Chapter 5
Pressure Blade Production with a Lever in the Early and Late Neolithic of the Near East

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5.1 Introduction

Methods associated with the pressure technique in Near East evolved significantly during the Pre-Pottery Neolithic. In this chapter, we present the evolution of this technique used for the detachment of obsidian and flint blade(let)s in the Tigris and Euphrates High Valleys and on the Anatolian plateau since the Early Pre-Pottery Neolithic B (EPPNB), during the middle of the ninth millennium cal B.C.

In the High Valleys, the methods associated with the pressure technique evolved significantly during the Pre-Pottery Neolithic, leading to more regularized and standardized products. In this context, the appearance of large obsidian blades produced by pressure with the use of a lever provides interesting insight to understand the social aspects of this production including the technological experimentation, the innovation and the exchanges that took place during that period. This provides explanation models that can be compared with the prehistoric context of the Balikh Valley. Such a comparison will permit us to understand if the chronological, technological and social contexts of introduction are similar or not in both regions.

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More specifically, we focus on the first evidence for the early production of large obsidian blades using the pressure technique with a lever in Late Pre-Pottery Neolithic B (LPPNB) contexts from the site of Çayönü Tepesi and in the beginning of the Pottery Neolithic (PN) context from the site of Sabi Abyad I. This comparative study permits us to discuss different aspects of pressure technique including the existence of specialists.

5.2 The Tigris and Euphrates High Valleys and the Anatolian Plateau

5.2.1 The Spread of Pressure Blade Production in the Region

The archaeological sequence at Çayönü Tepesi (Fig. 5.1), one of the major Pre-Pottery Neolithic (PPN) settlements in the High Valleys of the Tigris and Euphrates Rivers, provides evidence of the introduction of pressure techniques for bladelet production during the Early Pre-Pottery Neolithic B (EPPNB), in the second half of the ninth millennium cal B.C. This massive introduction overrode, but did not suppress, the technical traditions that were popular during the previous stages. Thus, during the Pre-Pottery Neolithic A (PPNA) and the beginnings of the Early Pre-Pottery Neolithic B (EPPNB), most bladelets were produced locally using soft percussion; the lithic assemblage is completed by importations of blades obtained

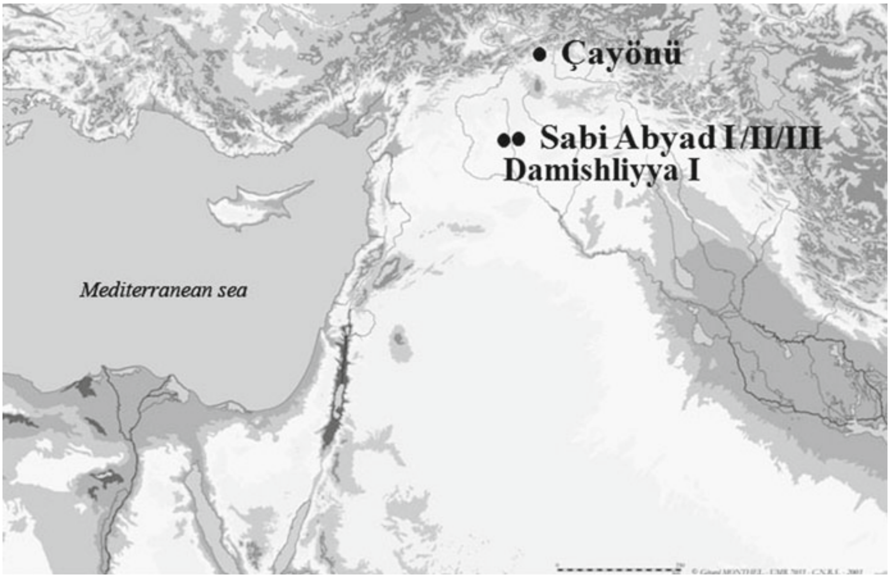

Fig. 5.1 Location of Çayönü Tepesi and Sabi Abyad settlements

from bidirectional or naviform cores, produced by direct percussion too. There is no evidence of the use of pressure to produce blades in the PPNA or PPNA-EPPNB transition occupations at Çayönü Tepesi which suggests that at this time, the High Valleys were linked, instead, to the lithic tradition of the Levantine Corridor (Binder 2008).

It was also during the ninth millennium cal B.C. (EPPNB) that pressure techniques appeared on the Anatolian plateau. The obsidian prismatic bladelet production from the Cappadocian workshops, in particular from the Göllüdağ outcrops, notably the well-known Kömürcü-Kaletepe workshop, spread throughout the whole Near East (Schillourokambos early phase A, Dja'dé, Mureybet, Tell Aïn El Kerkh) between 8700 and 8200 cal B.C. (Binder 2002, 2005; Binder and Balkan-Atlı 2001).

As previously suggested (Cauvin 1994; Inizan and Lechevallier 1994), the appearance of pressure blade production at Çayönü indicates links with Zagros, Caspian and Central Asia, as well as with Yubetsu-Gobi. As Inizan and Lechevallier argue, there is a geographical boundary between pressure and naviform use areas. However, the situation remains unclear for northern Anatolia and the Caucasus, where the early phases of the Neolithic or corresponding occupations are unknown. Despite some export of Cappadocian obsidian bladelets throughout the Levant at the beginning of the EPPNB (e.g. Dja'dé 3), several centuries before the appearance of blade production by pressure in Çayönü, the links between the pressure methods in use in Cappadocia and eastern Turkey are not clear. Radiocarbon dates are rare and often imprecise, and blade series are also uncommon or have been insufficiently studied.

5.2.2 *Trends in Pressure Blade Production at Çayönü Tepesi*

Çayönü displays a significant evolution of pressure methods from the middle of the ninth millennium cal B.C. until the adoption of ceramics in the beginning of the seventh millennium (Binder 2007). Pressure was used to produce blades from three types of raw material: (1) obsidian from Bingöl and Nemrut Dağ outcrops (100–150 km northeast), (2) local grainy flints that were exploited during the entire sequence by percussion and later by pressure, and (3) fine-grained flints imported as cores-on-flakes or as finished tools.

The Çayönü pressure technique is represented by the following evidence:

1. 'Channeled building sub-phase', dating from 8600 to 8200 cal B.C. (end of the Early Pre-Pottery Neolithic B [EPPNB] to beginning of the Middle Pre-Pottery Neolithic B [MPPNB])

   Excavations at building DI revealed (1) local microblade pressure production using imported cores-on-flakes and (2) wider central bladelets from obsidian or local flint. Obsidian accounts for about half of the blanks removed by pressure. The types of debitage produced by working flint and obsidian are similar: semi-conical core shapes, with high or very high transversal convexity, removed in small sequential series. Pressure platforms are orthogonal to the surface and systematically facetted; microblade butts are generally overhanging. Exhausted cores are bullet-shaped and often exhibit a residue of the inferior face on the core-flake. Blade widths are bimodal: bladelets produced from local flint are more than 8 mm wide; microblades produced from imported core-flakes are between 4 and 8 mm wide. Obsidian bladelets are between 4 and 15 mm wide and follow the same distribution pattern as the flints. These features indicate that the pressure detachment was done partly by hand for the microblades and partly with the use of a short crutch while sitting for the bladelets (Pelegrin 1988, 2003, this volume). Some of the characteristics observed on the proximal parts of these blanks, such as the overhang, the marked bulbs and the small platforms, could suggest the use of native copper pressure flakers (Binder 2007, 2008).

2. 'Cobble-paved building sub-phase', dating from 8250 to 7650 cal B.C. (MPPNB)

   Blades produced by pressure represent about half of the blades and bladelets recovered from the building CM series. The flint debitage resembles that from the obsidian from the Channeled building sub-phase and represents about one-third of the pressure blanks. Two-thirds of the flint pressure bladelets are wider than 8 mm. Most of the obsidian bladelets are wider than 8 mm; they were probably flaked in situ from cores with flat platforms, similar to Kaletepe P and Cafer (lower deposits) items, respectively dated to approximately 8300–8200 and 8250–7850 cal B.C. (Binder 2007, 2008).

3. 'Cell building sub-phase', dating from ca. 7500 to 7250 cal B.C. (Late PPNB)

   The CF and DS series show a major reduction in the quantity of flint blades produced by the pressure technique. Heat treatment of flint is evident but seems to be very marginal. Obsidian cores are shaped in situ; they have a low transversal convexity; there are few microblades; and the blade production is primarily represented by parallel and regular pieces. The platforms are flat and inclined or steeply inclined. The blades were probably produced with the use of a short crutch (Pelegrin 1988, 2003, this volume).

4. 'Large room building sub-phase', dating from ca. 7300 to 6750 cal B.C. (Final PPNB)

   The BF building assemblages provide abundant evidence of the production of obsidian bladelets produced by pressure (80% of the blade total) which are very regular (75% with extraction designs 212'; cf. Binder 1984; Binder and Collina, this volume). Compared to the cell building sub-phases, the widths of the bladelets have significantly increased (ca. 12 mm, based on proximal fragments and whole blades). Microblades disappear during this phase. A single, wide obsidian blade was identified in the sample studied by Binder. Flint was still produced by pressure during this sub-phase but in low proportions. The presence of a flint conical core with a faceted platform may illustrate the beginning of diversification in pressure production techniques.

5. Pottery Neolithic phase(s)

   Early Pottery Neolithic contexts in Çayönü are difficult to assign to a chronological period, and radiocarbon dates are not available. The analysis of an assemblage collected from an architectural complex in Trench P25G allows us to identify components for these phases representing obsidian tool production that are similar to one from the large room building sub-phase. During this phase, the production of obsidian blades by pressure became common (Algül 2008).

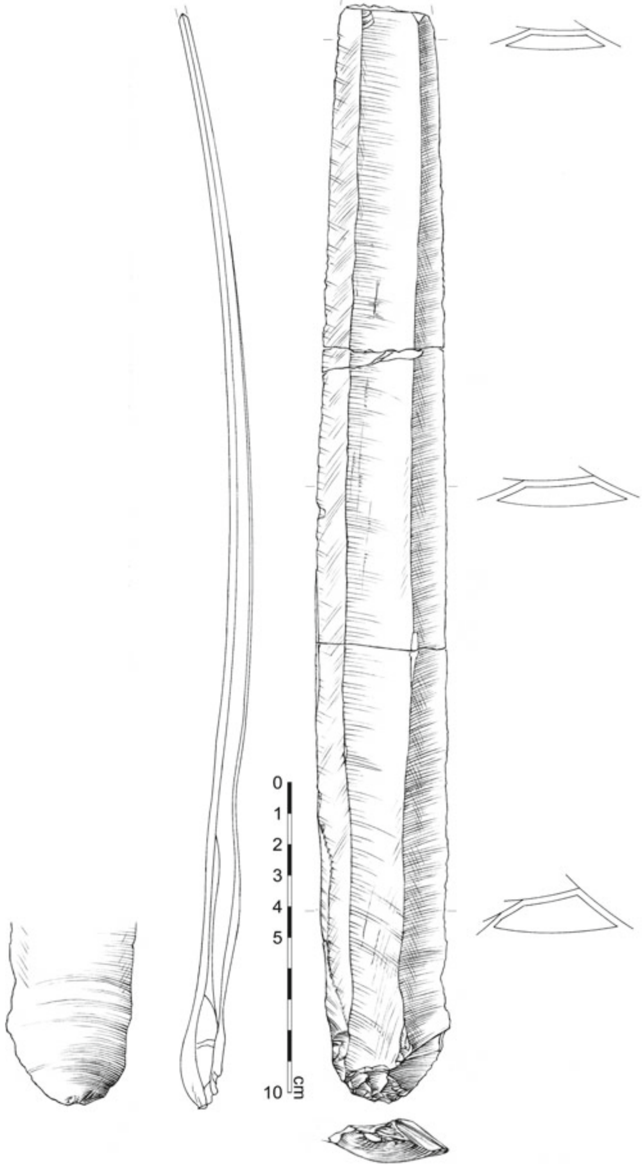

Fig. 5.2 Large blade from Çayönü Tepesi, CV building, Cell Building sub-phase 3 (Late PPNB)

In summary, Çayönü pressure debitage exhibits three trends: (1) an increasingly greater reliance on obsidian compared to flint through time, (2) a constant increase in the width of central bladelets and (3) a transition from a semi-conical type of removal sequence with faceted orthogonal platforms to a more frontal type with flat inclined platforms, which resulted in a more standardized product.

At the end of the PPN, large blades began to be produced (Figs. 5.2, 5.3, 5.4). Fourteen of these large blades have been identified from the cell building sub-phase

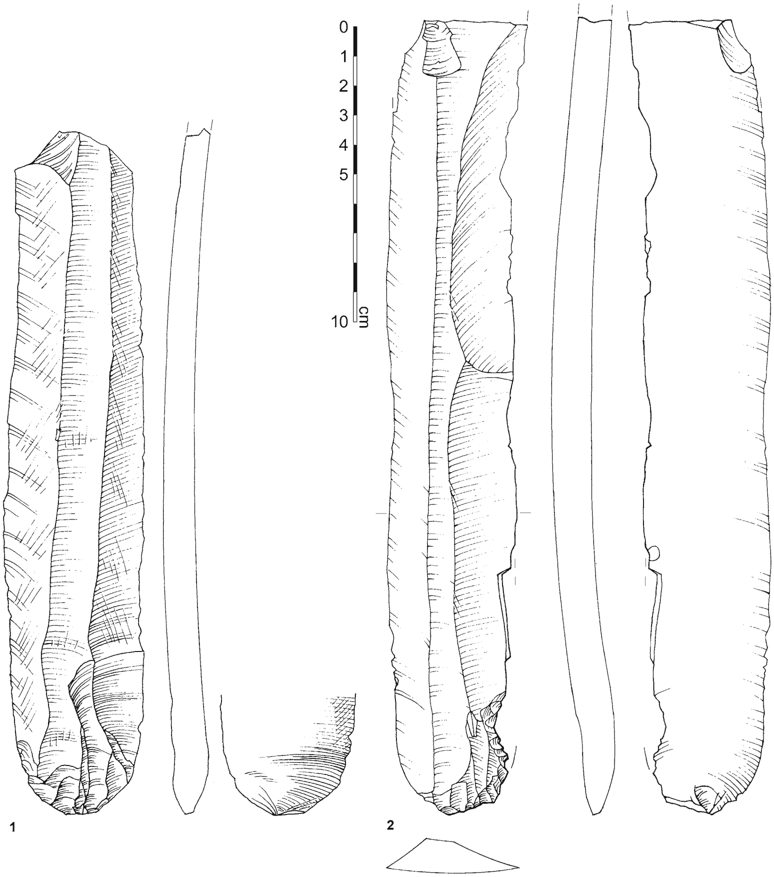

Fig. 5.3 Large blades from Çayönü Tepesi. *1* CV Building, Cell Building sub-phase 3 (Late PPNB), *2* Cell or Large Room Building sub-phase

to the Pottery Neolithic phase. This is a preliminary count based on a sample of the whole assemblage collected from Çayönü: eight blades in the cell building sub-phase (Buildings DE, CV, CE and CY, stages c2 and c3 / Late PPNB); four from the large room (Building BF, stage lr1 / Final PPNB); one from either the cell or large room building sub-phase (18 M, open area); and one fragment from the Pottery Neolithic phase. Among the 14 large blades, four are Çayönü tools, four are Çayönü tools which have been recycled as end scrapers, four are end scrapers and five are unretouched blades with traces of wear. Currently, the large pressure blades are well situated within the Çayönü sequence, dating from the second part of the eighth millennium cal B.C. and at the beginning of the seventh millennium, with a maximum date range of between 7340 and 7080 cal B.C.

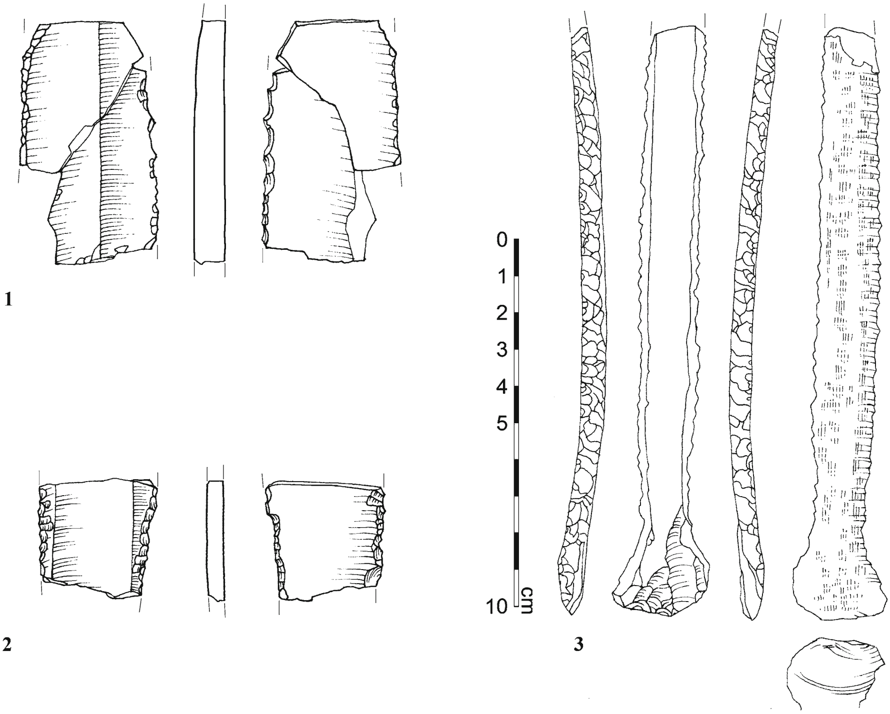

Fig. 5.4 1. Medial fragment of a light large blade with edges damaged, DE building, Cell Building sub-phase 2 (Late PPNB), 2. Blade with bi-lateral retouch, Pottery Neolithic, 3. Çayönü tool, BF building, Large Room Building subphase (Final PPNB) (After Caneva 1994)

5.3 The Balikh Valley and Northern Mesopotamia

5.3.1 Pressure Blade Production in the Region

The introduction and development of pressure blade production in the Balikh Valley from 8500 to 6200 cal B.C. is well documented at four neighbouring sites (Fig. 5.1): Sabi Abyad II (mainly Middle and Late PPNB, and PN) (Verhoeven and Akkermans 2000), Sabi Abyad I (operations 1-2-3, from Early PN to Early Halaf), and to a lesser extent at Sabi Abyad III (Late PPNB/Early PN levels) and Damishliyya I (Late PPNB and PN) (Akkermans 1988). Both excavations and technological studies are in progress for Sabi Abyad I (operation 3) and Sabi Abyad III, and detailed data are not presently available. The situation is rather different from that of Çayönü Tepesi, as pressure technique is clearly evident in the Balikh Valley only from the Middle PPNB onwards and only for obsidian. The obsidian originates in eastern Anatolia, specifically the Bingöl and Nemrut Dağ areas (Astruc et al. 2007; Cauvin et al. 1998). The homogeneous nature of the pressure-flaked materials is striking: they include rectilinear blades or bladelets from cores bearing plane or facetted orthogonal platforms and truncated bases, although variations in the size of the blanks do occur over time.

This specific tradition of obsidian blades produced by pressure is different from the pressure techniques associated with Cappadocian obsidians (as evidenced at Kömürcü-Kaletepe on the Gollü Dağ, EPPNB). It is the main tradition for this period (Late PPN and PN) in northern Mesopotamia, notably east in the Khabur Valley at Tell Sekher el Aheimar and at Kashkashok II (Nishiaki 2000), in the Sinjar at Tell Maghzaliah (Bader 1989), and possibly further south, at Bouqras (Roodenberg 1986). At these sites, pressure-flaked eastern Anatolian obsidian blades were introduced as blanks and, in some occupation levels, represent more than 60% of the assemblages. Bipolar blade production is absent or rare for obsidian and limited for flint. Future studies of these northern Mesopotamian assemblages will focus on the diachronic variations between these three microregions and will allow us to better relate them to the High Valleys, where both pressure technique and large blade production predate the northern Mesopotamian tradition.

5.3.2 Trends in Pressure Blade Production in the Balikh Valley

5.3.2.1 Sabi Abyad II and Damishliyya I (End of Middle PPNB to Early PN)

Pressure bladelets made of obsidian are well represented in Sabi Abyad II and Damishliyya I (Copeland 2000; Nishiaki 2000), making up, respectively, 55% and from 6% to 16% of the two assemblages. The blades are very regular and standardized in form, with widths ranging from 5 to 15 mm and thicknesses of 1–3 mm. They are made from semi-cylindrical or cylindrical cores with plane or facetted orthogonal pressure platforms. The bases of the preforms are truncated, as demonstrated by the quadrangular morphology of most of the distal parts of the bladelets. Careful study of a cluster of 21 blades in occupation levels attributed to the end of Middle PPNB from Sabi Abyad II allows us to reconstruct the method of production and to argue for the introduction into the settlement of a parcel of bladelets originally produced at, or close, to the obsidian sources (chemically identified as located in the regions of Bingöl and Nemrut Dağ in eastern Anatolia, 250–300 km to the northeast; Astruc et al. 2007).

At the present stage of our research, there is no evidence that the pressure technique was used locally by the inhabitants of the Balikh Valley to produce blanks but rather that obsidian blades detached by pressure were introduced into the village as finished products through regional exchange networks (Astruc et al. op. cit.). The parcels of blades introduced to the Balikh communities were stored in domestic spaces, exchanged with neighbours and used locally. This is a key difference with Çayönü, where we argue that the inhabitants, themselves, produced blades using the pressure technique.

5.3.2.2 Sabi Abyad I (Early PN to Early Halaf)

The end of the Late PPNB and the Early PN are currently under study at Sabi Abyad III and Sabi Abyad I (operation 3). The pressure technique and the method of production associated with it are well represented in the Early PN layers at these two sites and at Sabi Abyad II and Damishliyya I. This method of production persists throughout the sequence until Early Halaf and is the dominant technique used to produce obsidian tools. Chronological variation in the amount of obsidian introduced in these living spaces and in the types of obsidian tools produced are apparent, especially based on the results of the 2007 and 2008 excavation seasons.

In 2005, a nearly complete large blade (Fig. 5.5) was recovered from the courtyard of a storage building (Sabi Abyad I, operation 2, Astruc 2011 approximately 6200 cal B.C.). In the neighbouring open space, six fragments of large blades were also discovered (Fig. 5.6). These fragments belong to the typological group of side-blow blade-flakes (SBBF) or side-blow blade-flake cores (Braidwood 1960). They are, in fact, related to a very specific technique of breaking blanks by using percussion on an anvil (Nishiaki 1996). SBBF were recognized in Kashkashok II, Sekher-el-Aheimar and Sabi Abyad I as by-products of this technique. Wear patterns representing different activities occur on every specimen anterior to the intentional breakage or truncation of the blank. The SBBF technique is therefore a technique of rejuvenation and/or a technique of calibration of the blanks in the longitudinal axis, like a truncation for instance. Complementary to this, from Sabi Abyad I, operation 3, three fragments of large blades were recovered (Fig. 5.7).

The large blades from the Sabi Abyad I site are mainly produced from obsidian of a high quality, which is green and translucent except for one specimen, which is made from an opaque and bedded raw material that has a slightly rougher 'touch' and grain. Similar high-quality obsidian served as raw material for the large blades found at Çayönü. Despite the degree of fragmentation of the blades and the absence of proximal fragments, the identification of the pressure technique of production using a lever is obvious. Our objective is to describe the evidence for this type of blade production which has not been sufficiently recognized in previously studied collections largely because of the fragmented state of the specimens.

In the Balikh Valley, there is a striking continuity in raw material procurement and in the mode of preparation for the detachment and production of obsidian blade(let)s from 7500 to 6200 B.C. (cal). Very large blades are also produced by the pressure technique, with the use of a lever. This particular technique was clearly in use by 6100 B.C., based on the find of seven fragments, as well as several specimens from Sabi Abyad I, operation 1, dating to 6200 B.C. (Copeland 1989), and three fragments from Sabi Abyad I, operation 3, ca. 6100–6500 cal B.C. Although the initial introduction of large blades within the Sabi Abyad sequence is still in question, excavations at Sabi Abyad III bring more evidence of the way that the Balikh communities became integrated into the obsidian trade networks. Current hypotheses on obsidian production, exchange and use will be evaluated in order to understand the nature of the specializations and the structure of the networks. Variation in the relative use of flint and obsidian, for example, does not seem to

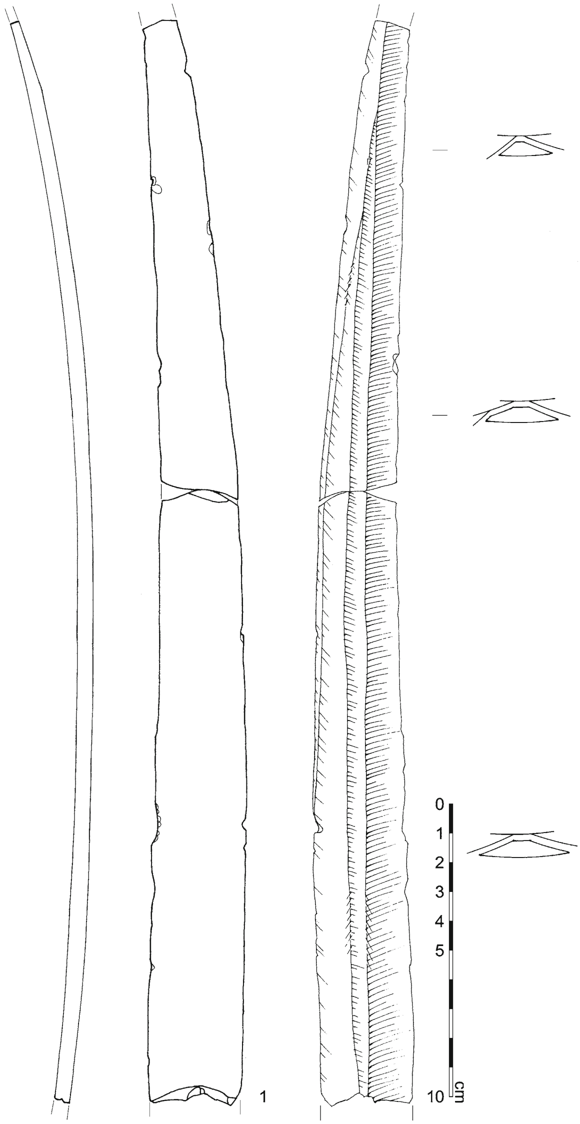

Fig. 5.5 Large blade from Sabi Abyad I, operation 2, proximal end truncated with the SBBF technique

follow a linear evolution. Similarly, the presence of very large blades is not necessarily linked to a constant increase in blade widths through time. Finally, the main changes in the sequence occur not at the end of PPN, as at Çayönü Tepesi, but during the subsequent 'Initial PN' (following Nieuwenhuyse's terminology) or Early PN period, with a diversification in the size and the nature of the products.

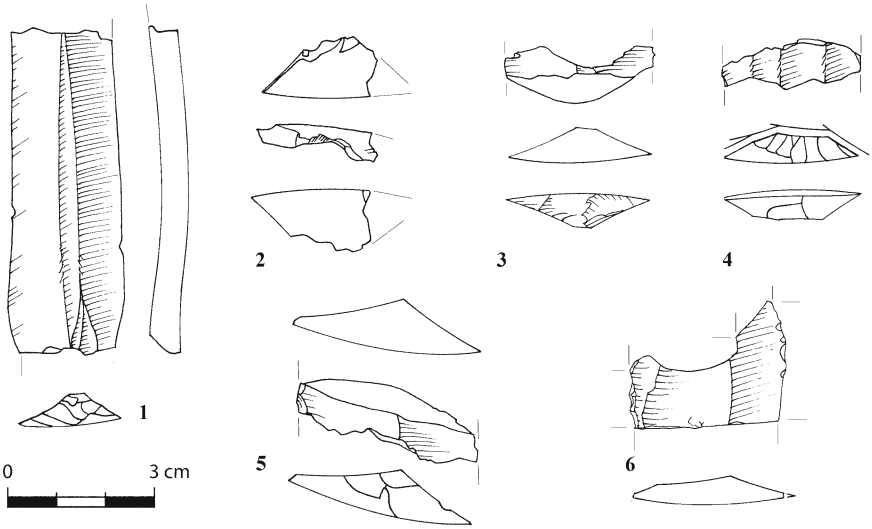

Fig. 5.6 Fragments of large blades from Sabi Abyad I operation 2. *1*, *4* Truncated large blades. *2*, *3*, *5* Side-blow-blade flakes. *6* Mesial fragment of a large blade

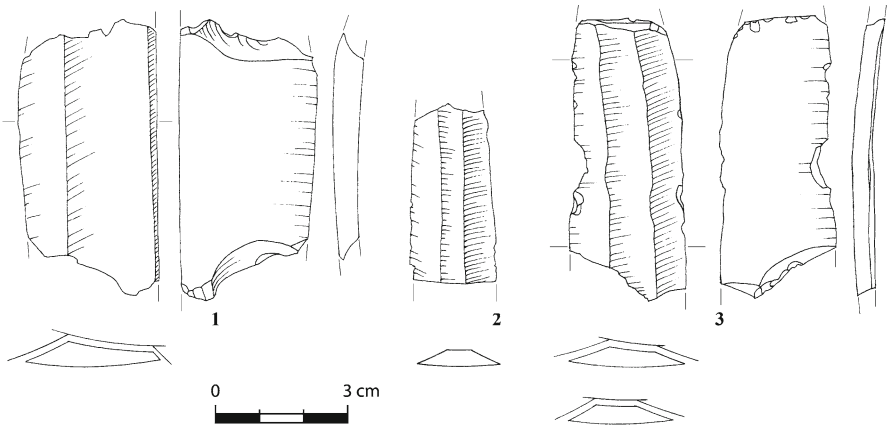

Fig. 5.7 Fragments of large blades from Sabi Abyad I, operation 3. *1* SBBF core. *2*, *3* Mesial fragments of large blades

5.4 Technological Analysis of the Large Blades

5.4.1 Description of the Archaeological Specimens

Six blade fragments were recovered from Çayönü Tepesi: one nearly complete blade, three fragments of large and regular obsidian blades, and two mesial fragments (Figs. 5.2, 5.3, 5.4, 5.8):

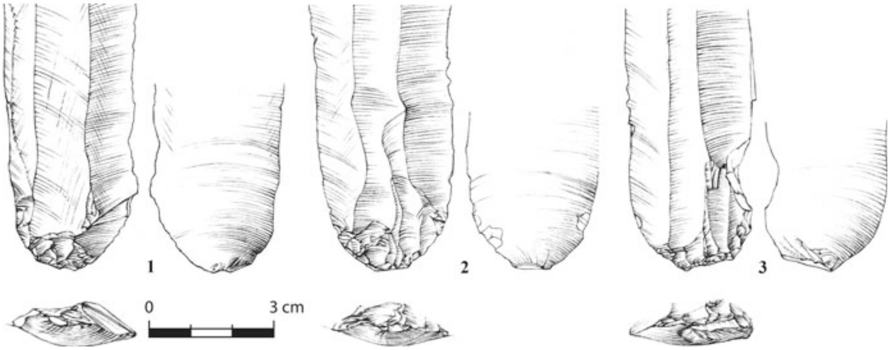

Fig. 5.8 Detailed views of the proximal portions of three large blades from Çayönü Tepesi (Figs. 5.2, 5.3)

- A nearly complete blade, 28.5 cm long, was found broken in three main fragments (Fig. 5.2, ÇT S3-1 CV building/cell 3). The mesial and distal fragments of the blade have been previously described (Binder 2005: Fig. 5), but the proximal part was only recently identified and refitted. The original length of the blade may have been as much as 33 cm, if we estimate that 5 cm are missing from the present distal end, which is uncurved and measures 24 mm in width and 3.8 mm in thickness. The proximal section is 31.9 mm wide and 8.4 mm thick, and the mesial section is 29.5 by 5 mm. The regularity of the blade's edges and arrises (Inizan et al. 1995) is impressive, and its thinness slightly decreases towards the distal end. The profile is moderately curved without inflexion or undulation. These characteristics are consistent with pressure blade production using a lever. The blade is four-sided in the proximal section, the code of *débitage* being 4321 (Binder 1984), but it becomes trapezoidal and asymmetric (321) in the medial section. A long scar measuring more than 68 mm long, together with rather hinged short scars, is evidence of core preparation to detach this large blade (Fig. 5.8(1)). The butt is small, ovoid and dihedral (7.8 mm wide and 2.1 mm thick). The butt shows a tiny inclination to the left edge, and its edge angle is greater than 90° (approximately 95°). The pressure point is located on the dihedral, defined by two tiny flake scars. The lip is clearly developed, and the absence of any cracking or damage suggests the use of a pressure stick armed with an antler point to detach the blade.
- A large proximal fragment, 17.2 cm long, comes from a blade that was probably 20–25 cm in length (Fig. 5.3(1), ÇT70 R2-10/4 CV building/cell 3). It is as wide as the previously described specimen (32 mm) and somewhat thicker (7.8 mm under the bulb, decreasing regularly to 6.4 mm at its mesial break). Its ventral face is perfectly regular, without any undulation, and the profile is almost straight (Fig. 5.8(2)). The butt is small (8.8 mm wide and 2.8 mm thick), with an oval and slightly concave surface that bears two tiny flake scars, probably produced by pressure, giving a platform angle of 80°. The detachment of the blade was

prepared by tiny bladelet-like removals from the core front towards the face of the core, which reduced the overhang and isolated the point of compression. Under a clear lip, the bulb is thick and high with a little concavity under the bulb. A clear ripple is visible just under the bulb, 22 mm under the lip, as well as in the bulb negative of two of the three blade scars on the dorsal face (right and middle). From our experimental reproduction of pressure blade production using a lever, this kind of ripple, frequent but not constant, is due to micromovements of the core in its wooden device when building up the full pressure that is detaching the blade (Pelegrin, this volume). Based on its width and thickness, this blade was detached by pressure using a lever. The clear lip and absence of cracking on the butt indicates the use of an organic pressure point (Fig. 5.8).

- Another long (20.5 cm) proximal fragment comes from a large obsidian blade that was probably at least 25 cm long before it broke (Fig. 5.3(2), ÇT 18 M 1–20/cell or large room building sub-phases). This blade appears to have been detached after a previous and unsuccessful attempt at its right side leaving a hinge at 11.5 cm from the top; hinge that was prolonged by a rippling splinter. However, the previous blade scars to the central and left side were regular and helped to correctly guide the blade, which has a uniform shape 30 mm+/−1 mm wide and 10 mm thick, and very discrete undulations of the profile. Prepared in the same way than the preceding described blade, the butt slants 10° laterally with an 80° platform angle (Fig. 5.8(3)). It is 13.5 mm wide and 3.2 mm thick and asymmetrical, the fracture initiating at its higher, left corner with no visible crack: a crack would indicate the use of a hard, metallic material for the pressure flaker. The bulb is rather prominent but without any concavity under the bulb and bears a ripple 16 mm beneath the lip. These features indicate a lever pressure detachment, probably with an organic point.
- The fourth piece recovered from the cell period (ÇT 84 18 M 3–6, related to DE building/c2) is a short mesial fragment of a light, large blade (Fig. 5.4(1)). The edges are damaged, but the initial width can be estimated as 32 mm, and the thickness is 6.2 mm. The regularity of the scars is very high with a straight profile, showing that the original blade was detached by lever pressure.
- A large 'Çayönü tool' previously described by Caneva et al. (1994) appears to have been made from a light, large blade similar to the one just described (Fig. 5.3, ÇT 70 U 3–0, related to BF building/Lr1). It comes from the subsequent 'large room' phase but helps to reconsider the blade blanks from earlier 'Çayönü tools' from the 'cell' phase and to understand one of the functions of large blades in this archaeological context. This tool, 12.3 cm long with a missing distal portion, was made from a large blade that might have reached about 20 cm in length, based on the existing profile. The original width of at least 25 mm has been significantly reduced by steep retouch (the initial arris to the right is totally removed), except at the proximal end which is less modified and 22 mm wide. The regularity of the blade blank is very high, with sides lacking any undulations and a regular thickness (5.2 mm under the bulb, 5.8 mm halfway, 4.3 mm at the distal break). The profile is slightly curved, a little more in the proximal portion. The butt was prepared with tiny axial removals and is thin

(8 mm wide and 1.5 mm thick), with an 80° platform angle. A marked ripple lies on the bulb 12 mm below the butt. The original blade was detached by pressure, and the remaining section is just wide enough to suggest that it was detached using a lever.

- A short mesial fragment (2.5 cm long) (Fig. 5.4(2), ÇT'89 P24I 5-28/5-29) comes from the 'Pottery Neolithic' layer, a much later occupation than the previous levels. The extreme regularity of the two upper arrises and the blade's thinness (3.2 mm) testify to the detachment of the blade by pressure. Presently 25 mm wide, the blade was originally 27 or 28 mm in width before it was retouched, an indication that it was made using the pressure lever technique.

From Sabi Abyad, ten fragments of long blades were recovered. These include seven fragments found in the courtyard of a burned building (operation 2, V6 sector, around 6100 cal B.C.[1]) and three specimens found in Sabi Abyad I, operation 3 (sectors I03, E03, E04), which provide evidence that this technique was in use by 6500 cal. BC. (Figs. 5.5, 5.6):

- Two long fragments were refitted to reconstitute a nearly complete blade (Fig. 5.5), which has its proximal end truncated just under the bulb and its distal point missing (possibly lost during production). The present length is 28.6 cm but was probably 2 cm longer at the proximal end and 1.5 cm longer at the distal end for an original length of approximately 32 cm. The blade was detached from a core that may, itself, have been 34 or 35 cm long, considering that two of the previous blade scars were a little longer than the blade itself, and that the core platform was probably somewhat reduced during earlier blade removals. Considering the profile and the arrises of the blade, the core front was an elongated and slightly convex bullet-shape. At that stage of the core reduction, the slightly convex profile and the regularity and thinness of the blade (from 4.8 mm thick at the proximal end to 4.3 mm at a few cm from the distal end) demonstrate a well-mastered pressure blade technique. The use of a lever is probable because this 24-mm-wide blade was necessarily preceded by the removal of wider blades in order to 'open' and regularize the production surface of the core (this opening included at least one or two crested blades and several lateral, under-crested blade). The section of the blade is initially trapezoidal and symmetric (212′) and then becomes slightly asymmetrical with an adjacent fourth lateral blade scar. The blade was probably a central blade belonging from at least the third series of blades detached from the core.
- One fragment represents the proximal portion of a large blade truncated at the bulb, the medial break resulting from a snap with a ventral tongue (Fig. 5.6(1)). The piece is 6.7 cm long, 24–21 mm wide, and 6.3 mm thick. The profile is rather

[1] The detailed study of the stratigraphy and its correlation to a new set of radiocarbon dates from tell Sabi Abyad I, operation 3, is in progress. The approximate dates provided here are therefore preliminary.

curved but very regular, as are the edges and converging arrises. The blade appears to have been detached by pressure using a lever. The blade material is a green but slightly grainy and bedded variety of obsidian, similar in appearance to one of the blades from Çayönü (Fig. 5.3(1)).

- Five fragments of large blades (Fig. 5.6(2–6)) are made from the same variety of green translucent obsidian as that of the blade illustrated in Fig. 5.5, and they originate from the same V6 sector of Sabi Abyad. Four of the pieces are 'side-blow blade-flakes'. The fifth piece is a damaged fragment of a blade. The fragments provide an estimation of the size of the section of the original blade they come from:

Figure 5.6(2) A 37.5-mm-wide and 6-mm-thick triangular section that may indicate an 'early' blade
Figure 5.6(3) An estimated width of 32 mm and a thickness of 6 mm, probably from a triangular section blade (different from the preceding Fig. 5.6(2))
Figure 5.6(4) A 31-mm-wide and 7-mm-thick symmetrical trapezoidal section
Figure 5.6(5) A 28-mm-wide and 6.6-mm-thick prismatic section with three arrises
Figure 5.6(6) An asymmetrical trapezoidal section with an estimated width of 34 mm and a thickness of 6 mm

Although the detachment technique of the original blades cannot be ascertained from these fragments, each of them lies in the range of blades produced by lever pressure.

From Sabi Abyad I, operation 3, three fragments of large blades were recovered (Fig. 5.7):

- Found in an open area of sector I03 (6250/6200–6050 cal B.C., Fig. 5.7(1)), one fragment comes from a large blade and is truncated by an inverse notch and snapped at its distal end. From the mesial to the distal end, the section decreases in size from 26 mm by 5.8 mm to 23 mm by 4 mm, with an increasing curvature, indicating that it comes from the distal half of the blade blank. A slight undulation of the dorsal side and arrises is mirrored on the ventral side. The overall regularity and slight curvature testify to a pressure technique, very probably with a lever, given that the mesial section of the blade is larger, about 28–30 mm. From an open area in sector E04 (6550–6500 cal B.C., Fig. 5.7(2)), a mesial fragment 4 cm long with a distal inverse notch comes from the distal half of a large blade (the width decreases from 20 to 17 mm, and it is 4 mm thick). The regularity and symmetry of the section suggest that the fragment is that of a central blade detached from a very well-treated pressure core, possibly using a lever.
- In sector E03 (6750–6600 cal B.C., Fig. 5.7(3)), a mesial fragment of a very regular obsidian blade was recovered. Truncated by an inverse notch at both ends, it is 6.3 cm long, 31.4 mm wide, and 6 mm thick. The remarkable regularity of the edges, the arrises and the ventral side, and the wide width of the blank suggest that the blade blank was detached by pressure using a lever.

5.4.2 *Blade Production Using the Pressure Technique with a Lever*

The detachment of blades by the pressure technique is characterized by regularity, reduced curvature and thinness (Pelegrin 1988: 48; 2003: 63; Tixier 1984: 66). Indeed, the mechanical conditions of a pressure technique, immobilization of the core, permanence of the compression along the fracture propagation and absence of shock, which would generate vibrations and therefore undulations, are the only means of detaching such a regular and fragile column of volcanic glass. The blades presented here bear the scars of two to four previous removals that are also highly regular, implying a very controlled and repeatable mechanism of detachment.

We made careful experiments on obsidian both using indirect percussion and pressure (standing pressure and pressure with a lever), and this after years of experience of these techniques with flint as a raw material (Pelegrin 2002a). Obsidian blades can be detached in series using indirect percussion, but they are far to be as regular as pressure blades (Pelegrin 2000, 2003, 2006, this volume). In this respect, we fully share Crabtree's opinion (1968: 459) that 'the impact from the percussor causes excessive undulations and waves on both the core and blade; the dimensions of the blade cannot be controlled with regularity; the bulbs of force are much too large, and the curve of the blades and termination of the ends cannot be controlled' (see also Figs. 5.4, 5.8). In addition, the fragility of obsidian leads to a high rate of proximal breaks when trying to produce relatively thin blades. These proximal breaks, which are rarely produced by pressure detachment, occur even more frequently with the use of indirect percussion than with direct percussion. They clearly occur during the detachment itself (and not after, as do simple medial breaks) because they produce distal ripples and hinged termination of the blade, thus spoiling the regularity of the distal end of the core. The extreme sensitivity of obsidian to breakage explains why, beyond 12–15 cm in length, irregularity of curvature and termination seems inevitable, even when using an elastic support for the core (which has a regulating effect on the detachment of flint blades) (Pelegrin 2000, 2002b, 2003).

There are two practical ways to produce large blades by pressure: using the full weight of the body transmitted by a crutch in a standing position and using a lever. During a recent colloquium held at Pennsylvania State University (Hirth 2003), some of the most experienced specialists agreed that more than length, it is the width of a blade that is dependent on the force of the pressure, as Crabtree (1968: 468) stated: 'the wider the blade, the greater the amount of pressure that is required'. In working flint, for example, the maximum width of pressure blades detached using a relatively long crutch placed at belt level by a person in a standing position can reach about 20 mm when using an organic (antler) pressure point and even 21 or 22 mm when using a copper pressure point (harder than antler, copper helps to detach thicker butts). Blades with these maximum widths have been observed in different archaeological contexts (Pelegrin, this volume). With obsidian, our attempts at using the standing pressure crutch technique produced blades with widths of up to 26 mm, confirming an earlier observation of ours that obsidian could yield blades which were 30% wider than flint, using an identical technique and level of effort (Pelegrin 1988, see also Kelterborn, this volume). Crabtree (1968: 468) concluded that the maximum size of the obsidian blades that he could produce using his standing technique was '1 in. wide and 8 in. long', while the 'Mexica' technique reconstructed by Clark and replicated by Titmus could be used to detach blades up to 24 mm wide (Titmus and Clark 2003). The width of the almost complete blade from Çayonü (Fig. 5.2; 31.9 mm) is clearly larger than that which can be achieved with the standing pressure technique; a more powerful device had to be used to detach the blade, one which involved the use of a lever, such as the one we used in our experiments (Pelegrin, this volume).

Our analysis of the proximal portions of four large obsidian blades found at Çayonü Tepesi (Figs. 5.4(3), 5.8) indicates that the point used for their detachment was probably made of an organic material. Three of the detachment butts are ovoid and plane, the fourth one is ovoid and dihedral; the clear lips and the absence of cracks on the butts favour an organic point, probably antler (experiments from Pelegrin in Astruc et al. 2007). This is even more apparent for the fourth butt: the point of pressure is located on the dihedral which did not suffer of any damage that would be caused by a copper point. At Sabi Abyad I, a proximal fragment of a large blade has been found at the surface of the Tell, in the operation 3 area. Its ovoid, plane butt is similar to those of Çayonü Tepesi's large blades.

5.5 Discussion

The analysis of the large blades of Çayönü Tepesi and Sabi Abyad I brings a new perspective to lithic specialization within Neolithic communities in the Near East. The production of large blades using a lever occurred as early as the second half of the eighth millennium cal B.C. at Çayonü Tepesi, likely between 7340 and 7080 cal B.C. This is the earliest evidence of this remarkable technique. It was thus testified in the Balikh Valley a thousand years later, between 6100 and 6500 cal. B.C.

5.5.1 The Degree of Production Specialization

The production of large obsidian blades demonstrates a remarkable level of technical specialization for these early periods. Pressure detachment with a lever was a technique likely practised by a few highly qualified specialists, who were possibly already fully trained in the standing pressure technique. To carry out this type of blade production, successive choices had to be made in order to reach the optimal exploitation of both raw material and technical investment and to avoid accidents that would lead to the waste of several blades or of the entire core. Risk levels associated with the various techniques would have been under constant evaluation, and substantial experience in pressure blade production would have been necessary to develop and control the whole production system, to manufacture the tools and to control the numerous practical details or adjustments.

Experimental research (Pelegrin 1988) has shown that the technical knowledge needed to produce medium-sized blades by standing pressure is considerable. However, the necessary expertise is much greater when the goal is to produce a standardized series of long blades. At both sites, the lengths of the nearly complete blades – 27.2 cm at Çayönü Tepesi and 28.6 cm at Sabi Abyad – allow us to estimate the length of the original cores as 32 cm or more. A very high level of understanding of the mechanical properties of obsidian is necessary to shape such huge cores and to produce these large, wide blades.

The initial core preparation has to be of very high quality, as any irregularity on the production surface will have a direct effect on the regularity of the ventral surfaces and edges of the blades. Once the critical roughing out by stone percussion is finished (no deep or hinged scars are allowed), the next stage is a patient shaping using direct stone percussion or indirect percussion for the detachment of transversal flakes, alternating from three to four axial crests; then the detachment of several large covering flakes by direct percussion, using a hard wood hammer, and, finally, shaping the crests by a subtle direct or indirect percussion or even by pressure flaking. The goal is to correct the volume that will be transformed into blades by defining the convenient convexities and avoiding any deviation – bumps or hollows – from an ideal of ±2 mm. Experimental reproduction by J. Pelegrin has shown that crested or under-crested blades (the first series of blades which serve to remove the pre-shaped surface of the core) can tolerate such irregularities if they are broad and thick enough, without reproducing these irregularities on their scar or without becoming hinged.

Difficult choices also have to be made when conducting the subsequent blade removal. The repartition of arrises on the core has to be strictly controlled, leading to different possible rhythms of *débitage* (convergent, divergent, inserted and adjacent unidirectional or alternating) (Astruc et al. 2007). In this respect, it is crucial to realize that each blade detachment is anticipated not only to visualize the final product but to control the effect of its removal on the geometry of the core. This requires meticulous attention to the preparation of each detachment not only to avoid accidents such as edge crushing, hinging and excessive plunging but to actually detach the expected blade with the most precision.

5.5.2 From Producers to Users

At Çayönü Tepesi and Sabi Abyad I, these large blades represent the highest recognized degree of specialization in lithic technology, attesting to a production technique that remained constant from the second part of the eighth millennium to the seventh millennium cal B.C. The large blades from Çayönü Tepesi and Sabi Abyad are so similar that they could have been made by the same craftsmen and remind us that the specialists involved in this type of blade production were part of a common technical tradition, which was transmitted through time by way of apprenticeships in the acquisition of the raw material and in the technical knowledge of production.

At Çayönü, it is difficult to estimate the relative importance of the large blades until further excavations are completed. At Sabi Abyad I, operation 2, the assemblage recovered from the burned building and its adjacent open areas reveals that these products represented a small proportion of the obsidian blades collected. For both Çayönü Tepesi and Sabi Abyad I, no evidence of the in situ production of large blades has been identified. Instead, these blades appear to have been introduced to the settlements as finished products. With the aid of experiments providing quantitative data, Pelegrin (Astruc 2007) determined that a core that is 12–15 cm in width and shaped with three axial crests can potentially produce up to 70–80 blades, of which 50 would be first choice blades (among which 80% are with a symmetric trapezoidal section, code 212′). The time input, according to Pelegrin, can be estimated as 2–3 h for shaping the core and 3–4 h for reducing it into blades. For larger blades produced by a pressure technique with a lever, these figures can be reduced to 20–30 blades per core produced within a full day of work. That means that a few specialists having easy access to obsidian and/or working seasonally on the outcrops could each produce several hundreds of large blades per year. One or few little groups of such knappers could therefore be at the origin of a direct or indirect diffusion on a large geographical scale. These large blades were exchanged within the obsidian trade networks from eastern Anatolian sources to Upper Mesopotamia: located in the High Valleys, Çayönü Tepesi lies 80 km from Bingöl and 250 km from the Nemrut Dağ area, while Sabi Abyad I is located in the Balikh Valley some 300 km from both sources.

Large obsidian blades are rare in both assemblages. Although both the functional patterns and the tool curation are different at Çayonü Tepesi and Sabi Abyad I (in the former site, the typology of the large blades includes notably Çayönü tools and scrapers, in the latter, the typological range is limited to SBBF and truncated blades (Algül 2008)), these tools do not appear to be related to specific activities or technical operations. Instead, their use seems embedded in everyday life with no special attention or treatment accorded to them. They are not found in caches, in funerary or symbolic contexts or in any other specific situations. While the size and quality of the products may reflect technological experimentation by the producers, these remarkable blades were most probably manufactured to be used in social contexts, including inter-community exchanges. They represent a great deal in terms of values, emulation and social image, but they do not seem to be related to rituals that could be the basis of long-distance diffusion of socially valorised objects (Pétrequin et al. 2006).

5.5.3 Concerning the Historical Aspects

The evolution of the pressure technique to detach blades within the High Valleys of the Near East between 8500 and 6000 cal B.C. has been interpreted by Binder (2007) as representing a long-standing tradition of craftsmen progressively exploring all the technical possibilities offered by the pressure technique, a behaviour that was directed by social demands, including the use of these products as status and/or identity markers.

For 1,500 years, eastern Turkey was a centre of highly specialized lithic production and the head of a trade network which covered a large part of the Near East. During this period, the Cappadocian workshops, very active during the ninth millennium, saw their influence wane considerably from the beginning of the eighth millennium cal B.C. to the middle of the seventh, a probable consequence of the autonomy taken by the Aşıklı-Musular-Çatalhöyük culture confronted to the cultures from the Levantine Corridor and the Mesopotamian High Valleys. During this time, pressure detachment does not seem to be in use in Central Anatolia. It is then re-introduced at Çatalhöyük VIB during the second part of the seventh millennium and spreads towards the Lakes District, the Marmara and the Aegean, perhaps as a consequence of the reactivation of eastern influence (Binder 2005).

Unfortunately, technological studies of the Çatalhöyük assemblage are currently not precise enough to discuss the evidence for pressure blade production with a lever at this site. However, the blade analysis conducted by Connolly (1999) indicates that a significant proportion of the blades are wide, and it seems a possibility that some were detached by pressure. On the other hand, conical pressure cores with orthogonal faceted platforms from phase VI could be similar to the shapes known or supposed at Sabi Abyad and Bouqras (Bialor 1962), indicating a common tradition. A re-examination of these studies could help us to appreciate the role played by Central Anatolia in the diffusion of the lever pressure technique between eastern Turkey and the Aegean, where lever pressure is in evidence during the very first stages of the Neolithic, approximately 6200 cal B.C. (Pelegrin in Perlès 2004: 28–29; Perlès 2004).

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