Invention and European Knapping Traditions

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Abstract and Keywords

This chapter discusses the two main Neolithic flint knapping techniques, pressure flaking and indirect percussion, and the possibility of identifying knapping traditions in archaeological assemblages. Lithic debitage is eminently suited for investigating the technological choices made by flint knappers, and differences in levels of technical competence. In the earlier Neolithic, the use of specific flint types may have contributed to the reproduction of identity on a household or lineage level, and to maintaining kinship and ancestral relations. During the later Neolithic/Copper Age, the patterns of production, distribution, and consumption of flint tools suggest that long blades and tools were endowed with special social and symbolic values.

Keywords: siliceous rocks, blade production, pressure flaking, indirect percussion, craft specialization, distribution networks, long blades, daggers

Knapping techniques

During the Neolithic, the making of tools from flint and other siliceous rocks was organized according to two great conceptual schemes. In the first, the flakes and, more commonly, blades detached from a prepared core were either used as such, or retouched further into specific tool shapes. In the second, blocks of flint were shaped into tools, mostly by bifacial reduction. The second method served mainly to produce rough-outs for axes. This article will focus on the knapping traditions connected with blade production. The different techniques, i.e. the physical actions used in flint knapping, together with the underlying conceptual schemes (often referred to as methods) can be studied by merging the results of three different approaches (Inizan et al. 1992; Beuker 2010):

- observing characteristic traces present on blades, cores, and knapping waste in archaeological assemblages (Andrefsky 1998);
- conjoining or refitting lithic material recovered from knapping sites (Cziesla et al. 1990);

- replicating blanks and tools by systematic experiments (Gallet 1998).

Knapping techniques are defined on the basis of how force is applied, the nature of the knapping tools, and the gestures made by the knapper (Inizan et al. 1992).
The main techniques used for Neolithic blade production are:

- *direct percussion* with a soft, elastic mallet, made from antler, bone, or hard wood;
- *indirect percussion*, in which an intermediate antler or bone tool (punch) is placed on the platform and then struck with a hard or soft hammer (Figure 25.1);
- (p. 484) *pressure*, whereby the blade is detached from the core by applying pressure on the platform with a 'flaker', basically a handle with an inserted tip made of antler, bone, or even copper (Figure 25.2);
- *direct hard hammer percussion*, in which force is applied directly with another rock. This technique is only rarely used in Neolithic blade production.

Unfortunately, the identification of knapping techniques in archaeological assemblages is not quite as straightforward as one would like. Experiments have demonstrated, on the one hand, that different techniques can produce identical or at least highly similar characteristics and, on the other hand, that a single technique may provide variable results (Tixier 1982; Gallet 1998; Pelegrin 2006). To make matters even more complicated, reports by different authors on different series of experiments are not uniform—and sometimes even downright contradictory—in their assessment of several attributes considered characteristic for a given technique, among them the shapes and sizes of butts and bulbs of force, or the longitudinal curvature of the blades (e.g. Gallet 1998; Mateiciucová 2003; Pelegrin 2006). Despite this caveat, most researchers would agree that inferences about knapping techniques, based in part on expert judgement, are feasible.

The most important distinguishing characteristics have to do with the angle between the platform (on which force was applied) and the core face (the surface from which blades were detached). The corresponding angle, between the butt and the dorsal face, on blades is commonly called *angle de chasse*. Cores suitable for direct percussion with a hard or soft hammer tend to display an acute angle between the striking platform and the core face. Consequently, the blades possess an acute *angle de chasse*. For indirect percussion, the cores need to be 'orthogonal', i.e. with an angle between platform and core face of *c*. 80-95°. Cores worked by pressure flaking may be either of the acute angle or the orthogonal type, and the *angle de chasse* on pressed blades varies accordingly. However, pressed blades always are extremely standardized, with parallel edges and arrises.

In practice, it is easy to distinguish direct soft hammer percussion from the other two techniques, either on the basis of the *angle de chasse* or because pressed blades are much more standardized, with very parallel edges and an almost straight profile. The distinction between pressed and punched blades is relatively unproblematic when the former possess an acute *angle de chasse*. Where orthogonal cores were used, the decision is less easy, as the differences are more of degree than of kind: punched blades tend to be thicker, 'heavier', less slender, and less regular than pressure-flaked blades of a similar length (Gallet 1998; Pelegrin 2006). Thus, the blades of the Blicquy culture have been alternatively described as being pressed or punched (Cahen et al. 1986; Allard and Bostyn 2006).

To execute a given technique successfully, a number of secondary 'technical procedures' (Inizan et al. 1992) are needed. They concern, amongst others, creating one or several crests (ridges) to guide the first blade removal and to predetermine the shape and curvature of the core face; preparing and maintaining the desired angle between platform and core face; rejuvenation of the core to correct knapping errors; and even (p. 485) the careful polishing of the blades' surface before applying final retouches. Most of these actions may be performed in several ways, independent of the actual knapping technique, and they leave specific traces on cores and blades. For instance, maintaining the correct platform angle, removing overhangs of previous negatives, and preparing the surface for the next impact may be achieved by trimming or dorsal reduction (removing microflakes from the core face), by faceting (detaching small flakes from the platform), or by rubbing or pecking of the platform and the ridge between platform and core face (Whittaker 1994).

Specific combinations of these procedures may be regarded, to a large extent, to result from technological choices (Lemonnier 1993) rather than technical necessity. In that sense, the way the main debitage technique and supporting technical procedures are combined makes it possible to recognize knapping traditions, with all their implication for the transmission of skills and identity, through time and space—even allowing for some uncertainty regarding the actual technique employed.

Although direct percussion with a soft or hard hammer was in use for the domestic production of blades and flakes throughout the Neolithic (Wechler 1992; Allard and Bostyn 2006), the other two techniques merit greater attention, as both were applied in increasingly complex *chaînes opératoires* to manufacture increasingly longer blades, subsequently shaped into increasingly sophisticated tools. Of the two, indirect percussion seems the more traditional, its different styles resulting mostly from gradual transformations in technical procedures. Within the pressure tradition, however, a number of real innovations—involving not only the invention of a new technique, but the adoption of its results by the community (Ottaway 2001)—have been recognized.

Pressure flaking

Pressure flaking as a technique for producing small blades and for retouching tools was invented during the Upper Palaeolithic (Inizan 2002), and was also practised in the Mesolithic—e.g. in the Scandinavian Maglemosian (Sørensen 2006) and the western Mediterranean Castelnovian (Binder 1998). However, its earliest Neolithic occurrence in Europe, in seventh millennium Greece, seems to have been inspired by Anatolian examples (Perlès 2001).

The first innovation connected to pressure flaking is the controlled, intentional heat-treatment of cores, which changes the physical properties of the raw material and facilitates the detachment of bladelets (Binder 1998). It is first encountered in early and middle Neolithic assemblages in Spain (Martínez-Fernández 1997), and became especially popular during the fifth millennium in the southern French Chasséen. There, heat treatment and pressure flaking interface with indirect percussion, not only as contemporary separate traditions, but sometimes as part of a single reduction sequence in which orthogonal cores first produced medium-sized punched blades and subsequently were reduced in size, given an acute platform angle, and heat-treated. Both the punched blades and the cores were then transferred to regional settlements (Léa 2005). (p. 486) The necessary force may have been applied with small, hand-held flakers—such as that found with the Hauslabjoch Iceman (Spindler 1994), made by inserting an antler spike into a wooden handle.

For the second innovation, no direct archaeological evidence exists as yet. In many areas, however, the pressure technique seems also to have been used to manufacture very long blades of over 40cm. As experiments and theoretical considerations of physical laws show that this would have involved forces far exceeding those a human body can provide, it is assumed that these blades were made using compound flakers, equipped with a levering device to multiply human strength (Pelegrin 2006).

The third innovation, closely connected with the second, concerns the use of copper-tipped levers. Initial indications for their use were derived from the recognition of characteristic cracks on the butts of both archaeological and experimental long blades. Subsequently, in at least one case chemical analyses revealed the presence of actual copper traces on the butts of pressed blades (Renault 2006), and possible copper tips were recovered from relevant archaeological assemblages (Manolakakis 2007). The oldest of these lever-flaked ‘super’ blades are documented in Copper Age north-east Bulgaria during the second half of the fifth millennium. Extraction and manufacturing sites have been discovered close to the Kamenovo tell near Ravno (Manolakakis 2007), from where the blades circulated over distances of up to 900km. Later on, the tradition was transmitted further north to the Ukraine and Poland (Balcer 2002; Migal 2006). Ultimately, it reached southern Scandinavia, where from *c.* 2500 BC onward it was used in the final stages of the manufacture of flint daggers (Apel 2008).

Similar long and very long blades, made from a great variety of high-quality flint types, were made in Spain, southern France, Sardinia, and northern Italy from the first half of the fourth millennium onward (Vaquer and Briois 2006). They, too, are produced by copper-tipped levers, at a period when early metallurgy first appears. Often they were retouched into dagger-like shapes, sometimes partly polished and carrying extremely careful parallel surface retouches, and subsequently distributed over large areas. Some daggers from the Lake Garda region in northern Italy crossed the Alps to reach south-eastern Bavaria, inspiring the manufacture of daggers and other cutting tools from bifacially worked tabular flints, as local raw material constraints precluded long blade manufacture (Tillmann 1993). Similar technological short-cuts have been documented in southern

France and Spain (Vaquer and Briois 2006) and show the importance of long-range networks and the emulation of prestige items for local practices and identities.

Given the considerable spatial and cultural distance between the early south-eastern and south-western European production areas, independent invention of both lever-pressing and the use of copper tips cannot be excluded. In both areas, evidence for the experimental stages of trial and error, and for the gradual acceptance of the new technique and its integration into existing technological and symbolic frameworks (Lemonnier 1993; Ottaway 2001), is still lacking. Its appearance in the western Mediterranean, at a time when copper daggers were still virtually unknown there, suggests that the intrinsic quality of the copper tip, enabling knappers to achieve long and (p. 487) regular blades more easily, may have been appreciated and led to their use before the appearance of copper daggers caused rivalry between flint and copper in the realm of prestige (Renault 1998).

Indirect percussion

The punch technique is rooted in late Mesolithic knapping traditions and was widely practised in both the Mediterranean and the Danubian current of Neolithization. In the former, it is best known from the Cardial (Binder 1998); in the latter it first occurs in the Starčevo-Körös complex. A good example of its gradual transformation is the LBK tradition of central and western Europe. In the earliest phases of the LBK culture, the procedure chosen for core preparation is indistinguishable from that practised by late and final Mesolithic groups (Gronenborn 1999; Mateiciucová 2003, 2008): before each blade was detached, fine-tuning took place by removing tiny chips from the striking platform. As LBK settlement spread westwards, new knapping procedures were devised, apparently independent from indigenous hunter-gatherer practices (De Grooth 2008). They involved increasingly careful initial preparation of cores by means of one or more crests; rather perfunctory trimming of the core face; centripetal platform faceting; and the systematic, almost exuberant removal of whole series of rejuvenation tablets (Figure 25.3)(Allard 2005). These procedures continued to be practised in various combinations by the later LBK and most of the groups succeeding it (Allard and Bostyn 2006), although a disruption occurred with the Cerny group. Core length gradually increased, too, and ultimately, whenever good quality flint was available, medium-sized and long blades were produced from pyramidal or cylindrical cores reduced (semi)revolvingly.

Application of the punch technique seemingly got a new impetus with the Michelsberg culture. At knapping sites connected to flint mines, such as Rijckholt-St. Geertruid (Netherlands) or Spiennes (Belgium)—where an antler punch was found among knapping debris—long blades of 15–25cm were manufactured all through the fourth millennium. The cores were given a flat back and a single, wide core face, which was opened after systematic preparation of three crests. The lateral ones were needed to control the curvature of the core face, and the frontal one served to guide the first blade detachment.

This same type of core is thought to represent the earliest long blade production in Touraine and Poitou, the region around Le Grand-Pressigny flint source. There, shortly before 3000 BC, the punch tradition underwent its final, and most remarkable, transformation with the creation of the *livre-de-beurre* (pound of butter) blade cores. As at Spiennes and Rijckholt, *livre-de-beurre* cores are opened on a wide front and have a flat back; they are, however, much longer, often over 40cm. Moreover, they had just two lateral crests, shaped so that the distal ends of the preparation negatives met at the central axis of the intended core face, forming a ridge to guide the first blade. Before every blade detachment, two small flakes were removed on the striking platform, creating a ridge that was then roughened with a special pecking stone. Experiments indicate that (p. 488) super-long blades could only be detached by indirect percussion using a heavy stone hammer wrapped in leather (to soften the blow) and a specially shaped antler punch, and resting the core on an elastic wooden support to absorb the shock of the heavy blow (Pelegrin 2002).

On a much smaller scale, this characteristic technique was also applied in several other regions, often at a distance of hundreds of kilometres from Le Grand-Pressigny, notably in the Bergerac (Delage 2004), in the Vercors (Riche 2006), and at Romigny and Lhéry close to Reims (Delcourt-Vlaeminck 2004), suggesting that some of the knapping specialists may have been rather mobile, and in part were actively involved in long blade distribution (Pelegrin 2002).

Social connotations

Until recently, many studies of lithic production were mainly concerned with the technological and chronological aspects discussed in the previous section. During the last decades, however, anthropologically inspired approaches increasingly regard flint tools not only in technological or functional terms, but as objects endowed with value and power, playing an important role in constructing individual and group identities (Barfield 2003; Van Gijn 2010). One of the key issues is the position of the flint knappers in their communities, and more specifically the question of specialization (Torrence 1986; Olausson 1997). It is generally—although mostly implicitly—assumed that acquiring and processing of flint was a predominantly male activity. As ethnographic accounts (e.g. Pétrequin and Pétrequin 1999) provide some justification for this view, I tend to adhere to it (but see e.g. Gero 1991 for a different perspective). Basically, the term 'specialist' refers to those people who perform complicated tasks more successfully than others and, because of their special skills, tend to perform them more often as well, whilst also coordinating the work of less experienced team-mates. Moreover, they consistently produce objects for people outside their own household. Because of their special skills, specialists may earn respect and acquire status within their community—there are, however, very few cases of persons identifiable as flint knapping specialists through grave goods (cf. Lech 1980; Korek 1986).

During the entire period, the most widespread type of specialization was regional or between groups. This distinguishes between producers and consumers, the former being involved more actively in the acquisition of raw material, the initial stages of core preparation, and/or blade production (Lech 2003). An early example is the circulation of obsidian in Greece (Perlès 2001). From the mid-fifth millennium onwards, there is increased evidence for within-group specialization as well, i.e. a situation in which the division of labour within a given community was not based on age and sex alone, and accordingly not all households participated to the same extent in lithic production.

Other relevant topics are the examination of the social relations of production, distribution, and consumption of flint tools, and the distinction between routinely produced (p. 489) domestic tools and objects possibly invested with additional, symbolic or prestige value, in part because their manufacture was time-consuming and required special skills.

A well-founded assessment of these issues cannot be based on a single production site or settlement, but should integrate data from extraction and production sites alongside the settlements of producers and consumers (Torrence 1986). Unfortunately, in many cases these conditions are not yet met (e.g. Léa 2005).

An example of such an integrated approach for an early Neolithic context is the Linearbandkeramik of central and western Europe. Here, flint knapping basically was a domestic activity in which all households participated (De Grooth 2007). All Bandkeramik groups preferentially acquired high-quality raw material from considerable distances, rather than make do with local lower-quality rocks. Moreover, they established multidirectional long-distance supply systems for distributing flint and other siliceous rocks, which were maintained for many generations. Ultimately, these networks connected nearly all Bandkeramik settlement regions (Burnez-Lanotte 2003). In many cases, flints were passed on between different regional groups (Allard 2005; Binsteiner 2005), but social boundaries preventing contact have also been identified (Zimmermann 1995). In some regions, pioneer settlements were more actively involved in knapping and functioned as regional redistribution centres (Kegler-Graiewski and Zimmermann 2003; De Grooth 2007). Flint circulated predominantly as prepared or partially reduced cores; only at the end of the supply lines, when cores became exhausted, were blades and tools handed on. However, in the latest phases, a more differentiated pattern emerged, in which nodules and cores were transferred in one direction and blades in others (Allard and Bostyn 2006). In some settlements, lithics arriving from different directions were unevenly distributed among the household clusters (Lüning 2005); in others, at the periphery of the Bandkeramik world, flints from the core region were used more intensively for tool production than local material (Lech 2003).

Thus, the use of specific flint types may have contributed to the reproduction of identity on a household or lineage level, and to the maintenance of kinship and ancestral relations. There is no evidence, however, that flint tools as such were endowed with special values. Repeatedly, subtle changes in knapping style occurred when new regions were settled and new flint sources were being explored (De Grooth 2008). This is probably connected to a need to create a new identity for groups moving away from the ancestral homeland, changing as much of their material culture as possible without alienating the ancestors or causing the preceding generations staying in the homeland to sever supply chains (Sommer 2001).

Production, use, and deposition of long blades

In many aspects, fundamental changes in the organization of lithic production and distribution manifest themselves from the second half of the fifth millennium onwards, especially in areas where more complex societies were emerging. Commonly, a clear dichotomy exists between the bulk of mundane domestic tools, often of low-quality (p. 490) flints, in whose production little skill and effort were invested, and a few exceptional tools made on standardized blades. Their manufacture, more often than not, did not take place in the settlements, but at special locations at or close to acquisition sites. This spatial concentration of procurement and manufacturing, as well as the increasingly complex *chaînes opératoires*, may well have been linked to a higher level of specialization, involving only a restricted number of craft specialists. This idea is borne out by the situation at the Ćmielow settlement in Poland, where only a few households were involved in TRB (Funnel Beaker culture) long blade production (Balcer 2002).

In most studies devoted to the organizational aspects of long blade manufacture, this is regarded as a part-time, seasonal activity, performed alongside subsistence activities (e.g. Felder et al. 1998; Balcer 2002; Pelegrin 2002; Riche 2006). Once more, the Le Grand-Pressigny area may serve as an example (Pelegrin 2002). Unfortunately, at present very little information on settlements in the area is available (Villes 2003), but one may envisage specialists living in the rather large area around Le Grand-Pressigny, where isolated examples of knapping waste occur. A maximum of 10,000 long blades are thought to have been produced there yearly, whilst the daily output of an experienced knapper could have been some 25 blades, deriving from two or three *livre-de-beurre* cores (Pelegrin 2002). Thus, five knapping teams would have needed about three months or, alternatively, 50 teams could have performed the task in less than two weeks.

It is tempting to regard the evidence from the La Creusette hoard (Geslin et al. 1980) as an indication that the latter figure is not entirely unrealistic, as its *c*. 130–140 blades represent a selection of *c*. 500–800 blades produced from 50–80 cores (Pelegrin 2002). Similar hoards of partly conjoinable blades also occur at other knapping sites. Their intentional deposition, with every knapper giving part of his production back to the earth, may be seen as the material expression of ritual, aimed at reconciliation (Edmonds 1998), or imprinting the cosmological significance of the sites on the community's collective memory (Högberg 2006), rather than as a purely utilitarian cache where blades were simply stored for future use.

In such a setting, the transmission of skills may have become more structured, too. However, as knapping traditions still persisted for centuries, the transmission of knowledge and know-how through trajectories of learning-by-doing, enhanced by myths and rituals, must have formed a stable part of communities' routine, not only involving just a chosen few. Although some attempts have been made to distinguish the work of children and less experienced knappers (Bąbel 1997; Pelegrin 2006), this aspect clearly needs to be explored more fully (Bamforth and Finlay 2008). It is not easy to assess how difficult it was to acquire the skills necessary for long blade manufacture in either the punch or the pressure technique. The experiences of modern knappers cannot be uncritically projected on the past, as they had to re-invent during a short time span a range of alien methods and techniques that in prehistoric real-life conditions would have been part of a community's shared heritage (cf. Dobres 2006).

Performing the manufacture of long blades close to raw material outcrops should be seen as a means not only of minimizing time and energy expenditure, but also of (p. 491) stimulating inter-group activities. The congregation of large numbers of people, whose day-to-day relationships as close neighbours may well have been rather strained, could have served primarily to lessen tensions, to re-establish traditional kinship ties and reciprocal obligations, and to re-emphasize group identities. Moreover, the act of knapping would have been performed in an atmosphere of male social competition and emulation, and thus could have played a role in the construction of individual identities as well. Estimates based on experiments and refitting suggest that at Le Grand-Pressigny, every *livre-de-beurre* core would have yielded only some ten super blades, and that a skilled knapper could work two or three cores a day (Pelegrin 2002). In terms of both raw material economy and investment of labour, this seems an extremely inefficient procedure, but it makes sense when regarded as the punchers' answer to the southern French pressers' impressive expression of their social identity.

Little is known as yet of the social context and organizational aspects of long blade distribution, although conjoinable blades in depositions outside production areas indicate that it may have been a structured activity, possibly involving specialist flint knappers. The circulation and consumption of long blades, and of the tools made from them, are commonly connected with male competition and prestige exchange. Some of the evidence suggests, however, that they may have moved in more differentiated social spheres, both in a regional context and after crossing social boundaries.

At the Bulgarian Varna cemetery, the longest blades occurred in the richest graves, suggesting that they were valued precisely because of their size. In other cemeteries of the same region, however, they did not mark high-status males (Sirakov 2002), and in one example they were associated exclusively with females (Chapman 1996). Moreover, in the domestic domain the rare, imported super-long blades were often intentionally broken to the size of locally produced blades and intensively used, for instance in plant-processing activities (Manolakakis 2007).

Fig. 25.1. Witold Migal’s (Warsaw) experimental work on blade production by indirect percussion.

(photo: Inna Mateiciucová, Brno).

Fig. 25.2. Witold Migal’s (Warsaw) experimental production of blades using the pressure technique.

(photo: Inna Mateiciucová, Brno).

Fig. 25.3. Refitted Bandkeramik blade core (L: 15cm) from Beek-Kerkeveld (the Netherlands), showing orthogonal flaking angles and large core rejuvenation tablets.

(photo: Bonnefantenmuseum Maastricht).

Fig. 25.4. Two ‘daggers’ found in the Netherlands: the smaller one on the top (Eext, L. 23.8cm) is made from Le Grand-Pressigny flint, the larger one on the bottom (Buinen, L. 25.1cm) from the Romigny-Lhéry flint type occurring in northern France. Both were manufactured by indirect percussion, carefully polished after detachment, and subsequently shaped by pressure retouch.

(photos: Jaap Beuker, Drents Museum Assen).

The situation in western Europe is equally differentiated. Both pressed and punched long blades were in part carefully retouched into knife- or dagger-like tools. Despite the martial connotation of the latter label, many of them were also intensively used in a variety of plant-processing activities (Plisson et al. 2002), and repeatedly sharpened and recycled. This was not only the case in, for example, Swiss lakeside settlements (Honegger 2001), where they could conceivably have lost their original value and social messages after moving beyond their regional context, but also closer to home—in the case of Le Grand-Pressigny, for instance, in the Paris Basin (Mallet et al. 2004). Recent microwear evidence indicates that even daggers deposited in a seemingly pristine condition in burials had been previously used in such an innocuous way (Clop et al. 2006). On the other hand, in the Single Grave culture of the Netherlands and north-western Germany, imported French daggers really were not treated as utilitarian commodities, but as valued prestige objects (Figure 25.4) (Delcourt-Vlaeminck 2004). This diversity suggests that long blades moved along multilayered trajectories, connecting different social spheres, in which the functional and symbolic aspects of consumption and distribution are best regarded not as entirely separate entities but as intertwined aspects of the same context. (p. 492) (p. 493)

(p. 494) Acknowledgements

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Notes:

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