Paleolithic Pioneer Technology at Banholt (the Netherlands).

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Summary
Banholt-TH shows parallels to MIS 11-9 industries and its geology supports a MIS 11-9 date. This makes Banholt-TH contemporary to the Acheulean, whilst it has a non-Acheulean toolkit. This paper discusses the characteristics of the toolkit and argues how non-Acheulean industries were defined by their raw materials and flaking techniques. This paper furthermore discusses how these flaking techniques led to technological coherences within the Northwest-European and also within the global context.

Introduction
Southwest-Europe was between 750 and 300 thousand years ago dominated by the Mode-II Acheulean industry. The Acheulean is defined as an industry in which classic handaxes, cleavers and pics play a major role: these formal bifacial tools represent more than 50% of all modified tools and they measure on average over 10 cm in length. The contemporary industries in the other parts of Europe show far fewer bifacial tools and most did not produce classic handaxes. Examples are the Clactonian (in Britain, Belgium and the Netherlands), pebble-tool industries (i.e. Vértesszölös, Kretzoi and Dobosi, 1990), the Pre-Mousterian in East-Europe (Doronichev, 2008), and Chopper Chopping-Tool Complex (Wouters, Franssen and Kessels, 1981 and Peeters, Musch and Wouters 1988a) or Bipolar Toolkit Concept (Van der Drift, 2019) in the Netherlands. The palimpsest Banholt-TH, discovered in 2020 by Olischläger, is part of this Complex or Concept.

1. The locus Banholt-TH
1.1. Geology
The Upper-Cretaceous (Maastricht stage) formed marine chalk deposits with flint strata in the Netherlands. During the Tertiary the upper-beds eroded as the result of rains that dissolved the chalk. This erosion left the flints behind, concentrated in a bed of insoluble clay-minerals. These eluvial flint-beds reached a total thickness of dozens of meters. The deep clay-beds protected the flints against temperature changes and preserved their quality, but most nodules must still be qualified as poor raw material due to their small and irregular forms. As a result of the Ardennes upheaval, the river Meuse began to cut into these eluvial flint-beds during the Early-Pleistocene.

Figure 1 (left): Löss strata above the artefact level in trench 1.

Figure 2 (below): Artefact level in trench 2.

The Meuse deposited a series of Early-Pleistocene gravel terraces (called East-Meuse gravels) on top of the remainder of the eluvial flint-beds. The Ardennes upheaval continued during the Middle-Pleistocene; the river Meuse shifted its bed westward, where it cut completely through the eluvial beds and deep into the the Cretaceous beds. By consequence the small tributaries of the Meuse also formed deep valleys. This dales-and-terraces landscape continuously underwent small changes: its surface was during cold climate-phases repeatedly covered by löss and the ongoing erosion removed parts of the löss and Meuse gravels.

The erosion repeatedly exposed the eluvial flint-beds in the dales around Banholt and Middle-Pleistocene man used the exposed flints. Repeated use led to palimpsests, which during Saale and Weichsel cold stages became covered by löss. Recent erosion partially removed the löss-cover at Banholt-TH. Exploratory trenches show an artefact level that continues below two löss strata (with a total thickness up to two meters, see *figures 1 and 2*).

1.2. Lithic industry

The Banholt-TH industry used three types of blanks: cores, flakes and fragments. The Levallois (Mode-III) methods were not used at Banholt-TH. The blanks were frequently flaked in two or more directions. *Figure 3* shows an example of a bifacial core tool: a backed knife or bifacial scraper. It is open to debate if the presence of such bifacial tools qualifies Banholt-TH as Mode-II. But these bifaces do certainly not classify the industry as classic Acheulean, because they were not deliberately shaped (= modeled) through alternating reduction. The Banholt-TH tools only show minimal shaping, the shape of each individual tool primarily depends on the form of its blank. This gave the industry opportunistic forms, instead of uniform formal tool-types. All the modifications to the blanks were made with functional intent; these modifications produced macroscopically visible Techno-Functional Units (TFUs). Most of these TFUs are short, in contrast to the classic Acheulean that focused on long sharp edges. The long TFUs of Acheulean tools tend to give us little insight into their actual use; only microscopic use-wear analysis can tell us which parts of i.e. a handaxe were meant to hold the tool or used for scraping or cutting. The forms of the short TFUs often suggest specific purposes.

Several TFUs can be recognized in the biface in *figure 3*. The thick edge shows intense pecking, leaving no doubt that this blunt edge is a grip-TFU. The opposite edge is sharp: a scraping-TFU or cutting-TFU. One face of the tool was flaked after the other, we argue in paragraph 2.3 that this was not done with the plano-convex “wechselseitig gleichgerichtete” (Bosinski, 1976) Mode-III technique but with the contre-coupe technique. The top of the biface was removed by a tranchet blow; similar removals are sometimes seen on Mode-II handaxes and often on Mode-III bifacial backed knives (Pradnick-spalls). The tranchet blow created a new edge and a sharp corner. The edge was resharpened with retouches and the corner by the removal of small burin-like spalls.

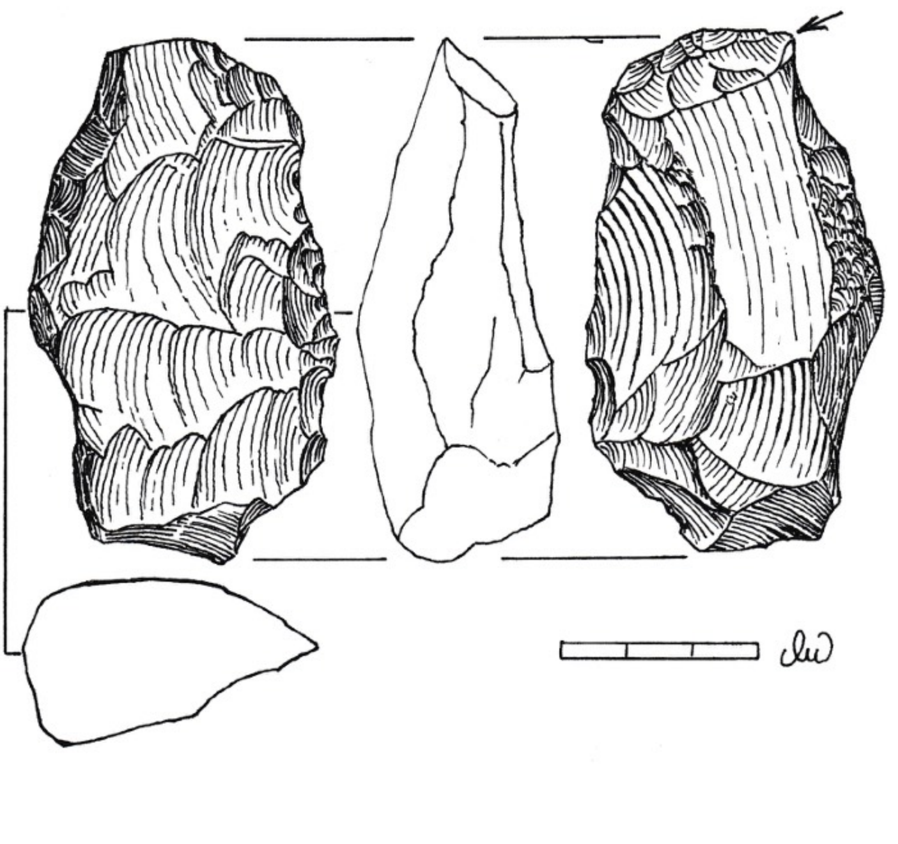


Figure 3: Bifacial knife or scraper, with tranchet blow and spalls. The scale measures 3 centimeters.

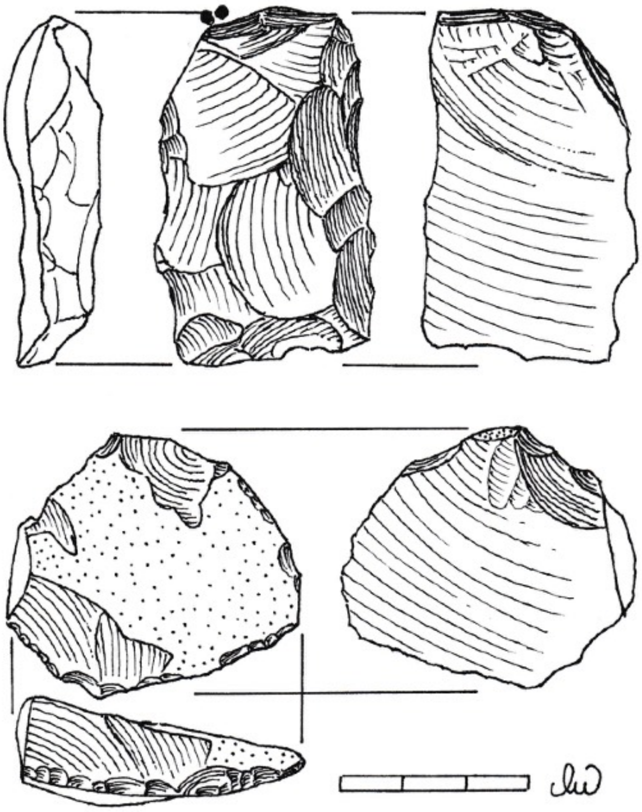
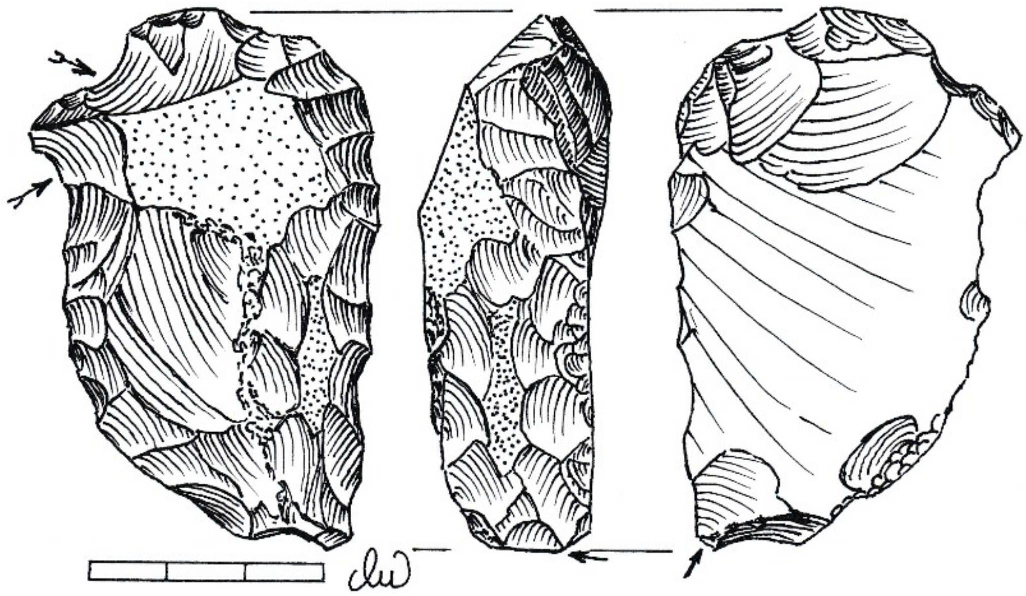


Figure 4: Top: flake with two impact-points and large bulb. Bottom: cortex-flake.

The top flake in *figure 4* is a steep denticulate scraper with a few negatives at its dorsal side. Please note the two impact-points on its platform, immediately next to each other. The distinctive rim on the ventral face of this flake seems to turn the proximal part into a very large bulb. Such multiple impact-points, large bulbs and distinctive rims are frequent in the Clactonian industry. The cortex-flake at the bottom of *figure 4* shows simple steep retouches.

The flake in *figure 5* shows stepped or scaled retouches. Scaled scrapers are often associated with the Mode-III Quina industry, but there is no consistent Quina core-reduction pattern at Banholt-TH. The resemblance to a Quina-scraper is just an incidental result of opportunistic flaking. Opportunistic blanks with steep stepped or scaled retouches already existed in Mode-I (i.e. on “scalloped scrapers” at Koobi Fora and Dmanisi). A special TFU, formed by two adjoining notches (indicated by arrows with hollow ends) can be seen at the left side of *figure 5*. Single notches (German: Buchten, French: encoches) were often used as a hollow scrapers, but this combination of two notches created a point-TFU (French: bec). The resharpening retouches at the ventral side accentuate the function of this point. The bifacial retouches at the proximal end of this flake created a short sharp TFU, called a cutter-TFU. Steep retouches also turned the distal end of this flake into a point- or bec-TFU. This second point-TFU shows a burin-like spall removal and was also resharpened by a ventral spall. Similar short TFUs with resharpening retouches and resharpening spalls can be recognized on many tools from Bilzingsleben (Mania & Weber, 1986).

Figure 5: Flake with stepped retouches and two adjoining notches forming a point-TFU.



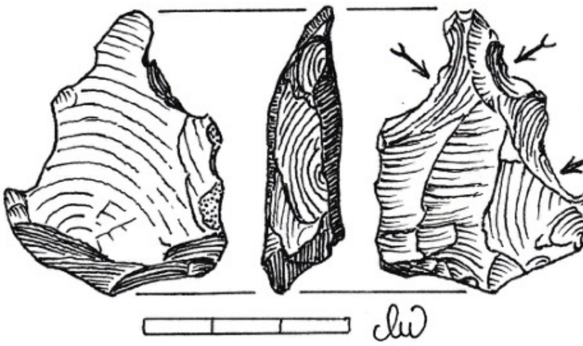
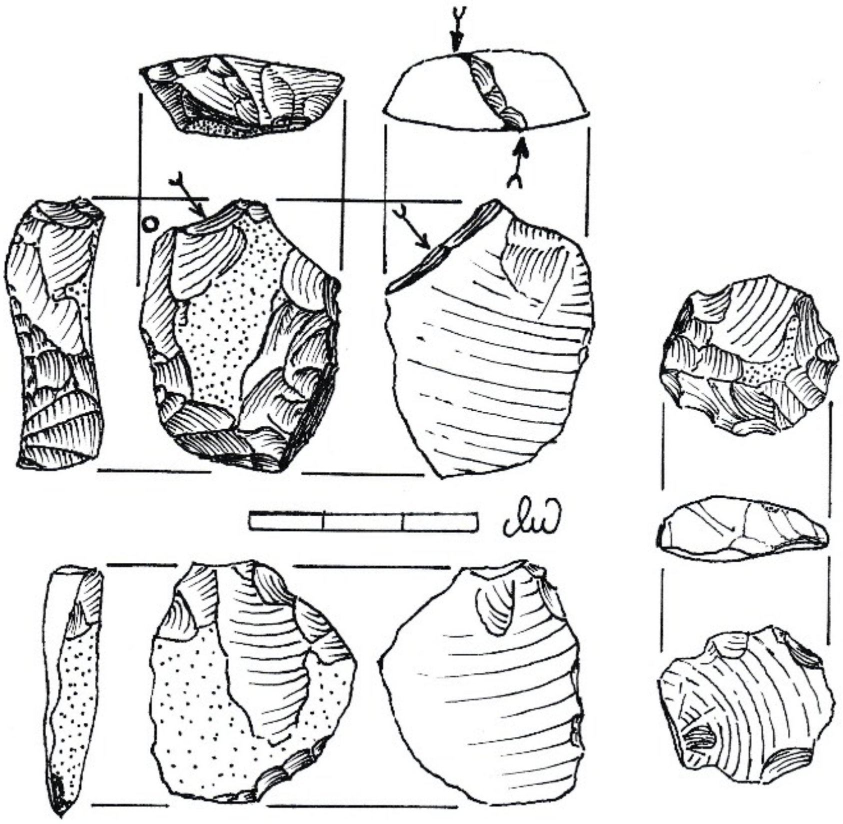


Figure 6: Notched or denticulate flake-tool.

The denticulate flake-tool in *figure 6* combines multiple notch-TFUs and point-TFUs. Such denticulates exist in the Southern-Acheulean (Acheuléen meridional) and they are frequent in the denticulate Mousterian, and Paleolithic industries based on small raw materials such as pebbletool industries and Bilzingsleben.



The flake at the top of *figure 7* shows two adjoining notches struck from opposed sides. The extra drawing (added at the top-right) shows this combination created a transversal cutter-TFU (Querhobel, bec burinant alterne). This transversal cutter was resharpened by three small retouches. The steep retouches along the sides of this flake either represent a scraper-TFU or a grip-TFU. The flake at the bottom of *figure 7* shows steep scraper retouches. The retouches in the very small scraper at the right of *figure 7* are flatter.

Figure 7: Flake with cutter-TFU, end-scraper on cortex-flake, small scraper.

Mania & Weber (1986, page 43) classified forms like we see at the left in *figure 8* as Levallois cores. The centripetal pattern in the top drawing does indeed resemble the pattern on single-face recurrent-centripetal Levallois cores. But centripetal cores also exist in Mode-I and Mode-II, those are generally non-recurrent. Cores can therefor only qualify as Levallois if they show a consistent recurrent reduction strategy (or a consistent preferential reduction strategy). This is not the case in Bilzingsleben, Mania & Weber (1986) therefor correctly classified Bilzingsleben as Lower Paleolithic. The same goes for Banholt-TH. The core at the left in *figure 8* may actually be a tool (a cutter-TFU is visible in the sideview). The denticulate at the right in *figure 8* presents a well-defined point-TFU (bec) between two deep notch-TFUs. This point-TFU was resharpened by spalls in two directions. The resharpening retouches at the top-end of the same tool turned this end into a short cutter-TFU. The bottom-end shows a burin-like removal that suggests this end served as a third point-TFU.

The similar but far larger denticulate flake-tool in *figure 9* shows a large point-TFU between a deep and wide notch-TFU and a concave scraper-TFU. Both concave TFUs may have been used to work wood, i.e. the Schöningen spears show traces of notched tools (Mania & Mania, 2005 p. 55). The large point-TFU was first resharpened by removing its complete top, and resharpened a second time by removing a series of narrow ventral spalls. Adding a smaller notch created a shorter point-TFU at the bottom-end (beaked scraper-TFU). The pecking or hammering along the cortex-rim (at the left) confirms this left side was used as grip-TFU. Finally the top-end was turned into a cutter-TFU by dorsal retouches and two large ventral resharpening spalls.

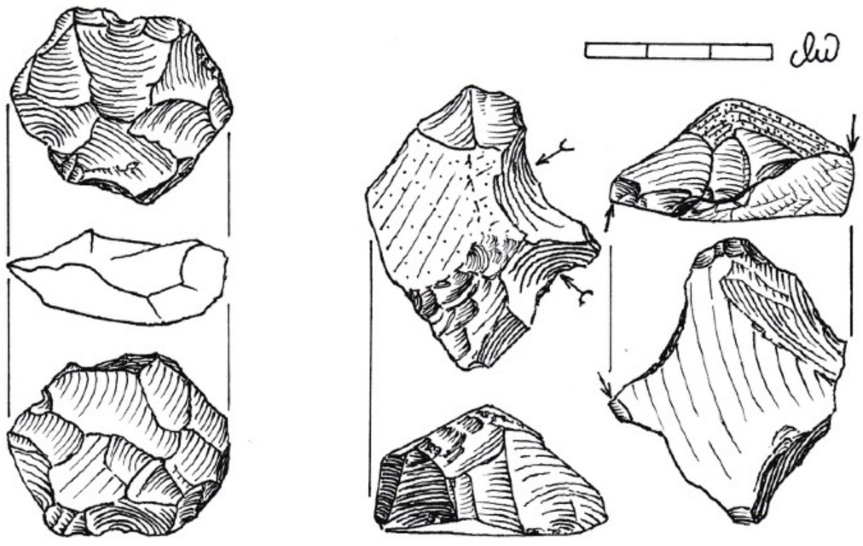


Figure 8: Core-tool with cutting-TFU and denticulate with multiple TFUs.

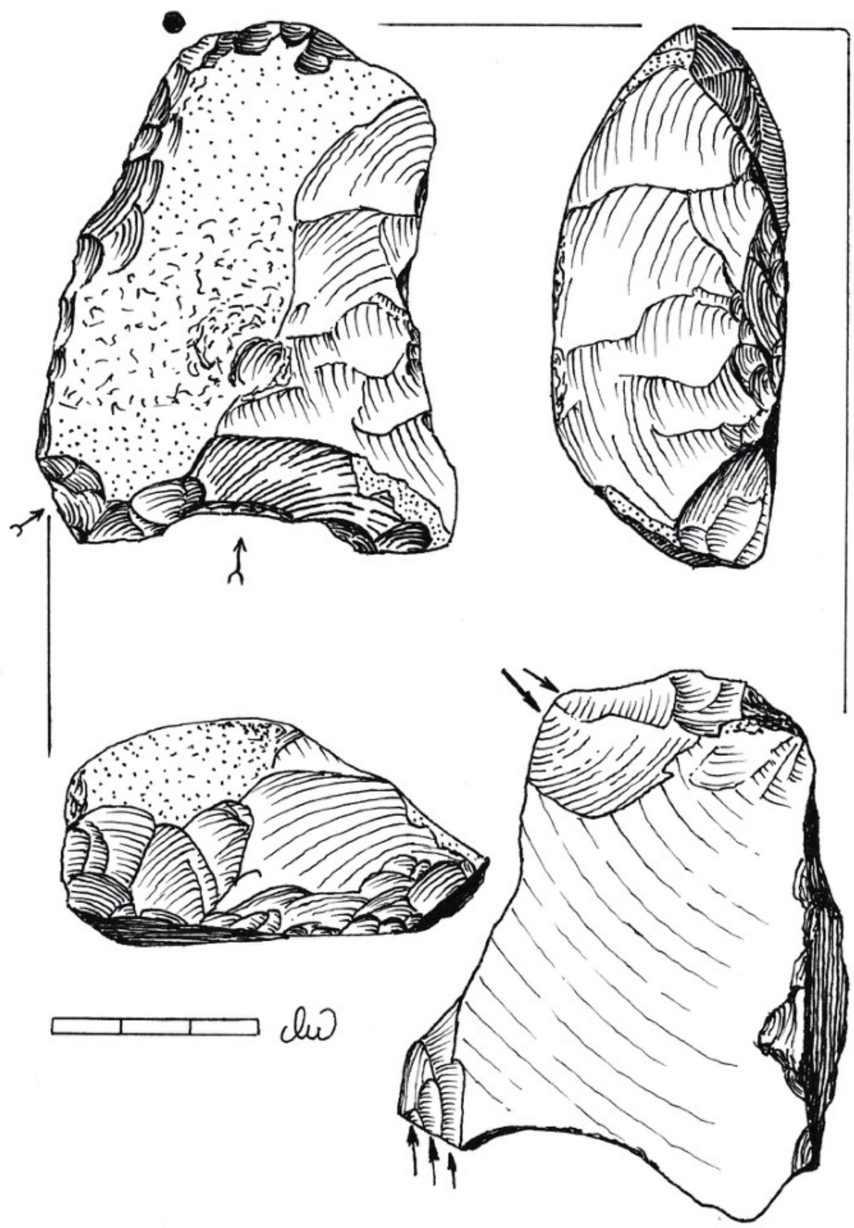


Figure 9: Large denticulate with multiple TFUs.

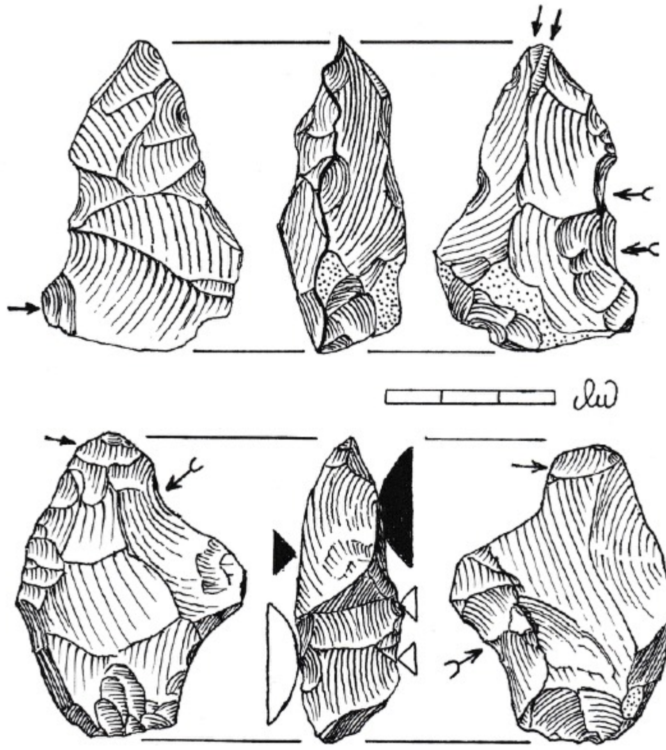


Figure 10: Top: Tayac-point with one jagged edge. Bottom: Tayac-point with notches in opposed direction. How such notches were made is explained in paragraph 2.3; the triangles indicate hammer-impacts and the circle-segments indicate the anvil-positions.

Figure 10 shows two Tayac-points. Tayac-points should not be mistaken for small handaxes; Bordes defined them in 1954 as converging denticulates and De Heinzelin explicitly added in 1962 that the notches must be large (macro-encoches). Tayac-points were made in the Southern Acheuléen, in pebble-tool industries (i.e. Kretzoi and Dobosi, 1990 Pl. 10 no. 7, 11) and Bilzingsleben (i.e. Mania & Weber, 1986 Tafel 1 no. 1, 10). The Tayac-point at the top of *figure 10* has a point-TFU that was resharpened with two burin-like spalls. One edge shows two deep notch-TFUs and the point-TFU at its base shows ventral resharpening. The edge in the sideview forms a jagged cutting-TFU. The top of the bottom Tayac-point in *figure 10* was sharpened with a dorsal and a ventral resharpening spall, and also two minute retouches. Its left-edge shows fine regular retouches, that create a straight cutting-TFU or scraping-TFU. The other side shows two deep notches, struck in opposed directions. The combination of these notches formed a transversal cutter-TFU (German: Querhobel, French: bec burinant alterne, Bordes, 1961). The retouches at the bottom-end, turned this end into an extra cutter-TFU.

The cross-section shows that the tool in *figure 11* was made on a fragment with triangular cross-section (trihedron). Such triangular fragments form when a core is struck from above, whilst it rests on the floor or on an anvil. This reduction technique is called straight bipolar flaking (paragraph 2.3). Mania & Weber (1986) called this method zertrümmern, and they determined that it was used at Bilzingsleben as the principal primary reduction technique. The TFUs on the tool in *figure 11* are relatively simple: there is a point-TFU and both long sides may qualify as retouched scraper-TFUs. This form is called a pointed chopping-tool or retouched trihedron.

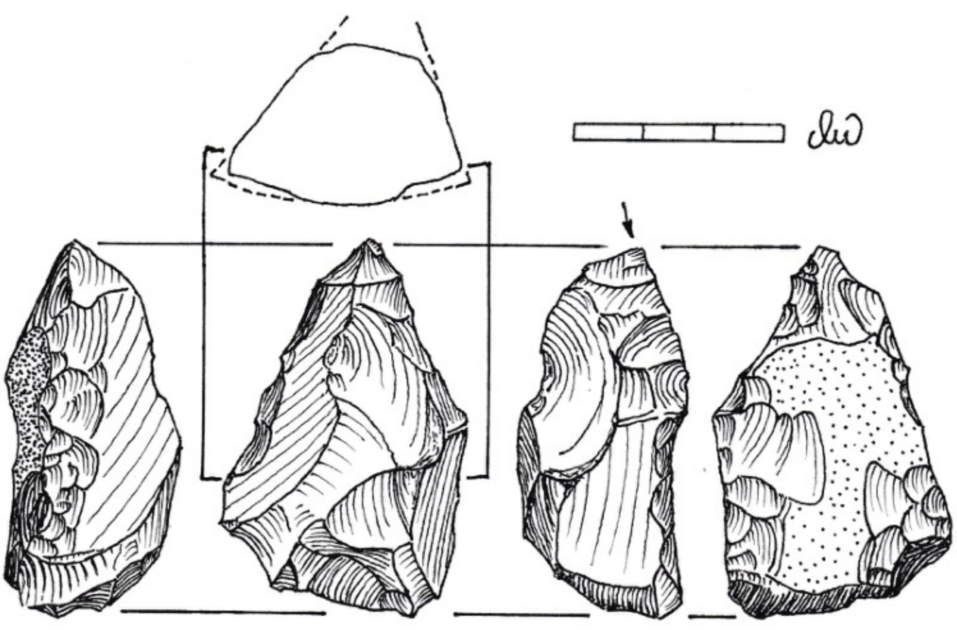


Figure 11: Retouched trihedron.

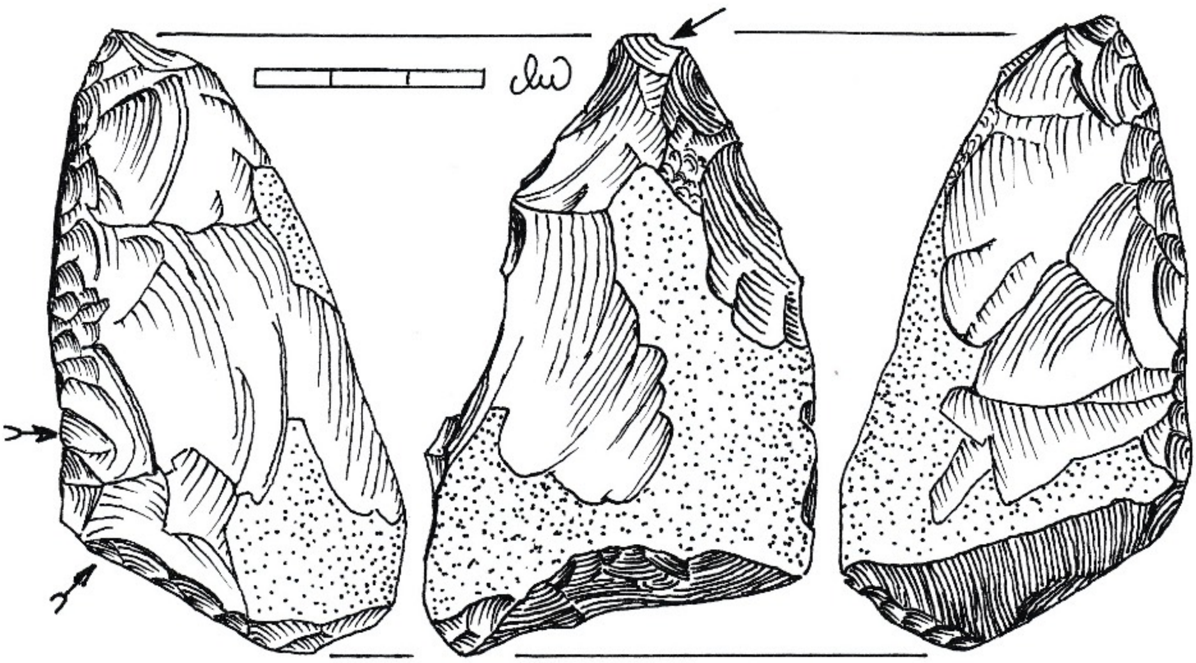


Figure 12: Steep converging scraper with multiple TFUs.

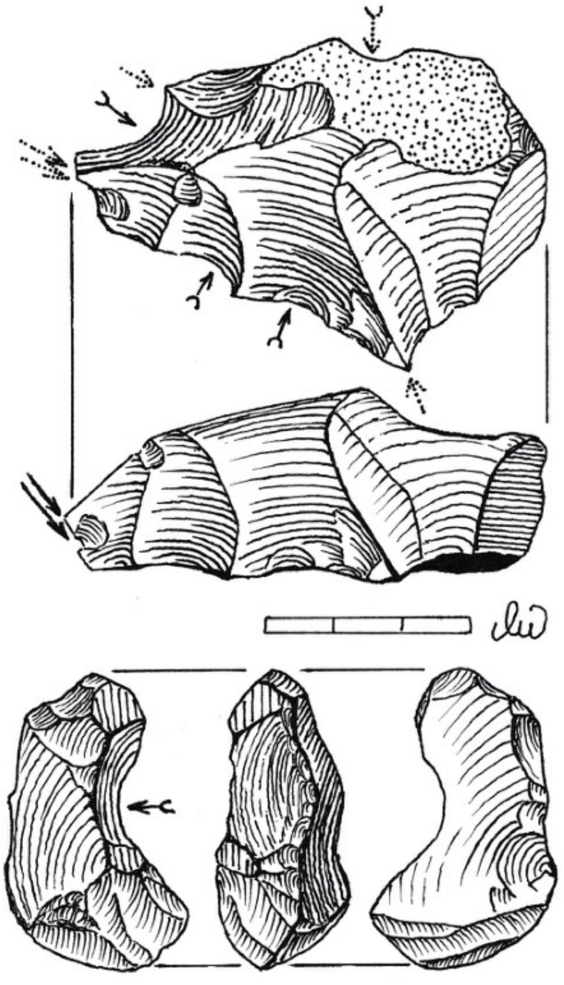


Figure 12 shows a converging scraper with steep stepped or scaled retouches. Mania & Weber (1986) show smaller versions of this tool from Bilzingsleben (i.e. Tafel 6 23-26). Tools with this form are called grattoir caréné, rostro-carinate or Nasenschaber (some authors associate both latter names with natural forms or pseudo-artefacts). This form combines two long sides (steep scraper-TFUs) with a point-TFU. The point-TFU in *figure 12* is resharpened with a large spall. Two notches are indicated at the bottom-left. Together these two notches created an extra point-TFU (protruding to the left in the central drawing). The retouches below the lower notch form a cutter-TFU along the cortex-edge.

The top drawing in *figure 13* shows a stretched denticulate scraper. Similar tools were found in Clacton-on-Sea (Wymer, 1999). Two additional notches and four resharpening spalls (indicated in the drawing) created extra TFUs. The bottom drawing in *figure 13* shows a small flake with a notch-TFU next to a point that functioned as cutter. This combination of a notch that ends in a short cutter is also frequently present in Clactonian bill-hooks.

Figure 13: Top: stretched denticulate. Bottom: flake with a notch next to a short cutter.

Some eluvial flints at Banholt-TH were big enough to make large flakes, *figure 14* shows one of these rare large flakes. This flake was in its first stage over 10 cm long, and as the dashed lines suggest 8.5 cm wide. It resembles the typical flakes of the Clactonian industry: it originally had a large non-facetted platform, a wide flaking-angle of 130 degrees, two impact-points and a large bulb plus rim on the ventral face. The unmodified flake had long sharp edges, these edges were probably used as long cutting- or scraping-TFUs. The flake was not discarded after these edges became worn, because it was highly desirable as a blank. The toolmaker gave that blank several new TFUs: steep retouches and large deep notches. The notches are similar to those in the Clactonian flaked-flakes. According to the strict definition, a bill-hook should have blunting-retouches at its distal end. The steep retouches in *figure 14* are at one side (sideview) but they nevertheless form the same grip-TFU as in a bill-hook. Because such top-quality blanks were rare, the toolmaker added extra notches. One deep notch (in the sideview, immediately next to the platform) gave the platform a point- or caréné-TFU. The ventral view in *figure 14* shows that this caréné-TFU was resharpened twice by spalls. These spalls removed the cortex from the lower half of the platform. These removals also exposed the second cone at the centre of the platform.

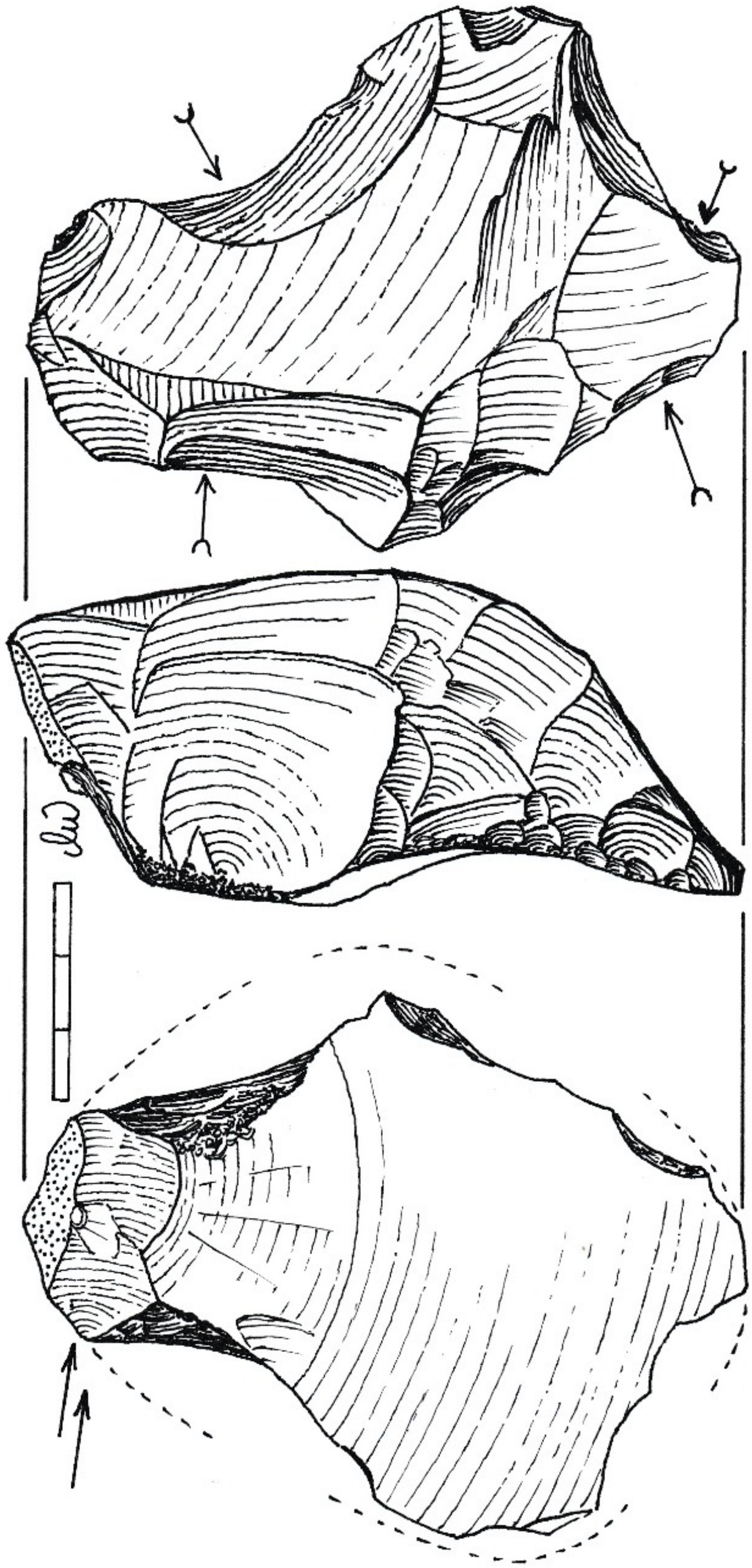


Figure 14: Large Clactonian-type flake with steep retouches and deep notches.

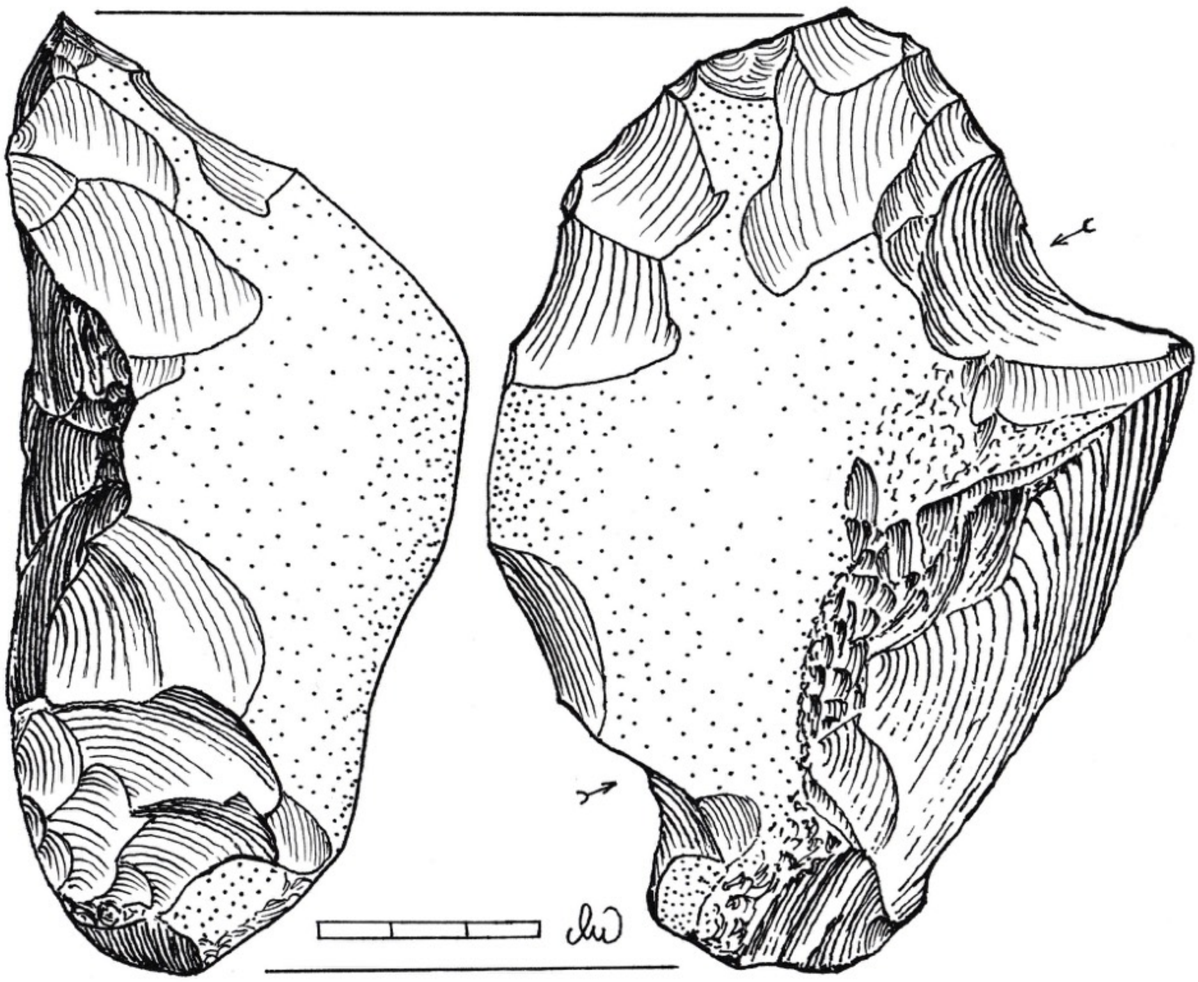


Figure 15: Large chopping-tool.

Repeated attempts to break the large flint in *figure 15*, whilst it lay on the ground (straight bipolar reduction or zertrümmern) crushed its centre. These attempts led to the removal of a large flake (negative at the bottom-right in the drawing). Bifacial flaking gave the opposite edge and top the function of a chopping-tool. Deep notches were added at the bottom-left and top-right. The combination of the top-right notch and the large flake-negative created a short cutter-TFU. Wouters, Franssen and Kessels (1981) called the Dutch non-handaxe industries the Chopper Copping-tool Complex because choppers and chopping-tools were in the 20th century qualified as primitive tools and as diagnostic for pre-handaxe industries. But the theory that Acheulean handaxes had evolved from choppers and chopping-tools was abandoned when Beyene et al (2012) showed how the Acheulean bifaces had developed on large flakes (Large-Flake-Based or LFB-Acheulean). Choppers and chopping-tools were produced by all Paleolithic industries that depended on rounded raw materials. Large numbers of these tools were made in Bilzingsleben from Muschelkalk-cobbles, Mania and Weber (1986) called these Haugeräte.

2 Discussion and conclusions

2.1. Clactonian question

In Darwin's days it was believed that man's tools reflected his evolutionary stage. Primitive tools supposedly indicated primitive humans, colored people would represent a lower cultural stage because they had simpler tools than white Europeans. The idea that handaxes were too sophisticated for early-man led to a search for the pre-handaxe stage. The Clactonian core-and-flake industry, the pebbletools from Beijing (and in the sixties also Vértesszölös) and Bed-I in the Olduvai-gorge were all believed to be pre-handaxe industries. But when the dating methods improved it turned out that only Olduvai Bed-I predated the Acheulean, so everyone wondered why the other two industries did not make handaxes. That question had an easy answer for the pebble-tool industries: small pebbles cannot be flaked into a large handaxes. But since the Clactonian industry used perfect raw materials, the ‘Clactonian question’ remained enigmatic. Ashton et al (2016) noted that the Clactonian arrived in Britain almost immediately after the cold MIS 12 stage, whilst the Acheulean industry arrived in the second half of MIS 11c (*figure 16*). They argued that these industries were therefor made by “distinct human populations from different source areas in Europe”. Our problem with this theory is that all Europeans could during the coldest part of MIS 12 only survive in the south. The source area of the Clactonian population must therefor be Southwest-Europe, and everyone in that area made Acheulean handaxes.

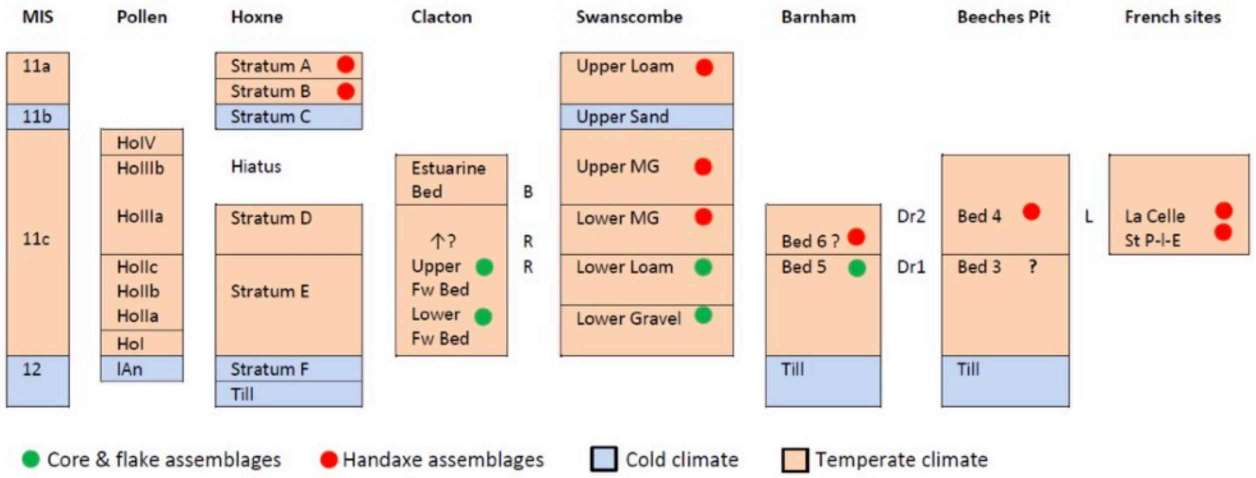


Figure 16: Chronology of the MIS 11 Clactonian and Acheulean in Britain, after Ashton et al 2016.

2.2. Pioneer migration

We believe the answer to the Clactonian question is in the routes that migrant groups followed from the southern MIS 12 refugia (like Tautavel in the south of France) towards Britain. Pioneers that venture into unknown territories generally follow rivers, because rivers provide water plus raw materials plus opportunities to obtain food. So the groups that went to Northwest-Europe followed the Garonne downstream (see *figure 17*). In the Upper- and Middle-Garonne valley, they used the boulders and cobbles on the riverbanks to make classic Acheulean handaxes. But on the riverbanks of the lowland Garonne there are only small pebbles (these gravels gave the vineyards near Bordeaux their name ‘Graves’). The pioneers could therefor only survive in these lowlands by making pebbletools.

Figure 17: Pioneer migration routes in MIS 11, after Van der Drift 2020.

Small pebbles cannot be flaked from the free hand, so the pioneers near Bordeaux had to use bipolar techniques (see paragraph 2.3). The generations growing up in the lowlands, therefor became experts in the production of small blanks by the use of hammer and anvil. It is impossible to give small blanks long cutting edges (typical for Acheulean tools), so the bipolar flaking experts had to shift their attention to short TFUs (notches, denticulates, cutters and resharpening spalls). The pioneers selected their best blanks, as top-quality blanks were in short supply it was efficient to combine multiple TFUs on each good blank. There were no large stones, so the parents in the lowlands could not teach their children how to make classic handaxes. The result was that the generations that traveled from the lowlands towards Britain had completely lost the mental template for the classic handaxe. So when these pioneers finally entered the Thames-valley, they used the large flints to make large Clactonian flakes but they neither had the knowledge nor the desire to make handaxes! So despite the fact that the large flint nodules and large Clactonian flakes were ideal blanks for handaxes, the Clactonian toolmakers gave them the same short TFUs as were used in the pebble-industries. This turned large flakes into flaked-flakes, bill-hooks and denticulates. Britain was (even during the warmest parts of MIS 11) connected to the Netherlands by the North-Sea Lowlands. The pioneers living in these lowlands also made pebble-tools (Van der Drift, 2014 presents an industry on beach-pebbles from off-shore Norfolk). Pioneers that crossed the North-Sea Lowlands reached the Netherlands, where they made Clactonian tools in the Rhine-valley (Peeters, Musch and Wouters, 1988b). In areas with miocene pebbles in the south of the Netherlands they made pebble-tools (Peeters, Musch and Wouters, 1988a) and the use of eluvial flint at Banholt-TH led to an industry that is similar to Bilzingsleben. We conclude that the humans in Northwest-Europe who made their stone tools with this pioneer technology were therefor genetically related to the Europeans with Acheulean technology, had the same hunting strategies and assumably the same cultural behavior.

Figure 18: Second-wave migration routes in MIS 11, after Van der Drift 2020.

The warm climate conditions during the first half of MIS 11c, soon led to growth of the Acheulean population in the Middle-Garonne. This forced groups to expand their territories; the population growth pushed the handaxe-makers from the Garonne-valley into the adjacent river-basins. *Figure 18* shows that this resulted in a second migrant-wave that also traveled north, but avoided the lowlands. These second-wave groups lived in areas with suitable materials for handaxes, they therefor continued to make handaxes. This brought the classic Acheulean back to Northwest-France, and in the middle of MIS 11c also to Britain.

The migrations in *figure 17* and *18* cannot have been mass-migrations since the total European MIS 11 population never exceeded a couple of thousand individuals. There were only small migrant groups that struggled to survive, it is therefor likely that the second-wave did not replace local populations but merely reintroduced the handaxe-technology. The MIS 11-9 climate allowed humans to thrive in the Netherlands and in Germany. But most industries remained non-Acheulean; there are no uncontested Mode-II Acheulean finds in the Netherlands and only a few in Germany. This suggests that most migrants lost the mental template of the classic handaxe, before they reached these areas.

2.3. Technological characteristics

The pebble-industries, the Clactonian and the Bilzingsleben industry had completely different raw materials. This resulted in completely different blanks. Pebbles (i.e. on the North-Sea Lowlands) led to pebble-flakes and segments with naturally rounded forms. Large flints (i.e. in the Thames-valley) led to large cores-and-flakes. The raw materials in Bilzingsleben and Banholt-TH led to small bipolar blanks with mostly angular forms. These blank-differences convinced Mania & Weber (1986) that Bilzingsleben could not be related to the pebble-industries. But when we look beyond the shape of the blanks we see they used exactly the same TFUs. This suggests they shared the same mental template. The same short-TFU-mental-template also existed in Beijing, whilst those humans were part of a distinctly separate human population. The shared mental template does therefor not always indicate directly-connected traditions; this mental template developed when groups were forced by poor raw materials to use bipolar pioneer technology.

We must compliment Mania and Weber for already recognizing the use of the straight bipolar technique (which they called zertrümmern) in 1986. But since then, our understanding of the

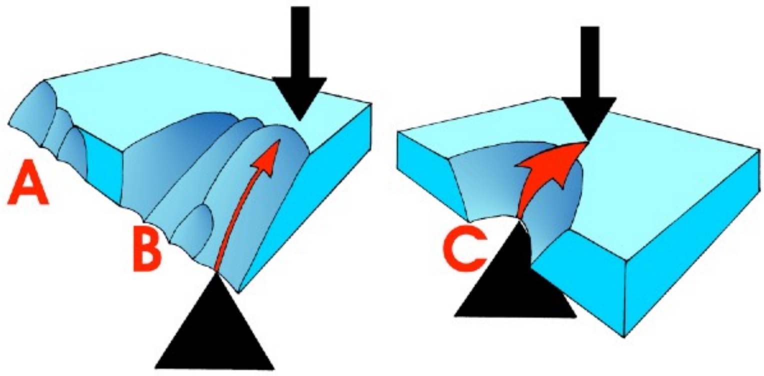


Figure 19: Contre-coupe flaking methods A: steep retouche, B: flat retouche, C: notching, after Van der Drift 2019.

bipolar techniques has grown. In 2012 Van der Drift defined Oblique Bipolar Flaking (OBF) as the key method for the production of blanks from rounded cobbles in Mode-I. OBF remained important in the LFB-Acheulean and Acheuléen meridional (Van der Drift, 2019). The key techniques for the production of TFUs are the bipolar contre-coupe method and bipolar notching (*figure 19*). Contre-coupe enabled the production of retouches that vary from extremely steep (*19A*) to extremely flat (*19B*). Simply shifting the anvil-contact further away from the edge (*19C*) resulted in notches and denticulates.

Pioneers with only small stones made long TFUs on bones. Such tools have been preserved at Bilzingsleben. Mania (1990 page 148-172) classified bone tools from Bilzingsleben with bifacial and stepped retouches as handaxes. But these tools show the same lack of handaxe-modeling as i.e. *figure 3* or figure 8.7 no. 16 in Van der Drift (2019) or the Clactonian non-classic handaxes. Classic handaxe-modeling developed around 1.75 million years ago when climate change forced groups in Africa to carry large flat blanks (Van der Drift, 2019). On flat blanks, the negatives of freehand strikes always form on the side that is not visible for the toolmaker. This forced the toolmakers to continuously turn their blanks, they used the new negatives as platforms for their next strikes. This alternating freehand method led to handaxes, pics and claevers (Beyene et al, 2012). But *figure 19A* and *19B* show that all contre-coupe negatives form in full view, the pioneers therefor had little reason to turn their blanks over. So they finished one side completely, before they began to flake the other side. Most non-classic bifaces were therefor flaked one side after the other. These pioneer bifaces must not be confused with 'wechselseitig gleichgerichtete' bifacial backed knives (Keilmesser). These Mode-III freehand methods developed in relation to the cross-sections of the Mode-III blanks (Van der Drift, 2019).

Nothing stopped the pioneers from flaking large stones from the free hand. But most held on to their habit (tradition) of working on anvils and on the ground. We can tell from the flaking-signals that many Clactonian flakes were struck from cores resting on the ground (OBF): experiments demonstrate that OBF leads to the typical large bulbs, double impact-points and distinctive rims. Experiments also show that when cores which rest on the ground, are turned over between consecutive strikes, these become like alternating Clactonian-cores and the flakes show the typical large platforms and wide striking-angles (i.e. figure 7.9 in Van der Drift, 2019). The deep notches in Clactonian flakes also indicate bipolar methods. Experiments show that it is easy to make freehand notches in sharp edges of thin flakes, but deep notches in thick blanks (as in i.e. *figures 10* and *14*) can only be made with bipolar methods. Clactonian bill-hooks and flaked-flakes were therefor made with the bipolar method in *figure 19C*.

2.4. Related industries

Mode-I used OBF (i.e. Dmanisi, Van der Drift, 2012) and the notches and denticulates (i.e. in Olduvai-DK see De la Torre & Mora 2005, pg 23 or West-Runton see Lagerweij et al, 2009) suggest Mode-I also flaked on anvils. Similar characteristics occur in industries from Waalian warm-stages in Germany (Fiedler et al, 2019) and the Netherlands (Peeters, Musch and Wouters, 1988a). Examples of pioneer industries with small angular blanks attributed to MIS 13 are Saint-Colomban (Northwest-France) and Sprimont (near Liège, Belgium). We already discussed such industries from MIS 11-9. This shows that bipolar techniques were not limited to one evolutionary stage or to one hominid type. Even Homo sapiens still used the same bipolar methods. For instance the mesolithic and neolithic in the South-American lowlands completely depended on bipolar tools (experimentally confirmed by Prous et al, 2012).

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