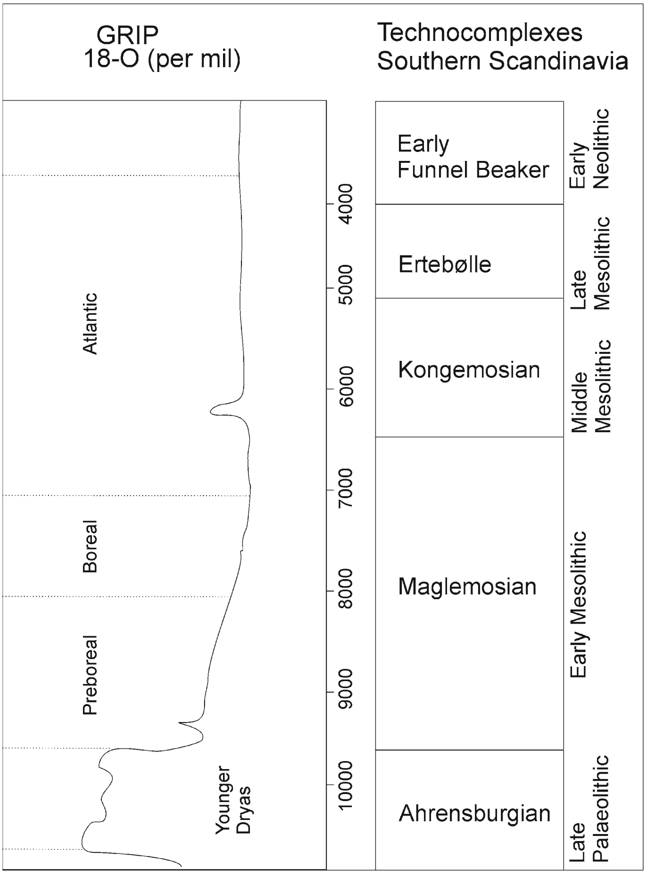

Fig. 9.1 Chronology, climate and chronozones of Mesolithic Southern Scandinavia (After Terberger 2006)

9.2 From Direct to Pressure and Punch Techniques in Southern Scandinavia: A Close Examination

Seven different concepts of blade production within the Maglemosian have been defined, representing four different diachronic techno-complexes (Sørensen 2006a, b) (Fig. 9.2).

During the Preboreal and the beginning of the Boreal period (9500–7000 B.C.), blades were made from unipolar cores. From techno-complex 2, dual platformed prismatic cores also appear. The blades from these periods have a generally irregular morphology. Typical blade attributes for the techno-complex 1 are triangular butts with impact cones, a variety of bulbs of percussion from mainly large to small and broken, with examples of split cone fractures. In the techno-complex 2, blades

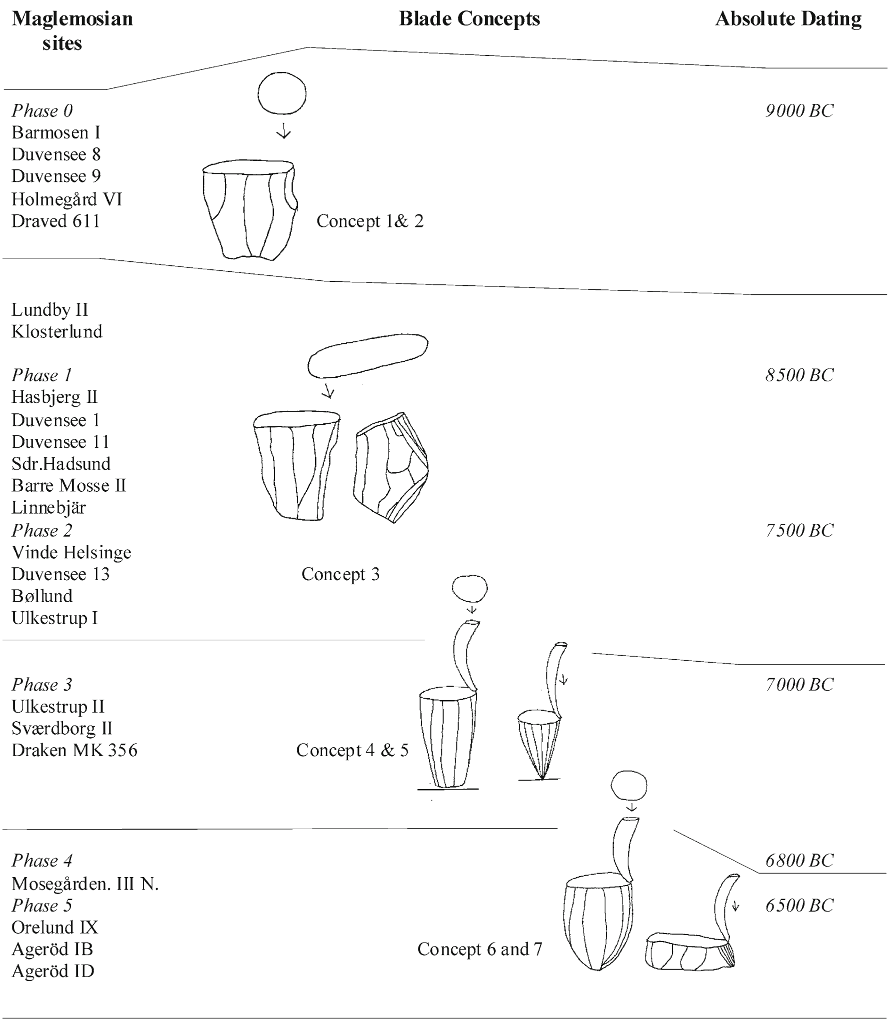

Fig. 9.2 The four technological defined complexes of the Maglemosian. The horizontal rows of the table below show the investigated sites classified according to the relative microlith chronology phases 0–5 with respect to the seven proposed concepts of blade production which are illustrated in the vertical columns. References: Barmosen I (Johansson 1990), Duvensee 8 (Bokelmann et al. 1981), Duvensee 9 (Bokelmann 1991), Holmegard VI (Becker 1945), Lundby II (Henriksen 1980), Klosterlund (Petersen 1966), Hasbjerg II (Johansson 1990), Duvensee 6 (Bokelmann 1971), Duvensee 13 (Bokelmann 1985), Sdr Hadsund (Petersen 1966), Barre Mosse (Skar 1987), Linnebjär (Salomonsson 1965), Vinde Helsinge (Mathiassen 1943), Bøllund (Petersen 1966), Ulkestrup I & II (Andersen et al. 1982), Sværdborg II (Petersen 1972), Mosegården III N (Andersen 1985), Orelund IX (Andersen 1985), Ageröd 1B & 1D (Larsson 1978)

are generally thinner with small bulbs and often small punctiformed butts or broken proximal ends (*fracture languette*). The blade attributes from the first two complexes thereby point to the use of respectively direct hard hammer percussion and direct soft stone hammer percussion when blades were produced.

Pressure blade technology arrived in Southern Scandinavia in the Maglemosian techno-complex 3 with the transition to the Atlantic period. Thereafter, this technology was in continuous use until the Ertebølle Culture. To understand the technological leap between direct percussion blade productions in techno-complex 2 to pressure and punch blade production in techno-complex 3, the contexts of blade production within the Maglemosian have to be investigated.

Substantial lithic material produced by pressure and punch technologies have been excavated as well as collected from several Maglemosian sites, especially in the large moors on Southern and Western Zealand and Eastern Denmark (Andersen 1983; Henriksen 1980; Johansson 1990; Schilling 1999). Most of these sites, however, were inhabited repeatedly through the Maglemosian (e.g. Sværdborg I and Lundby) and must be defined as mixed sites that are not suitable for contextual technological analysis. Among the few excavated sites, which are spatially defined and interpreted to have been used only within techno-complex 3, are the sites Ulkestrup II, hut 2 (Andersen et al. 1982) and Sværdborg II (Petersen 1972). Additionally a small, unmixed site named Draken MK 356 with an assemblage typical to techno-complex 3 was excavated recently in Scania (Sweden) (Gidlöf 2008; Sørensen 2007).

When blades and cores from the techno-complex 3 assemblages are analysed, extreme regularity is found compared to previous periods blade industries (Fig. 9.3). Techno-complex 3 blades range from 15 mm in width and 10 cm in length to 6 mm in width and 4 cm in length. Blades are prismatic, rather straight, and they generally show a combination of bulb and lip formation at their proximal ends. Butts are unfacetted and typically oval and unbroken. The dorsal faces of the blades display a careful trimming of the proximal edges by small feathering removals. A typical attribute is that most blades have broken distal ends and that blades generally seem to break during production. Fragmentation 'en languette' is seen on the larger blades, and this attribute appears in some cases also from the distal blade ends (Fig. 9.3k). Cores are single platform, unfacetted and can be both circular and single fronted. Generally, the cores display a series of regular blade removals (Fig. 9.3a, b).

Investigations of the blade production methods in techno-complex 3, employing a dynamical technological classification in which the blade assemblages are classified in accordance to the blade production process (*chaîne opératoire*) (Schild 1980; Sørensen 2006b) and series of lithic replicative experiments, by this author, in order to test, analyse and evaluate the specific technology (Sørensen 2006a, b) (Fig. 9.7), suggests that the blades were produced using two concepts: (1) a concept for production of macroblades by punch technique and (2) a concept for production of microblades by pressure technique. The appearance of regular bullet-shaped microblade cores up to 7 cm, together with microblades of extreme regularity and straightness being up to 9 mm in width, is evidence of the use of

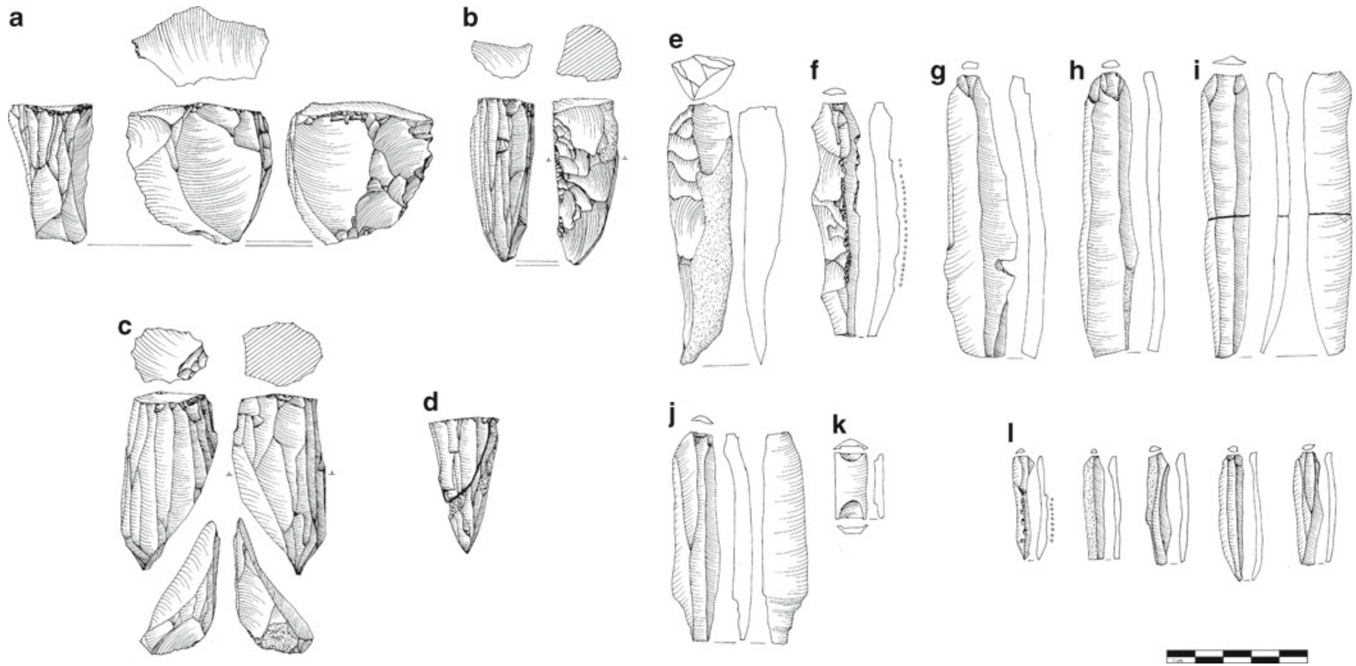

Fig. 9.3 Blades and cores from Maglemosian techno-complex 3. Site Ulkestrup II. (**a**) Single fronted microblade cores preform. (**b**) Exhausted single fronted microblade core. (**c**) Circular refitted core type. (**d**) Exhausted circular (bullet shaped) core type. (**e–h**) Macroblades typical of different production stages. (**j**) Blade with distal fracture *en languette* typical of punch technique. (**k**) Medial bladefragment with fracture *en languette* from both distal en proximal end typical of blades produced with distal support. (**l**) Microblades typical of an initial blade sequence (Drawing L. Johansen)

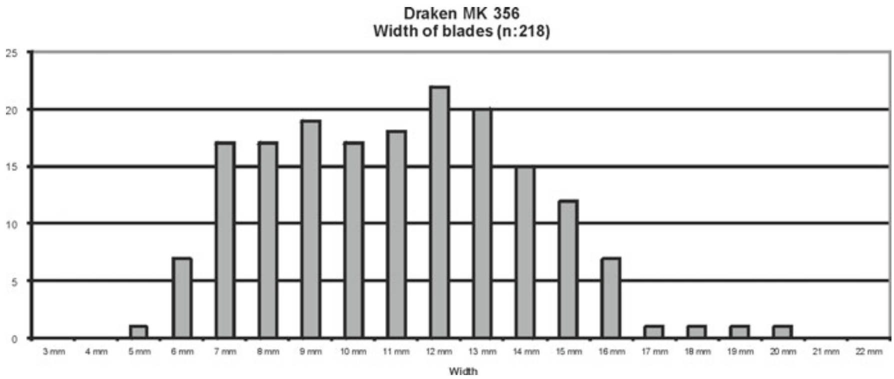

Fig. 9.4 Width measurements of the blade populations from the Scanian techno-complex 3 site Draken MK 356. It is seen that the blade populations of the concept 4 and 5 (punch and pressure techniques) have a metrical overlap. From the technological analysis it is suggested that the pressure blades have width up to 9 mm while punch made blades can have a greater width

pressure technique in techno-complex 3. Cortical, crested and regular thicker blades showing a width up to 15 mm are evidence of indirect percussion techniques. The blade industries from these two concepts, however, cannot be entirely isolated in the assemblages. The blades produced in the two concepts have many of the same morphological and technological attributes, and, as documented in the assemblage from Draken MK 356, there is a metric overlap between the two blade populations (Fig. 9.4).

Complete macroblade cores are seldom found at sites from techno-complex 3. The reason for this is probably that the macroblade cores were reused for the microblade production in a continuous production process. This continuous use can explain the metrical overlap between blades made by means of pressure and punch technique in techno-complex 3. One refitted blade core from Ulkestrup II can be interpreted as being in the stage when pressure technique was to be applied after the core initially had been exploited by punch technique (Fig. 9.3c).

An examination of the techno-complex 3 sites, for example Ulkestrup II and Sværdborg II, has revealed that two different methods for production of microblade core preforms are carried out at the sites (Fig. 9.5). Method A: Circular macroblade cores are reused as microblade cores resulting in circular conical (bullet shaped) microblade cores. Method B: (1) Oblong keeled microblade cores are produced and exploited from one front, resulting in exhausted single fronted cores. The two different methods for the production of pressure blades in techno-complex 3 constitute an important observation concerning the problem of arrival/innovation for the understanding of the development of the pressure blade technology in techno-complex 4, as shall be discussed below.

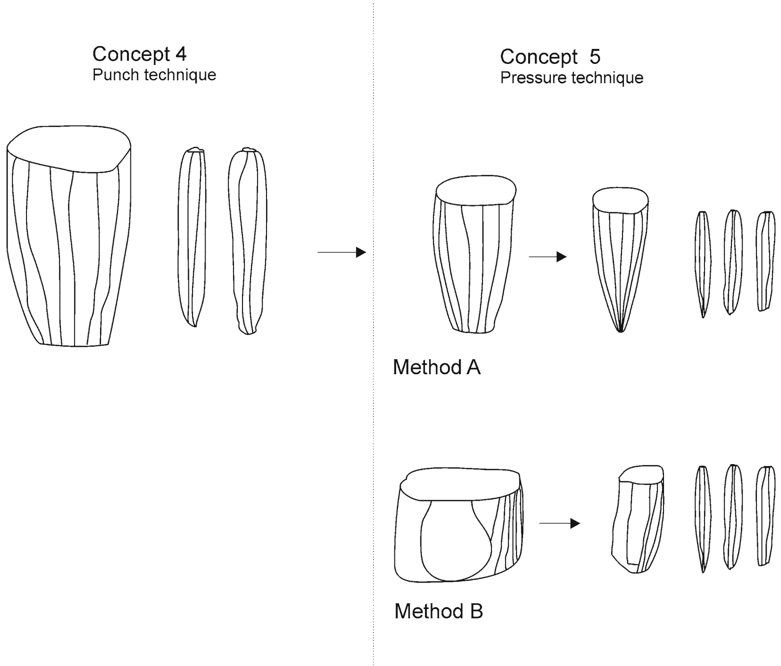

Fig. 9.5 Two methods for microblade production in Maglemosian techno-complex 3 (Drawing M. Sørensen)

Macroblade cores have, judging from the blade and core attributes, been distally supported during production in techno-complex 3. The straight blades of complex 3 point to this technological feature (Bordes and Crabtree 1969), and this hypothesis is strengthened by the fact that within the blade assemblage, there are fractures 'en languette' from the distal blade ends (Fig. 9.3k).

Several well-preserved elk antler tools were found at the Ulkestrup II site, which are interpreted as lithic pressure tools due to their morphology and use wear (Fig. 9.6) (Andersen et al. 1982: 79).

The bullet-shaped microblade cores must, due to their low inertia, have been fixed mechanically during blade production. Moreover, their circular morphology suggests that this fixation was flexible in a way which could allow the core to be easily turned after each blade detachment. Thus, a fixation system in which the core's lateral edges were held in a 'V'-shaped holder that also supported the distal end of the core seems most plausible (Pelegrin 1984c).

One of the observations made during the replicative experimental work was that the specialized single fronted microblade cores of techno-complex 3 (Fig. 9.3a, b) could be held as efficiently as the bullet-shaped cores in the 'V'-shaped holding system (Fig. 9.7).

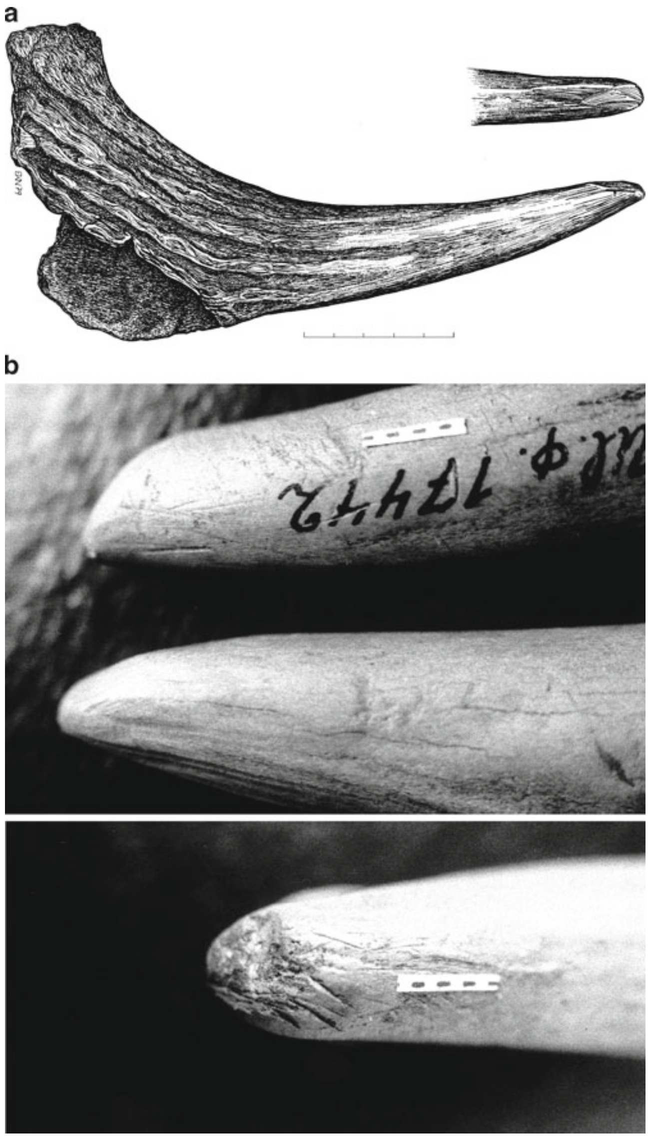

Fig. 9.6 Antler tools, possibly used for pressure blade production. (**a**) Pressure tool of elk antler from Ulkestrup II, length 21 cm (Drawing E. Koch). (**b**) Use wear on pressure tools from Ulkestrup II (Photo M. Sørensen)

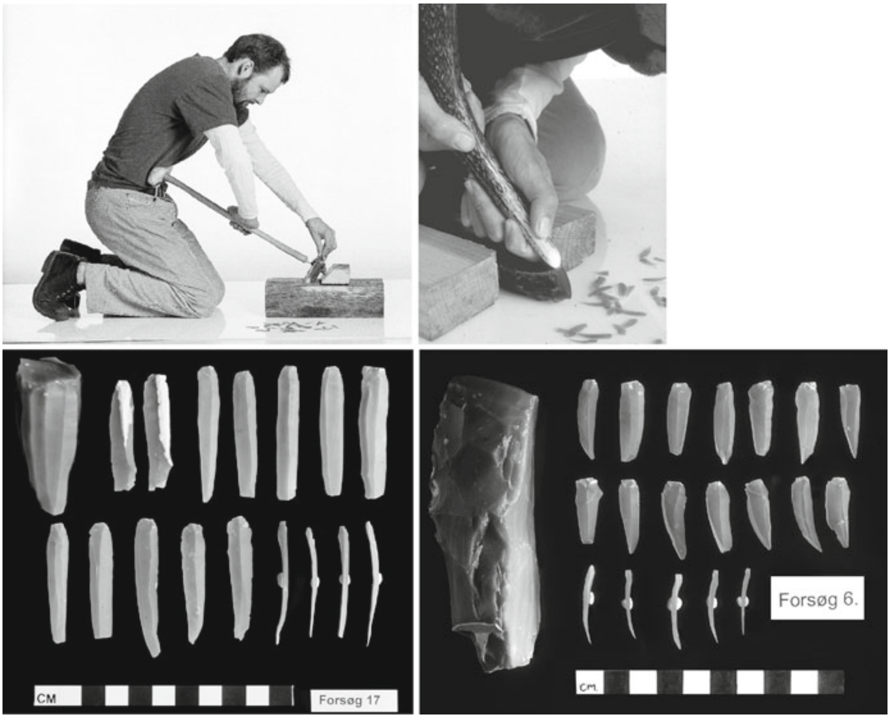

Fig. 9.7 Experiments the pressure micro blade concepts of techno-complex 3 (*to the left side*) and techno-complex 4 (*to the right side*) (Photos J. Sørensen)

9.3 The Absolute Dating of the First Pressure Blade Technology in Southern Scandinavia

Pollen analysis from the Sværdborg II and Ulkestrup II sites dates to the Boreal-Atlantic transition, 7500–7000 B.C. (Aaby 1993). Radiocarbon dating of the mentioned sites within techno-complex 3 is generally problematic as absolute dates are few and were made early in the history of radiocarbon analysis. From Ulkestrup II, hut 2, two dates have been obtained (K-1507 and K-2176) of which only the latter (8030 ± 140 B.P., calibrated to 7180–6690 B.C.) is considered viable due to a problematic site taphonomy. It thus seems possible that the pressure blade technology appears for the first time in Southern Scandinavia around 7000 B.C. Future AMS dating of artefacts from techno-complex 3, for example Ulkestrup II, can provide a more precise dating of this event.

9.4 The Development of Pressure Blade Technology in Southern Scandinavia

Concerning the subsequent Maglemosian techno-complex 4, many of the same problems existed with mixed assemblages as were seen for techno-complex 3. The sites Mosegården III and Orelunde IX from Åmosen on Zealand are among the few sites which can be considered unmixed (Andersen 1985). From Scania, the large sites Ageröd 1:B and 1:D belong to techno-complex 4 (Larsson 1978).

In techno-complex 4, a microblade and macroblade concept involving, respectively, pressure blade production and punch technique is maintained; however, the concepts are altered compared to techno-complex 3. Techno-complex 4 blades are generally very regular and prismatic, but metrically, the microblades generally decrease in size and thickness while the macroblades increase in size and thickness compared to techno-complex 3 (Fig. 9.8). Thus, in contrast to the techno-complex 3, two metrically different and distinguishable blade industries clearly exist in the techno-complex 4.

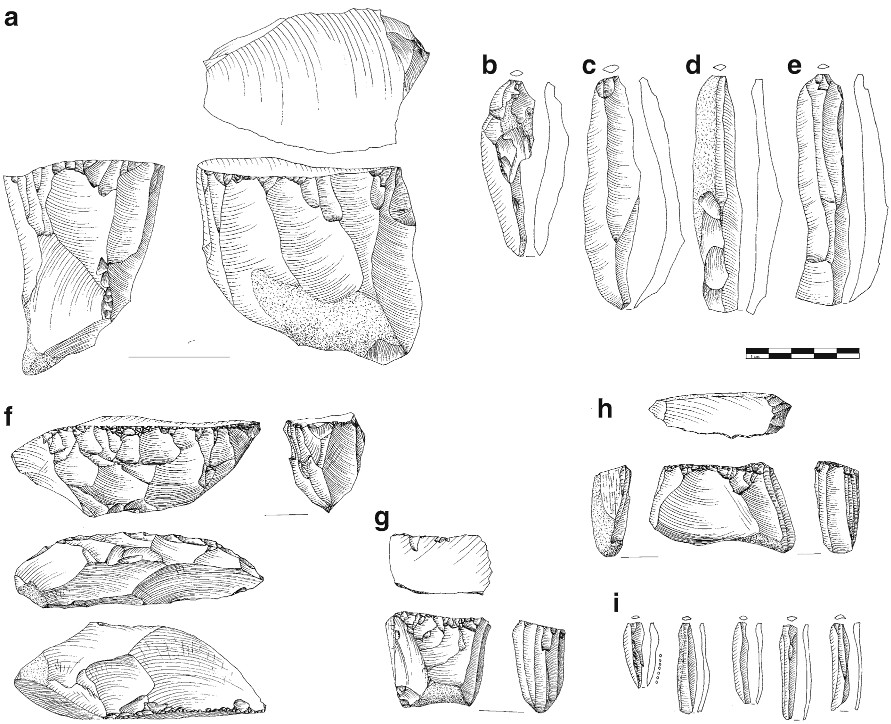

Fig. 9.8 Blades and cores from the Maglemosian techno-complex 4. Site Mosegården IIIN. (**a**) Preform for macroblade production. (**b**–**e**) Macroblades typical of different production stages. (**f**) Oblong keeled microblade core preform. (**g**, **h**) Exhausted oblong keeled microblade cores. (**i**) Microblades typical of different production stages (Drawing L. Johansen)

Concerning the regular macroblades, these are now generally more curved, larger and more robust than in the previous techno-complex 3. The difference can be interpreted as resulting from a change to distally unsupported macroblade cores, resulting in more curved subconical blade core morphologies and subsequently more curved and robust blades (Sørensen 2006a, b).

The microblade production undergoes a more substantial conceptual difference, in which the pressure blade method B from the previous techno-complex 3 seems to be developed. During techno-complex 4, a large keeled blade core morphology is produced (often termed the handle core). Such cores are produced from nodules or from large, specifically produced, thick flake blanks. The blade core type is mostly exploited from only one front, in few situations however, the core type is turned and reused from the opposite end.

A main difference between the microblade productions in techno-complexes 3 and 4 can be related to the morphology of the blade cores and how they were held during manufacture. While microblade production in techno-complex 3 probably had to take advantage of an open holding device, so that the knapper could be able to change the position of the circular (bullet shaped) cores after each blade detachment, the oblong keeled cores have a long rear end, that could be permanently fixed during blade production.

There are several attributes indicative of the change to a permanent fixation system of the rear ends of the oblong keeled core types in techno-complex 4. Firstly, this core type is generally discarded with a long rear end, as if the cores were not completely used up. This phenomenon can be explained if the cores were used in relation to a permanent fixation system, which 'occupied' the rear end of the blade cores. A second indication is based on microscopic analysis of the lateral blade core faces. A blade core from the Orelunde IX assemblage was examined under the microscope, and areas of use and wear, in the form of striations, were observed (Fig. 9.9). These striations are interpreted as resulting from a hard squeeze on the lateral faces of the core in combination with lithic dust and small movements of the core (Sørensen 2006b). This type of analysis was also conducted on keeled cores from the Scanian site Tågerup, belonging to the Kongemosian Culture, and showed wood polish on central arises on the lateral faces of the studied keeled cores. The interpretation is that a clamp made from wood had been in use to hold the core during blade production (Karsten and Knarrström 2003: 49).

A typical feature of the oblong keeled blade core type is that the lateral platform edges are heavily trimmed. These observations formerly lead to the belief that the core was a scraper, called the 'keeled scraper type' (Westerby 1927). However, in a series of replicative experiments, a permanent fixation system of the lateral sides of the keeled core types were tested, and the results can explain the heavy trimmed lateral core edges (Sørensen 2003; Sørensen 2006b). It was discovered that, if the clamp system rests on untrimmed lateral edges of the core, large damaging platform flakes will be detached when force is applied to the platform via the pressure tool. In order to avoid crucial damage to the blade core platform, the lateral edges should therefore be heavily trimmed before the core is mechanically fixed.

The two blade concepts and methods used in the Maglemosian techno-complex 4 were, with minor differences, continuously in use during the following

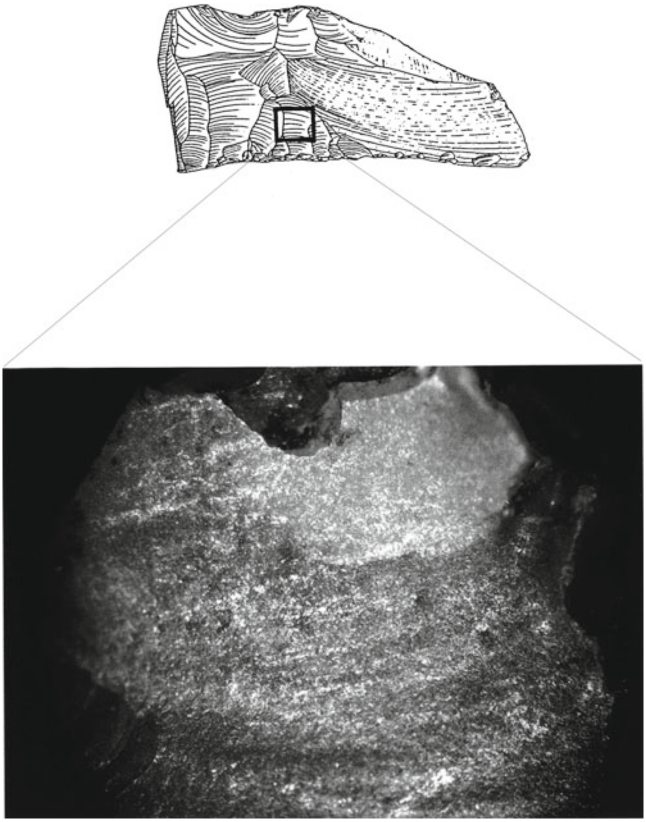

Fig. 9.9 Microwear seen as striations on the keeled blade core face from Orelund IX, interpreted as results of a holding device (Photo B. Knarrström)

Kongemosian period. Nonetheless, there is within concept 7 (Sørensen 2006a, b) (microblade production from keeled cores), during the Kongemosian, a tendency towards a decrease in the quality of the microblades and towards producing keeled core preforms increasingly on flake blanks rather than on small single nodules (Petersen 1993: 58). At the beginning of the Late Mesolithic Ertebølle Culture, the microblade concept 7 is discarded, and with the abandonment of this concept, the pressure blade technology in Southern Scandinavia 'dies out'.

9.5 Knowledge and Know-How in Relation to Pressure Blade Production

Pressure blade production can be described as a technology which, to be carried out, contains a great deal of knowledge in relation to know-how. The nature of knowledge is explicit, which means that it can be transmitted verbally, while know-how has an intuitive nature related to the body memory. Know-how can therefore mainly be achieved through practical training (Pelegrin 1990; Apel 2001).

Specific knowledge about pressure blade production in Mesolithic Scandinavia, appearing with the techno-complex 3, comprises information about several new techniques and knapping tool types in relation to earlier blade production techniques. These techniques are, for example, a mechanical core fixation system and a flexible, perhaps compound, pressure tool. The know-how needed to perform the pressure blade technology seems, on the other hand, to be limited and could thereby quickly have been achieved by Mesolithic flintknappers who already had substantial training from their day-to-day knapping experiences.

Personally, this paradox between knowledge and know-how was experienced when the pressure blade concept was practically learned. The knowledge needed to produce pressure blades, i.e. information about the construction of the pressure tool with the right flexibility and the construction of a holding device, was by far the most challenging part of the learning process. Once knowledge was gained about the device and the right tools were built, the blade production process itself was straightforward. In fact, with the system set up, it was possible to instruct (transmission of knowledge) a person without experience in flintknapping and have him or her produce pressure blades successfully. In contrast, this is generally not possible with blade concepts in which direct percussion is employed, as in techno-complex 1 and 2, because the knapper in this situation needs more practice (know-how). As discussed below, the relation between knowledge and know-how concerning pressure blade production is important when considering the crucial question of invention versus transmission of this technology.

9.6 Local Development or Diffusion of the Pressure Blade Technology in Southern Scandinavia

The Maglemosian is generally considered as a stable and conservative period with respect to typology, economy and settlement patterns. Despite the use of antler pressure tools and a possible holding device, no new tool types seem to have been introduced with the emergence of pressure technique in techno-complex 3. Thus, no new developments in subsistence and economy can be related to the use of pressure blade technology during the Maglemosian. The pressure and punch blade technology can be defined as a substitute for the former blade technologies, while the products (i.e. blades) are used for the same purposes as in the previous Early Mesolithic techno-complexes.

Economically, one could stress the raw material situation and argue that the increase in forests and coverage of the soils by vegetation during the Boreal periods resulted in a restricted access to lithic raw materials. This could have led to a more economical use of the lithic raw material and consequently the invention of the pressure blade technology. However, this argument does not seem to be valid as the assemblages from sites in techno-complex 3 often have large quantities of first quality flint materials and large surpluses of blade products, which are seemingly unused. Moreover, many areas in Scandinavia and Europe had a much more restricted access to lithic raw materials during the Early Mesolithic, which never resulted in the invention of pressure blade technology.

On these grounds, it is argued that the pressure blade technology did not fulfil a specific economic or functional need in the Maglemosian society which was not already fulfilled effectively or resolved by the previous blade production methods. To conclude, no functional, economical or environmental reasons have been found within the Southern Scandinavian area which can support an argument for a locally inspired innovation of the pressure blade technology.

9.7 The Problem of Studying Diffusion in the Maglemosian

The general idea within the Danish Mesolithic research has been that the Southern Scandinavian area yielded an independent development. In comparison, archaeologists from other nationalities in Northern Europe have, with some exceptions, described 'their' Early Mesolithic cultures independently and with a national terminology based on local site names. Regional and national research has often been focused on chronological studies, based on microlith morphology and frequency, and therefore not much attention has been paid to technology or the changes in blade production and the emergence of pressure blade technology within the period. This former research tradition of the Early Mesolithic complicates investigations of diffusion of ideas, technologies or the migration of people within the period.

9.8 A Search for Pressure Blade Technology in Areas Adjacent to Southern Scandinavia During the Early Mesolithic

In middle and Northern Scandinavia, the site Sujala in Northern Lapland, dated to around 8100 cal B.C., has clear traits of the pressure blade technology (Rankama and Kankaanpää 2008); however, this site is convincingly related to the post-Swiderian tradition and must be regarded as an example of a north-west penetration from the Eastern Baltic areas and Russia. From the West, i.e. the British Isles, pressure blade technology is not detected, as neither punch nor pressure seems to have existed in these areas during the Mesolithic (Costa et al. 2005). During the Preboreal and Boreal, when a land bridge existed between Southern Scandinavia and the British Isles, the blade technologies were similar in these areas; however, this similarity stopped when the sea level increased and the British Isles formed during the Boreal and Atlantic period, complicating contact between the two areas.

The Mesolithic of Northern Germany is part of the same cultural development as Southern Scandinavia from the Maglemosian onwards (Bokelmann 1999; Gerken 2001; Hartz et al. 2007; Terberger 2006), but in the adjacent Southern areas, there are seemingly no signs of pressure blade technology during the Early Mesolithic.

In contrast, the areas to the East, comprised of the Baltic states and Northern Poland, are yielding several Early Mesolithic assemblages from the post-Swiderian cultures, for example the Kunda Culture dated to the Preboreal and Boreal periods (9th–8th millennium B.C.), with artefacts indicating common use of pressure blade technology (Burov 1999; Sulgostowska 1999; Zhilin 1999). The Kunda Culture, as represented by the Pulli, Zvejnieki and Tlokowo sites situated in today's Estonia, Latvia and Eastern Poland, has an inventory and a technology which points towards an eastern Paleolithic origin (Sulgostowska 1996). Sites attributed to the Komornica Culture in Eastern Poland (e.g. the sites Lajty, Calowanie, Mszano and Chwalim) can, due to technology and typology, be regarded as part of the Early Mesolithic Western techno-complexes (Sulgostowska 1996, 1999), comparable to the Maglemosian techno-groups 1 and 2. Thus, in the eastern Baltic area, i.e. in today's Northeastern Polish lowland, there seems to have been an overlap between the Kunda Culture and Mesolithic groups of a Baltic/Western tradition.

9.9 Pressure Blade Technology in the Kunda Culture

A main lithic technology of the Kunda Culture is a blade concept in which extremely regular and straight blades are produced from single platform circular cores with facetted platforms. The blades are exploited so that the first sequence of relatively large blades are used for tanged points and large formal tool types, while the late blade sequence of smaller blades and microblades are used as inserts in slotted bone points (Sulgostowska 1996, 1999). If we focus on the Kunda blade technology in relation to the Maglemosian, it is evident that the concept of Kunda blade production is equal or strongly related to the blade production concepts introduced in the Maglemosian techno-complex 3. The main difference seems to be that within the Kunda Culture, platforms are currently facetted during the blade exploitation, while in the Maglemosian tradition, they are kept plain.

It is further evident that the technology of using snapped pressure blades as inserts into slotted bone points, a characteristic of the Late Maglemosian and Kongemosian in Scandinavia, is a technology which was used in the Baltic states and Western Russia, i.e. in the Kunda Culture prior to the Maglemosian. Thus, despite the fact that bone tools with lithic inserts appear before techno-complex 3 within the Maglemosian (Sarauw 1903), it is obvious that pressure blade production and the production of slotted bone tools are two connected technologies that are typical of an eastern Early Mesolithic tradition.

9.10 The Eastern Distribution of the Maglemosian Techno-complex 3

So far, only a little attention has focused on the relationship between the Maglemosian in Southern Scandinavia and the synchronous cultures in Poland (Bagniewski 1990; Domanska 1989). Galinski (2002) operates partly with a Maglemosian terminology

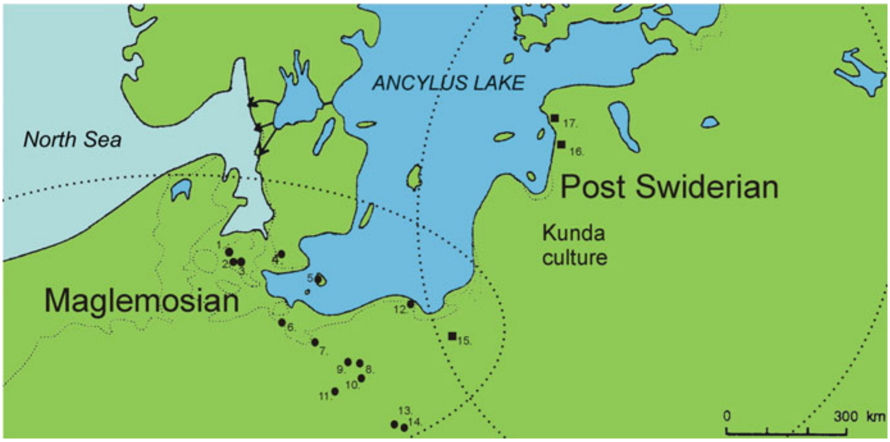

Fig. 9.10 The south Scandinavian and Baltic area with the Preboreal coastline (ca. 9000 uncal B.P.) (After Donner 1995). *Dotted line* represent present day coastline. Site mentioned in the text are numbered. *Round dots*: sites with pressure blade concepts typical of techno-complex 3. *1* Ulkestrup II (Andersen et al. 1982); *2* Sværdborg II (Petersen 1972); *3* Lundby 1 (Henriksen 1980); *4* Draken 356 (Gidlöf 2008); *5* Nr Sandegaard (Becker 1952); *6* Dobra (Galinski 2002); *7* Szczecin-Jezierzyce (Galinski 2002); *8* Wierzchow 6 (Bagniewski 1990); *9* Gudowo 3 (Bagniewski 1990); *10* Pomorski 3 (Domanska and Wąs 2009); *11* Trzebicz Mlyn (Domanska and Wąs 2009); *12* Jastrzebia Gora 4 (Domanska 1989); *13* Dąbrowa Biskupia 71 (Domanska and Wąs 2009); *14* Deby 29 (Domanska 1989); *square dots*: *15* Tlokowo (Sulgostowska 1999); *16* Zviejnieki (Sulgostowska 1999); *17* Pulli (Sulgostowska 1999)

for the different Early Mesolithic phases and complexes in Northern Europe and Poland, identifying, for example a 'Duvensee complex' and a 'Maglemose complex'. The complexes are defined solely on the basis of microlithic typology: The 'Duvensee complex' is typical of lanceolate microliths known primarily from techno-complexes 1 and 2, while the 'Maglemose complex' is defined by scalene triangular microliths typical of technology-complex 3; this typological horizon is sometimes also referred to as the 'Sværdborg phase'. Some of the 'Maglemose complex' sites belong, judging from published artefact drawings, to the Maglemosian techno-complex 3 (the sites Dobra Szcz and Szczecin-Jezierzyce) (Galinski 2002). Also, Bagniewski (1990), Domanska (1989) and Domanska and Wąs (2009) defined Maglemosian sites in Poland, of which several have to be ascribed to the techno-complex 3, often described as part of the 'Sværdborg Culture', including the Wierzchowo 6, Pomorski 3, Gudowo 3, Dobre 53, Trzebicz Mlyn and Dąbrowa Biskupia 71 assemblages from Northwest Poland. The Jastrzebia Góra site and the site Deby (Domanska 1989), situated respectively at the Baltic coast and in the Polish lowland, have blade industries and typologies that resemble the Maglemosian techno-complex 3 assemblages, for example, of the Baltic island Bornholm (Becker 1952). It can thus be concluded that the Maglemosian techno-complex 3, in which pressure blade technology appears for the first time in Southern Scandinavia, can be found from Southern Scandinavia through central parts of the Northern Polish lowland (Fig. 9.10).

It is comparatively interesting to notice that the techno-complex 3 in Southern Scandinavia have an eastern distribution. In fact, it was first defined on the island of Bornholm in the Baltic Sea (Becker 1952), while many of the classical sites (Sværdborg, Lundby and Ulkestrup) are found at Zealand in East Denmark. This picture might, of course, be biased by the research activity, but it nevertheless suggests a tendency towards the Baltic area, which is, perhaps, not coincidental.

9.11 Discussion: Innovation or Transmission

As argued above, pressure blade production mainly depends on knowledge to be carried out. Consequently, pressure blade technology 'only' needs to be shown or observed and transmitted orally before it can be reproduced effectively, while, on the other hand, it is a difficult technique to invent. Lithic technologies heavy in know-how, such as Upper Paleolithic blade concepts (Pigeot 1990) or Neolithic bifacial knapping (Apel 2001), involve training or even apprenticeship in order to be conducted, and they are therefore not quickly transmitted between people. In other words, pressure blade production (without reinforcement) is a technology which can rapidly be spread between people who already have practical know-how and knowledge about lithic fracture dynamics.

The second hypothesis concerns the lack of functional, economic or environmental explanations supporting the innovation of the pressure technique within the Maglemosian. The pressure blade technology replaces the former blade technologies and the blades function but does not fulfil new functional demands. An economical aspect related to pressure blade technology can thus be rejected as a cause for its use or invention in Southern Scandinavia. This does not, however, exclude the invention of pressure blade production during the Maglemosian, but the causes then have to be found within the social or ideological sphere of the society.

The third hypothesis concerns the areas adjacent to Southern Scandinavia. The Early Mesolithic tradition in the eastern Baltic area (Poland and Latvia, often termed the Kormonica Culture) overlaps geographically with the Kunda Culture, which employed the pressure blade technology during the Preboreal and Boreal periods (9th–8th millennium). This shared 'territory' suggests that knowledge concerning pressure blade production could have been transmitted between the two cultural traditions within the area, either with migrating people, or more possibly as transmitted knowledge during regional contacts between people. However, even though pressure was transmitted, the Kunda blade concept was not adopted completely. The Maglemosian tradition of maintaining the core platform's plane by avoiding facetting is unchanged within Southern Scandinavia, in contrast to the Kunda blade concept. The weakness of this hypothesis is the lack of sufficient data, since studies in the Polish area of pressure blade technology during the Early Mesolithic are only few (e.g. Płaza and Grużdź 2010). In order to understand the problem in depth, the original material needs to be studied from a technological perspective.

9.12 Conclusion

This paper has hopefully shed light on Maglemosian pressure blade technology and its development in Southern Scandinavia. On the basis of the technological analysis, it is suggested that the technology of producing pressure blades from single platform cores was transmitted from the Kunda Culture to Early Mesolithic hunter-gatherers of the Baltic and Scandinavian lowlands, known as the Kormonica Culture in Poland and the Maglemosian in Southern Scandinavia and Northern Germany. This transmission supposedly happened during the 9th millennium B.C. in the Southeast Baltic and in the Polish region and is observed in Southern Scandinavia in the 8th millennium. From only one absolute dating of techno-complex 3 assemblages within Southern Scandinavia, it can be suggested that pressure blade technology was carried out ca. 7000 B.C. AMS-radiocarbon dates need to be made on certain techno-complex 3 material before a more certain absolute age determination can be made on the arrival of the pressure blade technology in the region. The pressure blade concept of the Kunda and the Maglemosian differs concerning the preparation of the platforms, in that this preparation does not take place within the Maglemosian.

The pressure technique within flint-rich areas of the Maglemosian (Zealand, Denmark) was applied using two different methods of core exploitation (methods A and B) in techno-complex 3. The method A is equivalent to the Kunda Culture pressure blade concept, while method B employs single fronted oblong cores. It is suggested that during the following techno-complex 4, the single fronted core type is developed into a long oblong keeled core type (handle cores), while method A is abandoned.

So where did the Kunda Culture learn pressure blade technology? Was it a local invention from within the Kunda Culture? According to some researchers (Sulgostowska 1999), the Kunda Culture has an eastern origin in the Late Paleolithic of Siberia and Ural, with ties to sites such as Shikaevka, dated to 13000–12000 B.P. (Abramova 1984), or Mullino (Matiusin 1976). Skeletal material and anthropological data from sites related to the Kunda Culture, for example Zveinieki in Latvia and Popovo, do partly confirm this hypothesis (Potekhina 1999).

Seen from a technological perspective, pressure blades produced from single platform cores are found in the Butovo Culture in the upper Volga basin (Koltsov and Zhilin 1999), dated to the Preboreal period in the 9th millennium B.C. Thus, in a technological sense, there seems to be a link from the Kunda Culture towards an eastern area.

It is, as discussed by Inizan et al. (1992), possible that the pressure blade technology was transmitted as knowledge ('borrowed') across the central Russian plains and that this technology was invented during the Upper Paleolithic around 20000 B.C. in the Mongolian area. This hypothesis is supported by the fact that not only is pressure blade production as a technique 'arriving' in the hunter-gatherer societies of Northern and Eastern Europe (Butovo, Kunda and Maglemosian) but also almost the same concept of producing the blades, namely the use of single platform circular core types, is performed for the initial production of pressure blades. In this light, the Maglemosian can be understood as a cultural period, which receives knowledge about pressure blade production that has travelled across the continent from the Central Mongolian area.

There are many problems to be solved before more certain conclusions can be reached, especially concerning the relationship between the Maglemosian and the post-Swiderian cultures of the Baltic states and the Western Russian area. The national research traditions have so far prevented the Early Mesolithic of the North European lowland and Baltic area from being studied as a whole, i.e. a cultural phenomenon from Poland to Britain, and very few syntheses about the Early Mesolithic of Northern Europe are available. Secondly, the most chronological as well as regional studies of the Maglemosian are based on microlithic morphologies, a narrow perspective that does not facilitate, or in many cases permit, the study and discussion of cultural relations and cultural change within the Early Mesolithic Maglemosian. It is therefore time to leave the national focus and to study the Early Mesolithic internationally and interregionally and from new perspectives. One new perspective could involve detailed studies of specific technologies over large areas, as it has been clearly demonstrated that technology in prehistory, as in modern times, has strong social, traditional and cultural implications.

References

Aaby, B. 1993 Flora. In *Da klinger i muld,* edited by S. Hvass and B. Storgaard, pp. 24–30. Aarhus Universitetsforlag, København.

Abramova, Z.A. 1984 Pozdnij paleolit azjatskoj casti SSSR. In *Paleolit SSSR*, edited by F.I. Boriskovskij, pp. 302–346. Nauka, Moskva.

Andersen, K. 1983 *Stenalderbebyggelsen i den Vestsjællandske Åmose*. Fredningsstyrelsen, København.

Andersen, K. 1985 To Åmose bopladser med håndtagsblokke. *Aarbøger for Nordisk Oldkyndighed og Historie* 1984: 18–46.

Andersen, K., S. Jørgensen, and J. Richter 1982 *Maglemosehytterne ved Ulkestrup Lyng*. Det Kongelige Nordiske Oldtidsselskab, København.

Apel, J. 2001. *Daggers, knowledge & power: the social aspects of flint-dagger technology in Scandinavia, 2350–1500 cal. BC.* Uppsala University, Uppsala.

Audouze, F. 1999 New advances in French prehistory. *Antiquity* 73: 167–75.

Bagniewski, Z. 1990, Maglemose-Kultureinflüsse in Mitteleuropa. In *Contributions to the Mesolithic in Europe*, edited by P. Vermeersch and P.V. Peer, pp. 345–353, Leuven University Press. Leuven.

Becker, C.J. 1952 Maglemosekultur på Bornholm. *Aarbøger for Nordisk Oldkyndighed og Historie 1951*: 96–177.

Becker, C.J. 1945 En 8000-årig boplads i Holmegaards Mose. Foreløbige meddelelser. *Nationalmuseets Arbejdsmark 1945*: 61–72.

Bokelmann, K. 1971 Duvensee, ein Wohnplatz des Mesolithikums in Schleswig-Holstein, und die Duvenseegruppe. *Offa* 28: 5–26.

Bokelmann, K. 1985 Duvensee, Wohnplatz 13. *Offa* 42: 13–33.

Bokelmann, K. 1991 Duvensee, Wohnplatz 9. Ein präborealzeitlicher Lagerplatz in Schleswig-Holstein. *Offa* 48: 75–114.

Bokelmann, K. 1999 Zum Beginn des Spätmesolithikums in Südskandinavien. Geweihaxt, Dreieck und Trapez, 6100 cal BC. *Offa* 56: 183–197.

Bokelmann, K., F.R. Averdieck, and H.Willkomm 1981 Duvensee, Wohnplatz 8, Neue Aspecte zur Sammelwirtscharft im frühen Mesolithikum. *Offa* 38: 21–41.

Bordes, F., and D.E. Crabtree 1969 The Corciac Blade Technique and Other Experiments. *Tebiwa* 12(2): 1–20.

Burov, G.H. 1999 "Postswiderian" of the European North-East. In *Tanged Points Cultures in Europe,* edited by S. K. Kozlowski, J. Gurba and L.L. Zaliznyak, pp. 281–291. Wydawnictwo UMCS, Lublin.

Costa, L.J., S. Sternke, and P. Woodman 2005 Microlith to macrolith: the reasons behind the transformation of production in the Irish Mesolithic. *Antiquity* 79: 19–33.

David, E. 2006 Redskaber af ben og tak i tidlig Maglemosekultur. In *Stenalderstudier*, edited by B.V. Eriksen, pp. 77–100. Jysk Arkæologisk Selskab, Aarhus.

Domanska, L. 1989 Elements of a Food-Producing Economy in the Late Mesolithic of the Polish Lowland. In *The Mesolithic in Europe,* edited by C. Bonsall, pp. 447–455. Donald Press, Edinburgh.

Domanska, L., and M. Wąs 2009 Dąbrowa Biskupia 71: a specialised camp from the Maglemose culture. In *Mesolithic Horizons* Vol I, edited by S. McCartan, R. Schulting, G. Warren and P.C. Woodman, pp**.** 261–269. Oxbow Books, Oxford.

Donner, J. 1995 The Quaternary History of Scandinavia. In *World and Regional Geology* Vol. 7. Cambridge University Press, Cambridge.

Galinski, T. 2002 *Spolenczenstwa mezolityczne*. Museum Narodowe w Szczecine, Szczecin.

Gerken, K. 2001 *Studien zur jung- und spätpaläolithischen sowie mesolithischen Besiedlung im Gebiet zwischen Wümme und Oste.* Kommisionsverlag, Oldenburg.

Gidlöf, K. 2008 *Draken 1: Husie socken i Malmö stad, Skåne län: arkeologisk slutundersökning 2006.* Report, Enheten för arkeologi Malmö kulturmiljö, Malmö.

Hartz, S., H. Lübke, and T. Terberger 2007 From fish and seal to sheep and cattle: new research into the process of neolithisation in northern Germany. In *Proceedings of the British Academy. Going Over: The Mesolithic-Neolithic Transition in North-West Europe,* edited by A. Whittle and V. Cummings, pp. 567–597. Oxford University Press, Oxford.

Henriksen, B.B. 1980 *Lundby-holmen. Pladser af Maglemose-type i Sydsjælland.* Nordiske Fortidsminder Vol. 6. Det Kongelige Nordiske Oldtidsselskab, København.

Inizian, M.L., M. Lechevallier, and P. Plumet 1992 A technological marker of the penetration into North America: pressure microblade debitage. Its origin in the Paleolitihic of North Asia and its diffusion. In *Materials Issues in Art and Archaeology (III),* edited by P.B. Vandiver, J.R. Druzik, G.S. Wheeler and I.C. Freestone, pp. 661–681. Materials Research Society, Warrendale.

Johansen, F.K. 1919 En Boplads fra ældre Stenalder i Sværdborg Mose. *Aarbøger for Nordisk Oldkyndighed og Historie*: 106–235.

Johansson, A.D. 1990 *Barmose-gruppen. Præboreale bopladsfund med skiveøkser i Sydsjælland.* Århus Universitetsforlag, Århus.

Karsten, P., and B. Knarrström 2003 *The Tågerup Excavation*. National Heritage Board, Lund.

Koltsov, L.V., and M.G. Zhilin 1999 Tanged point cultures in the upper Volga basin. In *Tanged Point Cultures in Europe,* edited by S.K. Kozlowski, J. Gurba and L.L. Zaliznyak, pp. 346–360. Wydawnictwo UMCS, Lublin.

Larsson, L. 1978 Ageröd I:B, Ageröd I:D. A study of Early Atlantic Settlement in Scania*. Acta Archaeologica Lundesia* Vol. 12.

Leroi-Gourhan, A. 1964 *Le Geste et la Parole I – Technique et Langage.* Albin Michel, Paris.

Mathiassen, T. 1943 *Stenalderbopladser i Aamosen*. Nordiske Fortidsminder Vol. 3. Det Kongelige Nordiske Oldtidsselskab, København.

Matiusin, G.N. 1976. *Mezolit juznovo.* Nauka, Moskva.

Pelegrin, J. 1984a Debitage par pression sur silex: nouvelle experimentations. In *Préhistoire de la pierre taillée, 2: économie du débitage laminaire: technologie et expérimentation,* edited by J. Tixier, pp 117–127. CREP, Paris.

Pelegrin, J. 1984b Approche technologique expérimentale de la mise en forme des nucléus pour le débitage systématique par pression. In *Préhistoire de la pierre taillée, 2: économie du débitage laminaire: technologie et expérimentation,* edited by J.Tixier, pp. 93–103. CREP, Paris.
Pelegrin, J. 1984c Systèmes expérimentaux d'immobilisation du nucléus pour le débitage par pression. In *Préhistoire de la pierre taillée, 2: économie du débitage laminaire: technologie et expérimentation,* edited by J.Tixier, pp. 105–116. CREP, Paris.
Pelegrin, J. 1988 Débitage expérimental par pression: du plus petit au plus grand. In *Technologie préhistorique,* edited by J. Tixier. Notes et Monographies Techniques du CRA, (25), pp 37–53. CNRS, Paris.
Pelegrin, J. 1990 Prehistoric lithic technology: some aspects of research. *Archeological Review from Cambridge*, 9(1): 116–125.
Pelegrin, J. 2002 Principes de la reconnaisance des méthode et techniques de taille. In *Tell'Atij Tell Gueda. Analyse technologique et fonctionelle*, edited by J. Chabot, pp. 216–225. Cahiers d'Archéologie du CELAT 13, Quebec.
Pelegrin, J. 2006 Long blade technology in the Old World: an experimental approach and some archaeological results. In *Skilled Production and Social Reproduction. Aspects on Traditional Stone-Tool Technologies,* edited by J. Apel and K. Knutsson, pp. 37–69. SAU, Uppsala.
Petersen, E.B. 1966 Klosterlund – Sønder Hadsund – Bøllund. *Acta Archaeologica* (37).
Petersen, E.B. 1972 A Maglemose Hut From Sværdborg Bog, Zealand, Denmark. *Acta Archaeologica* 42: 43–78.
Petersen, E.B. 1973 A Survey of the Late Palaeolithic and the Mesolithic of Denmark. In *The Mesolithic in Europe,* edited by S.K. Kozlowski, pp.77–129. Warsaw University Press, Warszawa.
Petersen, P.V. 1993 *Flint fra Danmarks Oldtid*. Nationalmuseet, København.
Pigeot, N. 1990 Technical and social actors – flintknapping specialists and apprentices at Magdalenian Etoilles. *Archaeological Review from Cambridge* 9(1): 126–141.
Płaza, K., and W. Grużdź 2010 Experimental Study of Pomeranian Flint (Kugleflint) from Mesolithic Excavation Site in Jastrzębia Góra 4. *Materiały Zachodniopomorskie* IV/V (2007/2008): 5–21.
Potekhina, I.D. 1999 Postswiderian population of North-Eastern Europe as seen from the anthropological data. In *Tanged Points Cultures in Europe*, edited by S.K. Kozlowski, J. Gurba and L.L. Zaliznyak, pp. 333–337. Wydawnictwo UMCS, Lublin.
Rankama, T., and J. Kankaanpää 2008 Eastern arrivals in post-glacial Lapland: the Sujala site 10.000 cal BP. *Antiquity* 82: 884–900.
Salomonsson, B. 1965 Linnebjär. A Mesolithic Site in South-West Scania. *Meddelan Från Lunds Universitets Historiska Museum* 1964–65: 5–32.
Sarauw, G.F.L. 1903 En stenalders boplads i Maglemose ved Mullerup, sammenholdt med beslægtede fund. *Aarbøger for Nordisk Oldkyndighed og Historie* 1903: 148–315.
Schiffer, M.B., and M. Skibo 1987 Theory and Experiment in the Study of Technological Change. *Current Anthropology* 28: 595–611.
Schild, R. 1980 Introduction to Dynamic Technological Analysis of chipped stone assemblages. In *Unconventional Archeology*, edited by R. Schild, pp. 57–87. Ossolineum, Wroclaw.
Schilling, H. 1999 Maglemosekulturens bosættelse i Holmegårds Mose – miljøets diktat eller kulturelle valg. Unpublished thesis, Institute of Archaeology, University of Copenhagen, Copenhagen.
Skaarup, J. 1979 *Flaadet. En tidlig maglemoseboplads på Langeland*. Langelands Museum, Rudkøbing.
Skar, B. 1987 The Scanian Maglemose Site Barre Mosse II. A re-examination by refitting. *Acta Archaeologica* 58: 87–104.
Sulgostowska, Z. 1996 The Earliest Mesolithic Settlement of North-Eastern Polasnd. In *The Earliest Settlement of Scandinavia,* edited by L. Larsson. Acta Archaeologica Lundesia Series in 8, No. 24, pp. 297–305. Almquist & Wiksell International, Stockholm.
Sulgostowska, Z. 1999 Final Palaeolithic Masovian Cycle and Mesolithic Kunda Culture relations. In *Tanged Points Cultures in Europe,* edited by S.K. Kozlowski, J. Gurba and L.L. Zaliznyak, pp. 85–93. Wydawnictwo, Lublin.

Sørensen, M. 2003 Experiments with the "Tågerup pressure tool". In *The Tågerup Excavations,* edited by P. Karsten and B. Knarström, pp 146–150. National Heritage Board, Lund.

Sørensen, M. 2006a Rethinking the Lithic Blade Definition – Towards a Dynamic Understanding. In *Skilled Production and Social Reproduction -Aspects on Traditional Stone Tool Technologies,* edited by J. Apel and K. Knutsson, pp. 277–299, Societas Archaeologica Upsaliensis, Stockholm.

Sørensen, M. 2006b Teknologiske traditioner i Maglemosekulturen. En diakron analyse af maglemosekulturens flækkeindustri. In *Stenalderstudier. Tidlig mesolitiske jægere og samlere i Sydskandinavien,* edited by B. V. Eriksen, pp. 19–77. Jutland Archaeological Society, Århus.

Sørensen, M. 2006c The Chaîne Opératoire Applied to Arctic Archaeology. In *Dynamics of Northern Societies: Proceedings of the SILA/NABO Conference on Arctic and North Atlantic Archaeology, Copenhagen, May 10th–14th, 2004,* edited by B. Grønnow and J. Arneborg, pp. 31–44. Aarhus University Press, Copenhagen.

Sørensen, M. 2007 Draken MK 356. En teknologisk undersøgelse at et Mesolitisk inventar med henblik på datering og arkæologisk potentiale. Report, Malmö Museer, Malmö.

Terberger, T. 2006 The Mesolithic Hunter-Fisher-Gatherers on the Northern German Plain. In *Across the western Baltic*, edited by K.M. Hansen and K.B. Pedersen, pp. 11–185. Sydsjællands Museum, Vordingborg.

Toft, P.A., 2006 Hvor går grænsen? Et studium af sociale territorier og ornamentik i Maglemosekulturen. In *Stenalderstudier. Tidlig mesolitiske jagere og samlere i Sydskandinavien*, edited by B. V. Eriksen, pp. 101–119. Jutland Archaeological Society, Arhus.

Westerby, E. 1927 *Stenalderbopladser ved Klampenborg. Nogle Bidrag til Studiet af den Mesolitiske Periode.* Reitzel, København.

Zhilin, M.G. 1999 New Mesolithic peat sites on the upper Volga. In *Tanged Point Cultures in Europe*, edited by S. K. Kozlowski, J. Gurba and L. L. Zaliznyak, pp. 295–311. Wydawnictwo, Lublin.