1.8 MILLION YEARS OLD ARTEFACTS FROM THE NETHERLANDS

THE OLDEST ARCHAEOLOGICAL FINDS FROM THE NETHERLANDS

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1.1 INTRODUCTION

Claims for the oldest findings have been made many times; be it correct or not. It will certainly be difficult to find older artefacts than those presented here, because they belong to the first 'out of Africa' wave from around 1.8 Ma (1,8 million years ago). It is certainly fitting that we pay attention to these Dutch artefacts, immediately following the publication on the artefacts from East Anglia of the same age (in *APAN/extern 13*).

1.2 HISTORY

Fifty years ago, Tjerk Vermaning discovered Neanderthal camps[1]. Ten years later he was wrongfully accused of forgery[2] and because the press supported Vermaning, the court-case aroused a lot of public interest[3]. He was acquitted because his finds show silica gloss, colour patina and microscopic traces of cryoturbation[4]. The Vermaning finds are only 50.000 years old, but they initiated a greater interest in the Palaeolithic. The active inquiries as a result from this interest brought a series of older discoveries.

Many of these older finds were discovered in the ice-pushed ridges central in the Netherlands. Such as the upper-Acheulian, Clactonian and even a million year old pebble tradition.[5, 32] The group of amateur archaeologists that made these discoveries ultimately discovered finds from the Tiglian period, around 1,8 Ma.

1.3 DISCOVERIES OF THE OLDEST ARTEFACTS

The first mentions of artefacts of Tiglian age, were made by Jan van Es[6]. Peeters Musch and Wouters doubted these finds and did not include them in their article in *l'Anthropologie*[5]. I have not been able to study these finds and therefore abstain from further conclusions.

In 1982 I found a pebble-tool at the edge of a field near Gulpen (in the south of the Netherlands). At that time dr. Jean-Marie Cordy was conducting his investigations in the nearby Belgian village Sprimont[7]. He recognized the artificial character and encouraged me to keep searching. When I showed Wouters my finds in 1987, at first he thought these might be of Cromerian age. But my discussions with the geologist Peter Bosch[8] have left me no doubt that they are of Tiglian age. I collected further finds until the field became inaccessible in 2006.

In a quarry in the ice-pushed ridges (Vogelenzang near Rhenen, in the centre of the Netherlands) a sand-pit reached the depth of 18 to 20 meters in the nineties. At this depth the pit produced loamy deposits with Tiglian fossils and stone artefacts. These were collected by Max Franssen, one of the best known collectors from the ice-pushed ridges. He named the location Rhenen-I. In 2000 the quarry Vogelenzang was closed.

2.1 GEOLOGY OF THE EAST-MEUSE

The most southern part of the Netherlands is, in travel brochures, called the 'Heuvelland' (hills-land). But from a geological viewpoint this is wrong because the area has an almost flat horizon. There are no hills, only a few coal-mine waste deposits protrude from the horizon. What seem to be hills, are actually old river terraces, separated from each other by deep valleys created by younger streams. The river Meuse (*Maas*) played a central role in the formation of the terraces[8]. In the Palaeocene (50 Ma) this river rose from the Ardennes and flowed towards the Rhine. But as the Alps were raised, so were the Ardennes and this mountain chain forced the Meuse to shift to the west. In the process she than began to take in water from the Paris basin. Since the Pliocene the Meuse cuts through the Belgian Condroz to the southern tip of the Netherlands at Eijsden. At the Pliocene-Pleistocene transition the Meuse flowed east from Eijsden along the Dutch border to Aachen in Germany and reached the Rhine near Jülich. Therefore we call this the East-Meuse valley (*figure 1*). Geologically the Pleistocene terraces (Noorbeek and Simpelveld) deposited by the Meuse are nowadays considered as part of the Beegden formation.

As the Ardennes kept rising, the south of the Netherlands rose as well (Ardennes-peneplain). At the end of the Tiglian period the area near Aachen in the east became as high as Eijsden in the west. The flow of the Meuse stagnated and marshes developed in the

1 J. D. van der Waals & H. T. Waterbolk: The Middle Palaeolithic Finds from Hogersmilde. In *Palaeohistoria* XV, Bussum 1973 pp 35–166

2 K. Geertsma: Professor Francois Bordes en de zaak Vermaning. 'In de voetnoten leeft de beschaving voort'. In *APAN/Extern* 7, Groningen 1998, pp 6–24.

3 Ton Verhulst: *Tjerk Vermaning, steen des aanstoots.* Groningen, 1975.

4 Ad Wouters: *J'accuse, de zaak Vermaning.* 's-Hertogenbosch 2001.
Open brief van G. J. van Noort aan prof. Dr. L. P. Louwe Kooijmans. In *APAN/Extern* 12, Groningen 2006, pp 13–24
G. J. van Noort: Artefacten met hyalietglans, gevonden op het Drents Keileemplateau, moeten behoren tot de culturen van vóór de bodemverzuring in het Eemien. Een grensoverschrijdend onderzoek. In *APAN/Extern* 8, Groningen 2000, pp 31–53

5 H. Peeters, J. Musch et A. Wouters: Les plus anciennes industries des Pays-Bas. *L'Anthropologie* (Paris) Tome 92 (1988) pp 683–710
H. Peeters, J. Musch et A. Wouters: Les industries Acheuléennes des Pays-Bas. *L'Anthropologie* (Paris) Tome 92 (1988) no. 2 pp 1093–1136

6 J. van Es en C. Franssen: Een component van het CCC in het Tigliën van Midden Limburg. *Archaeologische Berichten* (Duizel) 13, 1983 pp 174–180.
J. van Es en C. J. H. Franssen: Artefacten van het CCC uit het Vroeg-Pleistoceen en Laat-Plioceen van Nederland. *Archaeologische Berichten* (Duizel) 15, 1984 pp 4–28.

7 W. Roebroeks and D. Stapert: On the 'lower palaeolithic' site of Sprimont. An alternative interpretation. *Current Anthropology* Vol. 27 no. 4, 1986.
J.-M. Cordy, B. Bastin, R. Geeraerts, A. Ozer, Y Quinif, J. Thorez et M. Ulrix-Closset: La Belle-Roche (Sprimont, Belgium): the oldest archaeological site in the Benelux. A report on a field trip, in M. Toussaint (ed.) Cinq millions d'années, l'aventure humaine, *E.R.A.U.L.* 56 pp 287–301.
J.-M. Cordy: *La Belle-Roche, La nature et l'homme, il y a 500.000 ans.* Liège 1995.
C. Draily, J.-M. Cordy: L'industrie lithique de la Belle Roche á Sprimont (Liège, Belgique): Paléolithique inférieur. *Notae Praehistoricae* 17-1997 pp 11–20.

8 Peter Bosch: Het stroomgebied van de Maas: gesteenten en herkomstgebieden. *Geologie Weekend Zuid-Limburg*, 1982.
P.W. Bosch en W. M. Felder: *Geologische kaart van Zuid-Limburg en omgeving. Afzettingen van de Maas.* Rijks Geologische Dienst, Haarlem 1989.

9 W. Roebroeks: *Oermensen in Nederland.* (Amsterdam) 1990

East-Meuse valley. Peat from this period (with Azolla Tigliensis) has been found in the quarry Roodeput. After 1.8 Ma the flow of the Meuse had to take another course, the new riverbed turned north near Banholt. And with each following ice-age the Meuse shifted further to the west, creating lower terraces and a deeper cut river valley.

The small town Gulpen lies deep in a valley where the Gulp-stream debouches into the Geul-stream, at about 90 meters above sea level. From the town you can travel uphill to a viewpoint with a monument at about 160 meters above sea level. But if you think this will bring you to a hilltop you are wrong. It brings you to the old Meuse valley floor, because at 160 meters above sea level you find the 1.8 million years old gravel terrace from the East-Meuse (*figure 1*).

It would certainly be wrong to suppose that finds from a 1.8 Ma terrace should inherently be 1.8 million years old. I collected Neolithic, Mesolithic and Middle-Palaeolithic finds in the same field as the very old artefacts. There are however compelling arguments to place the old finds in the Tiglian period. Beginning with the fact that these artefacts are struck on the local gravel (whilst the younger finds are made from non-local flint). In ploughed fields the frost can bring stones closer to the surface. But the early hominids that made choppers lived in a warm climate, where stones (as Darwin had already demonstrated) rapidly get buried by worms (bioturbation) and covered by dense vegetation and humus. It is therefore not feasible that hominids in a later stage (for instance during the Waalian) would have left the West-Meuse valley, gone into the dried up East-Meuse valley, where they then removed the vegetation and dug up stones in order to make choppers. The only realistic scenario is that the raw material was picked up from the embankments of the East-Meuse, this makes the hominid presence contemporary with the East-Meuse. The high age is further confirmed by the patina and rounded edges that the younger finds from this field do not show.

2.2 GEOLOGY OF THE ICE-PUSHED RIDGES

Contrary to the south of the Netherlands, there are real hills in the centre of the Netherlands. These hills were formed around 150 Ka, when the glaciers from Scandinavia reached the centre of the Netherlands. These glaciers had an enormous weight, the mass of the ice pushed up the ground in front of it, forming ice-pushed ridges. Therefore we find glacial moraine north of and on these hills. But the inside of the ridges consists of older layers, that were pushed up and sometimes folded. Sand-pits in these hills therefore reach middle and old Pleistocene layers.

As the south of the Netherlands was raised by the Alpine folding, the north rapidly declined. It was only kept above sea level trough the deposition of fluvial sediments from the Rhine and Meuse. An archaeologist prefers imbedded finds over finds from eroded terraces, but in the north of Holland the 1.8 Ma layers are out of reach, at a thousand meters below sea level. Access to Tiglian deposits was however possible near the town of Tegelen (6), from which the name Tegelen-deposits or Tiglian was derived. And access was possible in sand-pits in the ice-pushed ridges. At Rhenen-1 (*paragraph 1.3*) Tiglian beds were reached at a depth of 18–20 meters. Dark coloured sands, loam and coarse gravel were retrieved from this depth. Geologically these deposits are from the Harderwijk formation that is currently considered part of the Waalre formation. The artefacts and fossils probably originate from the embankment of the Tiglian-Rhine, also known as the Bunnik-Rhine. A loamy matrix stuck to many of the artefacts. And bones and teeth from early mammoths were found. Max Franssen donated the teeth to Van Kolfschoten and Van Essen. The palaeontologist Van Kolfschoten confirmed the Tiglian age. The Harderwijk formation was covered here by 15 meters of mainly sands from the Kedichem formation, which is also currently considered part of the Waalre formation.

The depth of the sand-pit increased over the years, as the sand was sucked up from the bottom. Therefore there is always the theoretical possibility that an artefact originating from of one of the sides of the pit from for instance 8 meters depth, tumbles down to the bottom whilst material is sucked up from 18 meters depth. In this case however the Max Franssen collection consists of about a hundred artefacts associated with fossils and all were collected in a limited timeframe. Therefore there can be no doubt that the provenance of this group is the Harderwijk formation and that the group can be safely dated to the Tiglian era.

10 W. Roebroeks and T. van Kolfschoten: The earliest occupation of Europe: a reappraisal of artefactual and chronological evidence. In: *The earliest occupation of Europe.* Edited by W. Roebroeks and T. van Kolfschoten. Leiden 1995 pp 297–309

11 A.C. Lagerweij, A. Cardol, J.M. de Koning, H. Van der Made: Werktuigen uit het Stone Bed van East Anglia 1,8 miljoen jaar BP. *APAN/Extern 13*, 2009. See: http://www.apanarcheo.nl/West%20Runton%20Stonebed%20East%20Anglia/West%20Runton%20Stonebed%20East%20Anglia.html

12 D. Mol, J. de Vos, R. Bakker, B. van Geel, J. Glimmerveen, H. van der Plicht, K. Post: *Kleine encyclopedie van het leven in het pleistoceen. Mammoeten, neushoorns en andere dieren van de Noordzeebodem.* Diemen, 2008.

13 L. Fiedler: *Jäger und Sammler der Frühzeit. Alt- und Mittelsteinzeit in Nordhessen.* Kassel 1997.

14 Jan Willem van der Drift (1991): Inleiding in de steentechnologie, achtergronden bij steenbewerkingstechnieken. *Archeologie* 3 (Meppel) pg 2–37.
Jan Willem van der Drift (2001): Bipolaire technieken in het oud-paleolithicum. *APAN/extern* 9 (Groningen) pg 45–74.
Jan Willem van der Drift (2007): *The bipolar toolkit concept*. See: http://www.apanarcheo.nl/bipolair/bipolaircd.html
Jan Willem van der Drift (2009): *Bipolar techniques in the Old-Palaeolithic* http://www.apanarcheo.nl/bipolair apanarcheo.pdf

15 According to the Greek historian Vitruvius, Archimedes shouted *'Heureka!'* ('I found it', heuriskein = to find) as he discovered his hydrostatic law. This is often corrupted to eureka.

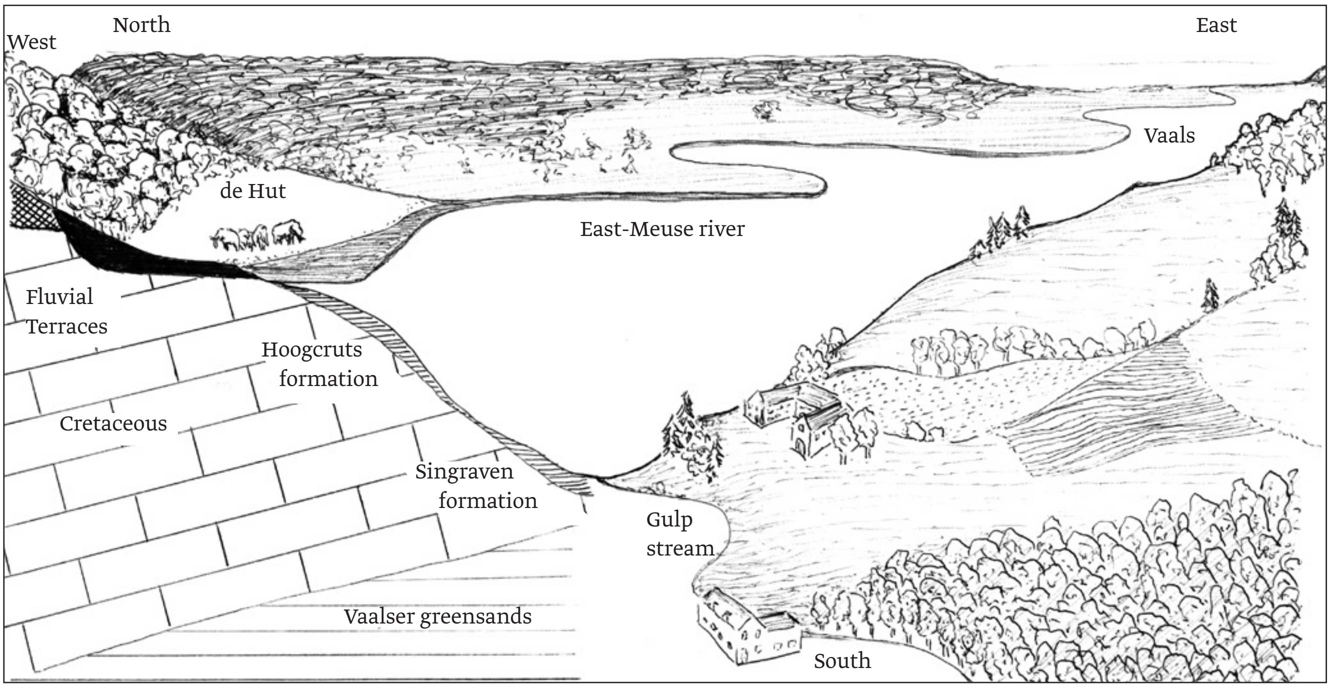
16 F. Diez-Martín, P. Sánchez, M. Domínguez-Rodrigo, A. Mabulla, R. Barba: Were Olduvai hominids making butchering tools or battering tools? Analysis of a recently excavated lithic assemblage from BK (Bed II, Olduvai Gorge, Tanzania). *Journal of Anthropological Archaeology* 28, 2009 pp 274–289.

176 M.N. Brézillon: La dénomination des objets de pierre taillée. *Éditions du Centre National de la Recherche Scientifique*. Paris, 1968.

18 A.M. Wouters, C.J.H. Franssen, A.M.L. Kessels: Typologie van de artefacten van de chopper choppingtool complexen. *Archaeologische Berichten* 10 (Duizel) 1981, pp 18–117.

19 The terms mode-1 and mode-2 were introduced by J.G.D. Clark: World prehistory in new perspective, Cambridge, 1977.

20 J. Richter: *Social memory among late Neanderthals. In Neanderthals and modern humans-discussing the transition.* Eds J. Orschiedt und G. Weniger, Mettmann 2000 pp



▲ **Figure 1:** Situation in the East-Meuse. The top of the drawing shows the East-Meuse valley 1.8 Ma. The horizon has been shaped by older fluvial terraces (Kosberg, Crapoel and Noorbeek terraces). Partially this horizon still exists. The Meuse flowed in meanders to the east (along Vaals to Aachen). Early hominids used the gravel from the embankment to make tools. At the end of the Tiglian the Meuse turned north, breaking through the valleys side, perhaps where in earlier times a stream came from the north. At the bottom of the drawing the present situation can be seen. The Gulp and Geul streams are now running 75 meters lower than the Meuse at 1.8 Ma. On the left the geology is shown. At the top we see the fluvial terraces, the 2 Ma Noorbeek terrace is hatched, the 1.8 Ma Simpelveld terrace is black. Underneath we see the cretaceous Gulpen layers and greensands. The Gulp-stream has cut a very deep valley into these layers during the Pleistocene. The sides of this valley are covered with loamy deposits. These contain angular flint at the top (Hoogcruts formation) and clay from the stream (Singraven formation) lower in the valley. The drawing on the right shows the present landscape. When you stand on the (Simpelveld) East-Meuse terrace at 'de Hut' and look down into the deep Gulp valley, it seems as if you are on a hill but actually you are at the lowest point of the East-Meuse valley.

3.1 HOMINIDS AND BIOTOPE

Just twenty years ago, Roebroeks assumed that early hominids could not have survived in the Netherlands before 250 Ka because of their low climatic tolerance[9] and that Europe was not inhabited before 500 Ka[10]. From Happisburgh we have now learned that survival in a cool climate was possible even at twice that age. But skills to survive cold winters were not essential during the Tiglian, because the climate in the Netherlands was subtropical. In the Tiglian even *Macaca Florentina* lived here[11, 12]. We must also keep in mind that the proximity of the ocean makes the European climate milder than the mid-Eurasian climate at the same latitude; as a result there was no significant difference in winter temperature between the Netherlands and Dmanisi in Georgia. The key difference between Georgia and the Netherlands was the amount of rain resulting in a different vegetation pattern.

This reduces the biotope issue to the question whether or not early hominids were actually limited to the open grasslands. Robin Dennell claimed at the Dmanisi congress in Leiden 28-11-2009 that open grasslands formed migratory corridors. But in the opinion of David Lordkipanidze, Dmanisi actually owed its success to its varied landscape. This opinion is also in line with for instance the Modjokerto child fossil (found in 1936 by Andojo) and of course the oldest artefacts from West-Runton England, discovered by our group-West[11].

3.2 BIOTOPE WITH WATER

If we accept that early hominine foraging strategies required a varied landscape, both strict open grasslands and strictly forested areas seem less favourable. The ideal biotope for early hominids must have been a half open landscape with access to water. And from this key biotope, early hominids could either venture into the woodlands or into the open grasslands. The importance of the proximity of water can be recognized for instance in Grossenbach[13] and in the finds from this article, as these are all linked to river embankments.

At this point it might be good to inform readers who have not studied the Pleistocene to-

123–132.

21 L.R. Binford: Organization and formation processes: looking at curated technologies. *Journal of Anthropological Research* 35, 1977, pp 255–273.

22 V.E. Shchelinsky, A.E. Dodonov, V.S. Baigusheva, S.A. Kulakov, A.N. Simakova, A.S. Tesakov, V.V. Titov: Early palaeolithic sites on the Taman Peninsula (Southern Azov Sea region, Russia): Bogatyri/Sinyaya Balka and Rodniki. *Quaternary International*, 2009.

23 M.D. Leakey: *Olduvai Gorge, Volume 3.* Cambridge University Press, 1971.
M. Leakey: *Olduvai Gorge, my search for early man.* London, 1979.

24 E. Boëda: Determination des unites techno-functionelles de pièces bifaciales provenant de la couche Acheuléenne C'3 base du site de Barbas I. Les industries à outils bifaciaux du Paléolothique moyen d'Europe occidentale. *ERAULT* 98, 2001 pp 51–75.

25 H. de Lumley, M. Nioradzé, D. Barsky, D. Cauche, V. Celiberti, G. Nioradzé, O. Notter, D. Zvania, D. Lordkipanidze: Les industries lithiques préoldowayennes du début du pléistocène inférieur du site de Dmanisi en Géorgie. *L'Anthropologie* 109 (2005) pp 1–182.

pography, that England was part of mainland Europe during the early Pleistocene. During the Elster or Anglian ice-age (450 Ka) an ice-cap blocked the (northern) exit of the North sea; as a result the affluent rivers raised the sea level until the land-bridge overflowed and this *'Fleuve Manche'* cut out the Channel. In my opinion waterways formed important migratory corridors as they provided varied food resources. Therefore early hominids could have easily travelled from Gulpen (East-Meuse effluent in the Rhine) to Rhenen (Bunnik-Rhine) following the rivers and to West-Runton in England following the coast line.

3.3 TECHNOLOGY AND BIOTOPE

Picture an Australopithecus picking up a stone with his left hand and just for kicks also picking up a stone with his right hand. He smacks one stone hard against the other, hitting one just at an edge; and a flake blows off. Surprised he drops both stones and picks up the flake. Now his intellect comes into the picture, for this Australopithecus recognizes the functional sharp edge; he calls out 'eureka'[15], and runs to the closest carcass to cut it open. That is a wonderful story, but is it not far more logic that hominids used stones to crack open bones in the same way that apes crack nuts? They would then be using hammer and anvil and must without doubt accidentally have broken stones. With sharp broken stones and meat at the same place and at the same moment, the discovery that flakes cut meat is far more probable. Cracking bones might be the way cutting edges were discovered, anvil techniques could be very old. Once that the cutting edge principle was understood, hominids took the next steps. From the simple 'nut-cracking' technique they could have developed the complete bipolar reduction strategy. It is important to note that oblique bipolar reduction (when the hammer-strike is not directed towards the anvil) creates far more options than 'nut-cracking'[14]. It has been proven that anvils were used to break stones in Olduvai[16].

A completely different next step would be the switch to striking a core with a hammer whilst this core was held up in the air in the free hand. This freehand reduction strategy was for instance used in Kada Gona (2.6 Ma). Freehand reduction requires good quality raw material. Because of this, freehand reduction is often linked to open landscapes preferably in climates where erosion makes the raw material visible. Whilst bipolar reduction can be used on just about every stone or pebble. The independence of raw material quality makes bipolar reduction the technique of choice in partly forested landscapes and climates where sedimentation prevails.

4.1 BIPOLAR TYPOLOGY

The finds from Gulpen and Rhenen were made on coarse gravel in a climate with much vegetation and where sedimentation prevailed. Therefore it should not come as a surprise that the dominant technology was bipolar reduction. The classic (French) typology with tool-types like the *'biface cordiforme'* and *'pointe moustérienne déjetée'* as described by Brezillon[17] has been developed for freehand reduction. It proves difficult to apply this classic typology to the traditions without hand axes. That is why many authors have developed their own typology for such finds (irrespective of the fact that most did not recognise the bipolar technique). Examples are the typologies by Vértes, Ramendo, Dies, Pei, Movius, van Riet Lowe, Alimen et Chavaillon and Mary Leakey. Recognizing the bipolar reduction as common denominator, Ad Wouters developed his own typology[18] aided by the finds from Dutch collectors. We consider Wouters work to be one of the great achievements of Dutch archaeology.

4.2 TYPOLOGICAL DEVELOPMENTS

The earliest European finds showed no hand axe technology, therefore they are usually called mode-1 assemblages[19]. Around 500-600 Ka mode-2 (with hand axes) became the dominant line. And at 350 Ka the Levallois technique was present. From around 150 Ka points and blades were present in the western European traditions. All of this looks like a straight forward rectilinear development. It is tempting to link this to the development of hominid intelligence. But if we look a bit further, we see that mode-2 already developed in Africa around 1.5 Ma and Levallois around 1.1 Ma. And at the time when the Europeans finally took up the mode-2 concept the Africans were already making points and blades. Does that mean the European hominids were less intelligent? No of course not; there simply were far more Africans and these were living closely together. This resulted in a far greater social memory[20] and greater competition. The small group size and wide spread of groups were the key factors that limited technical development levels in Europe.

26 J.D. Clark: The stone ball: its associations and use by prehistoric man in Africa. In L. Balout (Ed) *IIe Congrès Panafricain de préhistoire, Alger.* Paris (1955) pp 403–417

27 Ph.V. Tobias: De evolutie van de mens in Olduvai, In De evolutie van de mens, de speurtocht naar de ontbrekende schakels. *Natuur en Techniek.* Maastricht 1981

28 K. D. Schick and N. Toth: *Making silent stones speak.* London 1993

29 Texier et Roche: Polyèdre, sub-sphéroïde, sphéroïde et bola: des segments plus ou moins longs d'une même chaîne opératoire. *Cahiers Noir* 7 (1995) pg. 31–40

30 I. de la Torre & R. Mora: Technological strategies in the lower pleistocene at Olduvai Beds I & II. *Études et Recherches Archéologiques de l'Université de Liège,* 2005.

31 Jan Willem van der Drift: Comparing bipolar artefacts with pseudo-artefacts and industrial waste. An overview based on experimentation. In: *Notae Praehistoricae* 30 Leuven (2010) pp 7–12

32 C.J.H. Franssen en A.M. Wouters: Artefacten uit het Waalien-C. *Archaeologische Berichten* 10. Bennekom/Lent (1981), pp 118–123.

33 A.R. Templeton: Out of Africa again and again. *Nature* 416, pp 45–51, 2002. www.nslc.wusH.edu/courses/Bio4181/templeton/2008/history.pdf
A.R. Templeton: Nested clade analysis: an extensively validated method for strong phylogeographic inference. *Molecular Ecology*, 2008, 17 pp 1877–1880.

34 P.B. Beaumont, J. Vogel: On a timescale for the past million years of human history in central South Africa. *South African Journal of Science* 102, 2006.

35 R. Kittler, M. Kaysar en M. Stoneking presented an investigation into the molecular evolution of Pediculus humanus (lice) in *Current Biology* 13 (2003) pp 1414–1417. They made the connection between the evolution of clothing-lice and the invention of clothes. Since then, the date that clothing-lice have evolved was dramatically upgraded by David Reed to 650 Ka. (www.research.ufl.edu/publications/explore/current/story_1/index.html)

36 G. Wagner, H. Rieder, L. Zöller, E. Mick (Eds): Homo heidelbergensis. *Schlüsselfund der Menschheitsgeschichte.* Stuttgart 2007.
G.A. Wagner, K.W. Beinhauer (Eds): *Homo heidelbergensis von Mauer. Das Auftreten des Menschen in Europa.* Heidelberg 1997.

37 B. Demarsin, M. Otte (Eds): Neanderthals in Europe. *ERAUL* 117 Liège 2006 / Atuatuca 2 Tongeren 2006.

38 M. Otte, M. Patou-Mathis et D. Bonjean (Eds): Re-

Now that we understand that the toolkit is not a measure for the intelligence, the next thing we must understand is the difference between expedient technology and curated technology[21]. The expedient technology is the quick job, for instance when you want to cut a rope. All you need is a simple cutting edge (flake or broken pebble). But if you are short on raw material, you keep the flake for a next job. And once it has become dull you resharpen it by retouching it. Now the retouches have turned the expedient flake into a recognizable 'curated' knife. Hand axes, prepared cores and other developments of course all belong to the curated technology.

Obviously the most prominent curated tools were made in freehand reduction. The bipolar toolkit was predominantly expedient. Picture an early hominid group on the embankments of the East-Meuse river, wanting to cut up the food they just found. What would be easier than to pick up a pebble, break it on an anvil and get to work. These early hominids saw absolutely no need to carry a bag of flakes with them and resharpen these in a later stage; as pebbles were readily available it was far easier to make new expedient tools. It is certainly true that a chopper has a less effective cutting edge than a hand axe. But this disadvantage was more than made good by the fact that no time at all was wasted on the search for good quality raw material from which a hand axe could be made. Good quality raw material was far better available in open landscapes in African (i.e. quartzite from the clearly visible Naibor Soit hills). And in Africa the threat from carnivores soon encouraged the choice for the better cutting edge in LCTs (large cutting tools) and freehand flakes. Therefore mode-2 was developed in Africa around 1.5 Ma. But in Europe the expedient bipolar toolkit remained the most economical option for another million years.

4.3 RAW MATERIALS

In general the raw materials strongly influence developments. It is not easy to turn large lumps of isotropic quartzite from the Naibor Soit hills in Olduvai into choppers. The choice for this material must have encouraged flaking (from the free hand or in oblique bipolar reduction). Therefore it speaks for itself that according to the researchers in Olduvai, flake production was the main goal of early hominid technology. But in Europe flake production was not the main goal, for instance the quartz pebbles from the German site Grossenbach were not fit for the production of large effective flakes. As a result, the production of choppers was the main goal of early hominid technology in Grossenbach. Therefore I believe we should say in general that the goal of early hominid technology was the production of cutting edges, be it either on flakes or on cores. And be it in freehand or bipolar technology. Although bipolar reduction was used in East Anglia[11] and in the East-Meuse and the ice-pushed ridges, the different raw materials have led to a very different appearance of these closely related toolkits.

4.3.1. EAST ANGLIA

When you look at the similarities within series of pebble-choppers or series of flakes you are inclined to believe this points to standardisation. In the East Anglia Stone Bed in West-Runton, the tool shapes seem to be less standardized as a result of the irregular flint nodules. This makes the East Anglia finds seemingly archaic. This general appearance is highly comparable to the 1.5 Ma artefacts from the Taman peninsula[22] not far from Dmanisi. The flint nodules in East Anglia however show a sublime quality, they are very fine grained and isotropic with few inclusion bodies. This high quality made it more economical to retouch blunted cutting edges rather than discard them. The elaborate fine retouch seems to contradict the archaic first impression, but both are induced by the raw material. Therefore we should not interpret these technical traits as typical for the 'level of intelligence'. Let me explain this by pointing to the Tayacian/Heidelbergian group (from near Gulpen) that I show in the first chapter in my DVD ([14], 2007). This group has a very similar appearance to West-Runton, even though it is of middle Pleistocene age! The main difference is a higher percentage of more standardized tools (i.e. Tayac points and bill-hooks) in this younger group. Therefore the similar appearance results from the similar raw material.

That middle Pleistocene group also teaches us another lesson. It is obvious that we should certainly expect freehand flakes and hand axes in this group, if we look at the timeframe and the raw material. Nevertheless freehand flakes and hand axes are strikingly absent amongst the 5000 artefacts in this group. This shows us that the social memory of this particular middle Pleistocene group focused on the use of bipolar techniques. I have called this use of bipolar techniques as a specific strategy: 'the bipolar toolkit concept'[14]. The

cherches aux grottes de Sclayn. *ERAUL* 79 Liège 1998.
39 B. Walet, A. Boelsma: Kwartsiet-paleolithicum in Nederland. Een voorbericht over een unieke site. *APAN/Extern* 8, Groningen (2000) pp 27–30

40 G.J. van Noort: Een middenpaleolithische vindplaats van de Tayac-cultuur op de stuwwal 'de Hooge Berg' op Texel. In *APAN/extern* 14 Groningen (2010) pp 30–50

41 J.W. van der Drift: Keilmesser Gruppen Neanderthalers. *APAN/extern* 14, Groningen (2010) pp 8–27

42 J.W. van der Drift: Wat gebeurde er nou echt met de Neanderthalers? *APAN/Extern* 10, Groningen (2003) pp 77–85
For English version see: http://www.apanarcheo.nl/neanderthaler%20engels.pdf

43 M.V. Sorensen and W.R. Leonard: Neandertal energetics and foraging efficiency. *Journal of Human Evolution* 40 (2001) pp 483–495

44 J. Kolen: Hominids without homes: on the nature of middle Palaeolithic settlement in Europe. In: *The middle Palaeolithic occupation of Europe.* Edited by W. Roebroeks and C. Gamble. Leiden 1999 pp 139–175

mode-1 traditions from West-Runton, the East-Meuse and Rhenen-1 are obviously too old to hold hand axes. But I see only incidental indications for freehand flaking in these mode-1 industries. Therefore I consider these European Tiglian traditions to be bipolar from the conceptual viewpoint.

4.3.2 EAST-MEUSE

The majority of the finds from East Anglia and the East-Meuse can be classified as simple choppers or scrapers. Yet the toolkits give a completely different impression. In the East-Meuse, artefacts are often made on rounded pebbles. These pebble-tools show much similarity with the Oldowan toolkit[23] as it is shown in *figure 2*. In choppers that are made on rounded pebbles (such as found in Grossenbach) it seems far easier to understand the techno functional units (TFUs [24]). Because it is obvious that the fractured part has a chopping or cutting function, and the rounded part is the grip-part held in the hand. This makes the East-Meuse toolkit seemingly more standardised than the East Anglia group. But the pebbles from the East-Meuse often had a lesser quality (i.e. coarse quartzite). And this did not invite to retouch the choppers, therefore the character remained more expedient.

4.3.3 ICE-PUSHED RIDGES

The raw materials used in the Rhenen (ice-pushed ridges) were rounded pebbles, just like in the East-Meuse, resulting in a similar toolkit. Many tools were made on large stones from the Bunnik-Rhine. A special feature is that Max Franssen also recognized and collected large quartz flakes. Such quartz artefacts are common in Olduvai[16] and Dmanisi[25]. Large quartz blocks were obviously considered important raw material. In the Franssen collection there are two large fragments of elephant bone with fractures that do not fit weathering or gnawing patterns. These bones were possibly broken intentionally by early hominids. Perhaps these bone fragments were used as tools.

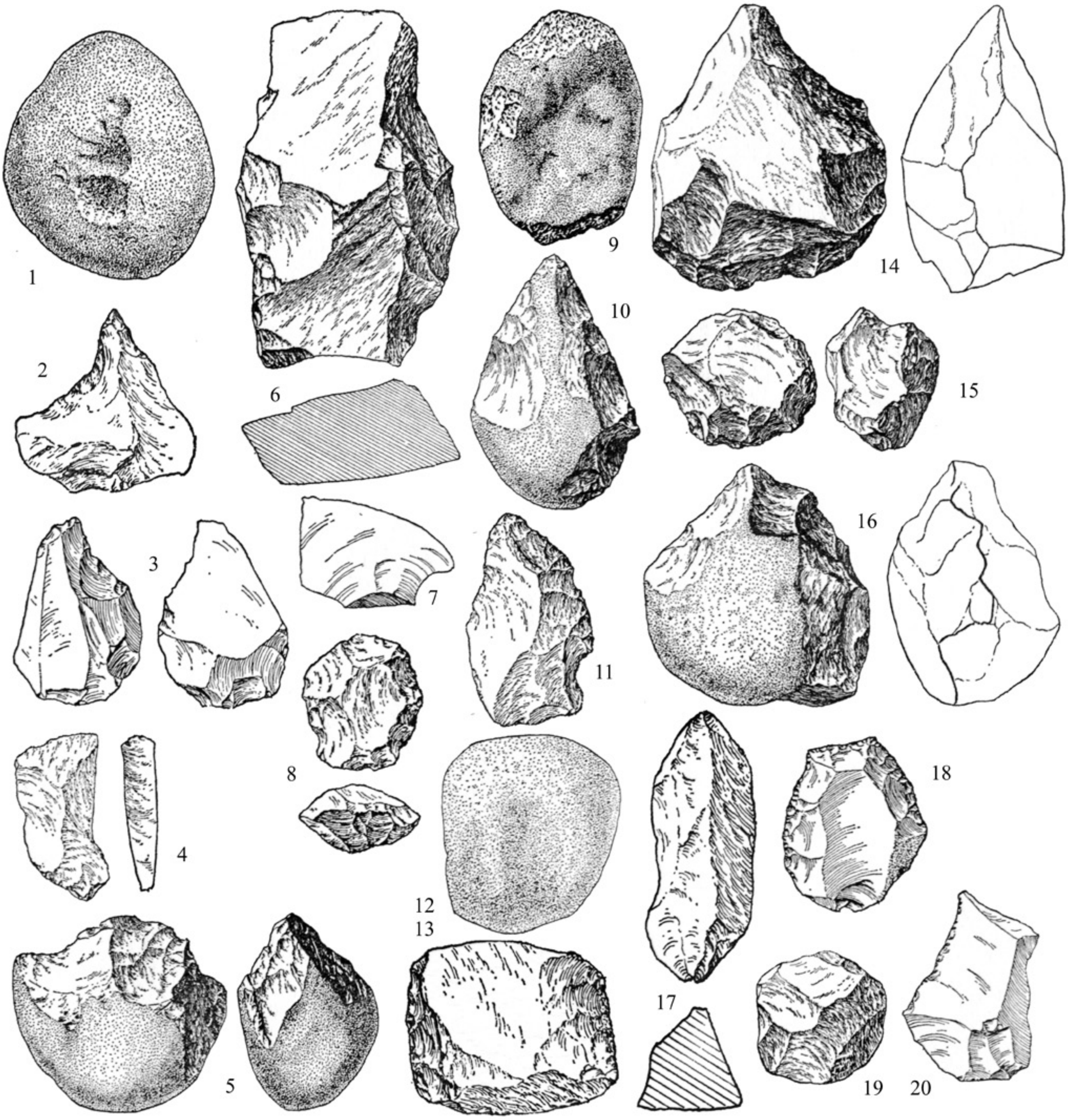
4.4 COMPARISONS

Many manuport pebbles were found in Dmanisi and Olduvai; stones that show no traces of being worked by hominids. Sadly the geology does not allow recognizing unmodified manuports in either the East-Meuse, ice-pushed ridges or East Anglia. The conditions in the Stone Bed in East Anglia preserved the complete flint toolkit from large blocks to the smallest flakes and al these materials were collected and studied[11]. It was not possible to recognise the smaller artefacts in the gravels from the East-Meuse and the Bunnik-Rhine. Large quartz blocks and flakes were found in the ice-pushed ridges. In Dmanisi unmodified manuports and large blocks form a large part of the lithics. If we leave these out, simple choppers dominate the Dmanisi artefacts. It is no surprise that such simple choppers also dominate the East-Meuse and Bunnik-Rhine artefacts. In fact choppers also dominate the East Anglia artefacts but this tool-type is not mentioned in the descriptive table of the Stone Bed artefacts[11]. This is a deliberate choice of the authors, they have classified the chopper group as scrapers. They have done this because of the frequent presence of intense steep retouch and because of the absence of the grip-TFU that is characteristic for pebble choppers. This is of course raw material defined.

Small retouched tools are almost absent in Dmanisi[25] but they are abundant in Olduvai in sites from the same era[23, 25]. These small tools are mostly scrapers, denticulates and notches. In the ice-pushed ridges collection small retouched tools are rare as they are in Dmanisi. The East-Meuse collection has an intermediate position and in East Anglia small retouched tools are abundant[11]. When we look at this we must however take into account that the raw material and the method of collecting were ideal for small retouched tools in East Anglia, where intact layers were found and sifted. The tools from the East-Meuse and from the ice-pushed ridges have been rolled, small material has probably washed away.

4.5 TOOL USE

Insights in tool use develop in time, as we can for instance see from the polyhedron discussion. In 1955 it was thought that polyhedrons were made on anvils[26] and we have confirmed this in experiments. Louis Leakey thought polyhedrons could be throwing weapons or bolas[27] and performed experiments to prove his idea. Shick and Toth came with the idea that polyhedrons and spheroids were worn out hammers and the result of intense battering[28], and their experiments also confirmed their theory. The next suggestion was made by Texier and Roche[29], they considered polyhedrons to be cores. These are just a few of many opinions on the same subject, often built on keen observation and good expe-



riments but nevertheless leading to totally different conclusions. In the East-Meuse and ice-pushed ridges, the weathered and rolled conditions makes it impossible to determine microscopic traces of use-wear. This means that, just like in the polyhedron discussion above, we can only make general assumptions.

1. Tools were used for the cutting of meat, hide and plant material. For cutting long cutting edges with an acute opening angles are preferred. Modern steel knives function best when the angle approaches 20 degrees. In flint, freehand flaking is the best way to produce long and acute cutting edges. As bipolar reduction was the dominant technique, many angles are steep or even obtuse. Oblique bipolar flakes[14] and choppers with acute angles make the best cutting options. A special tool-type is the Large Cutting Tool (LCT, [30]) examples are shown in *figure 3* and the quartz LCT in one of the photos.
2. Scraping hides. Edges with regular retouch at an acute angle are preferred. There are few finds like *figure 4.2* and *6.2* or in East Anglia EWR-5 no 24 and 25[11] that are very

▲ **Figure 2:** Mary Leakey made this selection of artefacts to show us the tool-types in Olduvai. Most fit into the bipolar toolkit, but freehand flakes are also present in Olduvai.

1: anvil, 2: awl, 3: bifacial point, 4: burin, 5: chopper, 6: cleaver, 7: débitage, 8: discoid, 9: hammerstone, 10: hand axe (probably freehand), 11: laterally trimmed flake (probably freehand), 12: manuport, 13: outil écaillée, 14: pick, 15: polyhedron, 16: proto-biface, 17: punch, 18: scraper, 19: spheroid, 20: utilized material.

suitable for working hides. Perhaps working hides was not common in these traditions.

3. Scraping wood or bone. Many bipolar tools with a steep edges are effective at working wood or bone. Perhaps making pointed sticks was an important task. Apes have been seen to break sticks and use these as spears, early hominids perhaps went a step further and used scrapers to make sharp points on spears and digging sticks. It was not until the middle Pleistocene that we see the typical large Clacton-type notches that might have been used to make developed throwing spears.
4. Denticulate tools could have been used on a variety of fibrous plant materials. Fine denticulates only become commonplace in the middle Pleistocene.
5. Chopping and fracturing. Heavy tools, preferably with a cutting edge for a precise directed blow, could have been used in butchering and bone breaking. Cleavers like *figure 4.1* and large choppers like *6.1* could have been used for butchering.
6. Bipolar reduction. Hammers and anvils have been found in West-Runton. Rolled hammers and anvils in gravel are hard to recognise, but one intensely used hammer was found in the East-Meuse Tiglian. Surfaces littered with traces of battering are good indicators for the hominid provenance of assemblages[31].
7. Awls. Pointed tools for piercing have been found, but real drilling/boring was probably not performed in the European Tiglian.
8. Burins like *figure 4.5* and *6.1* are common in all bipolar traditions. These bipolar burins can be used to cut or scratch in bone or wood. But functionally they cannot be compared to upper-Palaeolithic gravers.

5 PALAEOLITHIC CONTEXT

Most readers with a general interest will find it hard to understand the place of these mode-1 toolkits in a broader European Palaeolithic context. Those readers can get a better understanding from the next paragraphs and *figure 8*.

5.1 OLD PLEISTOCENE

Atapuerca (at 1.3 Ma) is presently seen as the oldest European site on which there is no debate. But as the impact of the short chronology hypothesis[10] declines, other old Pleistocene finds like Barranco Leon, Grossenbach and the finds in this article also become better accepted. Early hominids could have entered Europe via the eastern or western route. If we take into account that the Danubian farmers and before them the Aurignacian modern humans entered Europe by the eastern route, than the eastern route seems to be a very probable option. On that eastern route lies Dmanisi (1.8 Ma) with its early hominid fossil finds. At 1.8 Ma early hominids had also reached Modjokerto on Java and Majuangou in China. In comparison the eastern route to Europe is short and simple. But the western route is certainly an option as well, when we look at the 1.8 Ma site of Ain el Hanech in North Africa. Just like the English Channel (paragraph 3.2) and the Bosporus, the Gibraltar Strait has not always been the formidable barrier we see in the Holocene period. The Movius-line strongly suggests that the second 'out of Africa' wave (0,65 Ma) crossed the Gibraltar Strait. Therefore fauna and hominids could have perhaps used this western route at 1.8 Ma when the Mediterranean sea level was very low.

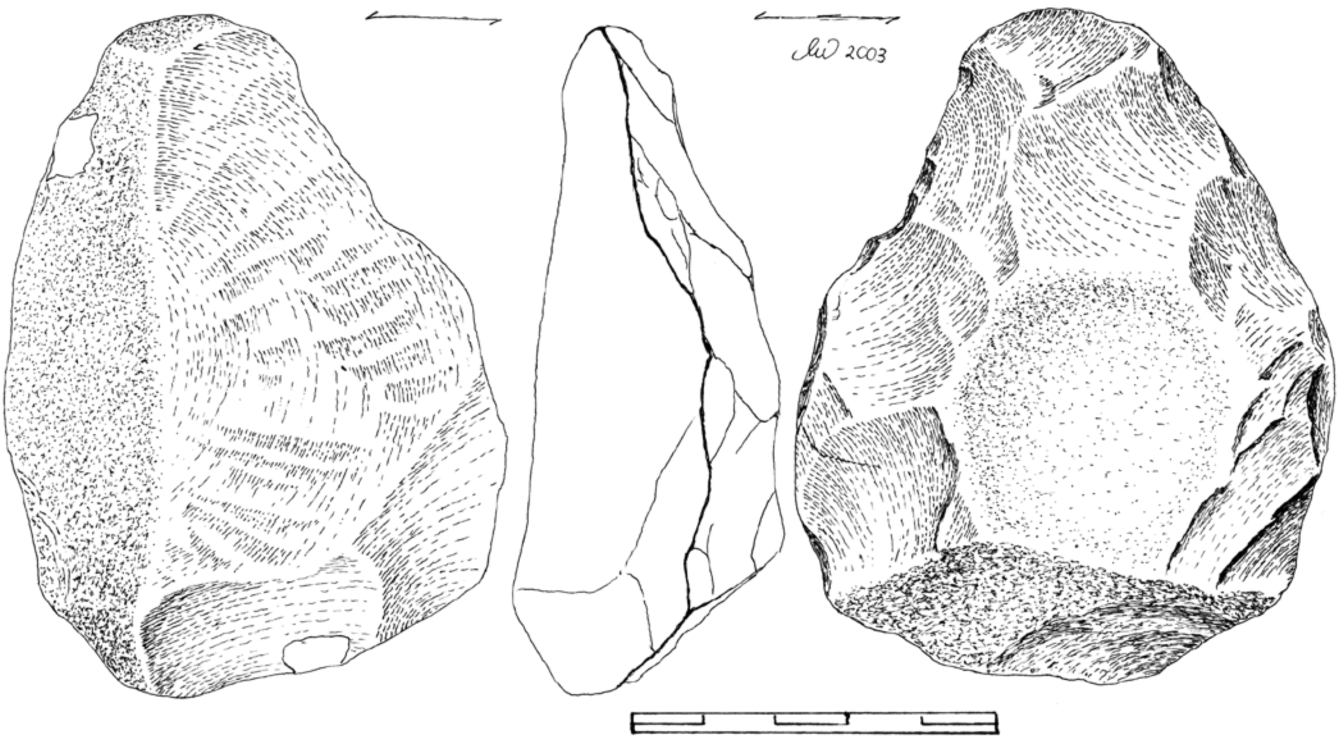
As we see in *figure 8* the climate became cooler after the Tiglian (in the Eburonian). In the coldest phases hominids could only survive in a few warm 'refugia' in southern Europe. A group of choppers with fauna from the early Eburonian (1.6 Ma) has been found in Lézignan-la-Cèbe (France). And a larger group of artefacts that is more comparable to West-Runton and to the Taman peninsula was found in a 1.4 Ma layer in Kozarnika (Bulgaria), with hominid fossil fragments. The famous site of Atapuerca has a layer dated to the end of the Eburonian.

In warmer stages and in the warmer Waalian era, pollen diagrams and fossils show that the warm flora and fauna migrated north again. Warming up drives species north as an ineluctable biological process, therefore I like to call this 'climate-drive'. The early Pleistocene hominids were of course subjected to this climate-drive. So it should not come as a surprise that we found human settlement in the ice-pushed ridges dated to the warm Waalian-C (just over 1 Ma[32, 5]). The climate-drive is one of the most important factors in the early Palaeolithic settlement of Europe.

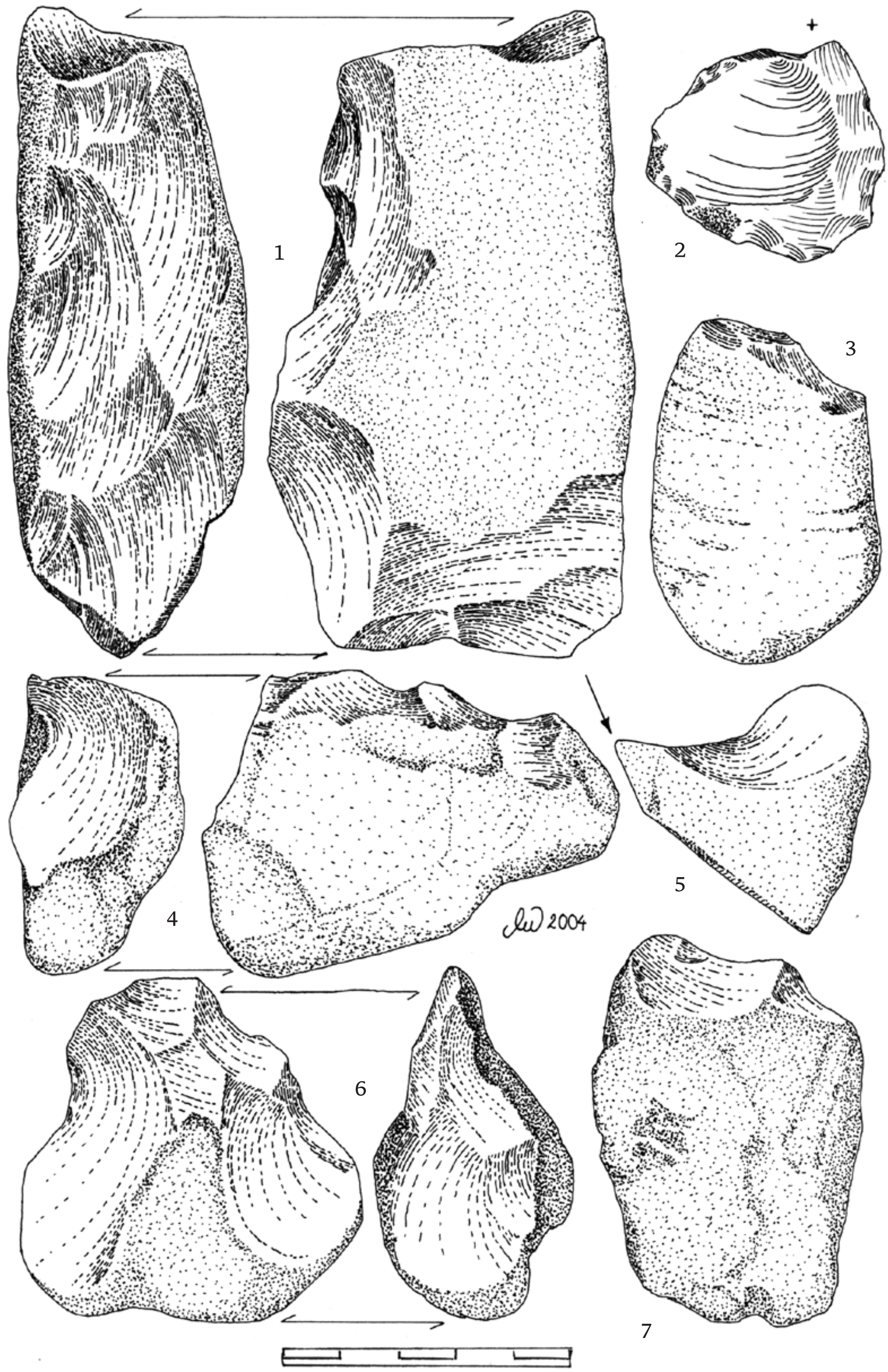
5.2 MIDDLE PLEISTOCENE

But unlike the rest of the fauna, the Pleistocene hominids tried to break the biological rules that the climate-drive imposed on them. And at the beginning of the middle Pleistocene era they had their first successes at conquering the cooler climate zone. We clearly see this in Happisburgh, a site very close to the Tiglian site of West-Runton. As mentioned in paragraph 3.3 and explained elsewhere[14], in climates where we see more erosion (dry and in the European context often cool) and open landscapes we notice a shift to freehand flaking. Because freehand flaking requires good quality raw materials, this is of course linked to the increased exposure and the very large foraging area hominid bands need in cool dry climates. With the beginning of the middle Pleistocene we therefore see the beginning of freehand flaking in Europe and this inevitably coincides with the beginning of hand axe making[14]. Sites that demonstrate this are Quipar (0,9 Ma) in Spain and Happisburgh (0,8 Ma) in England. In *figure 8* you can find the sites with mainly bipolar reduction (the bipolar toolkit concept[14]) in the left columns. And sites like Quipar with mainly freehand reduction (the hand axe concept) belong in the right column.

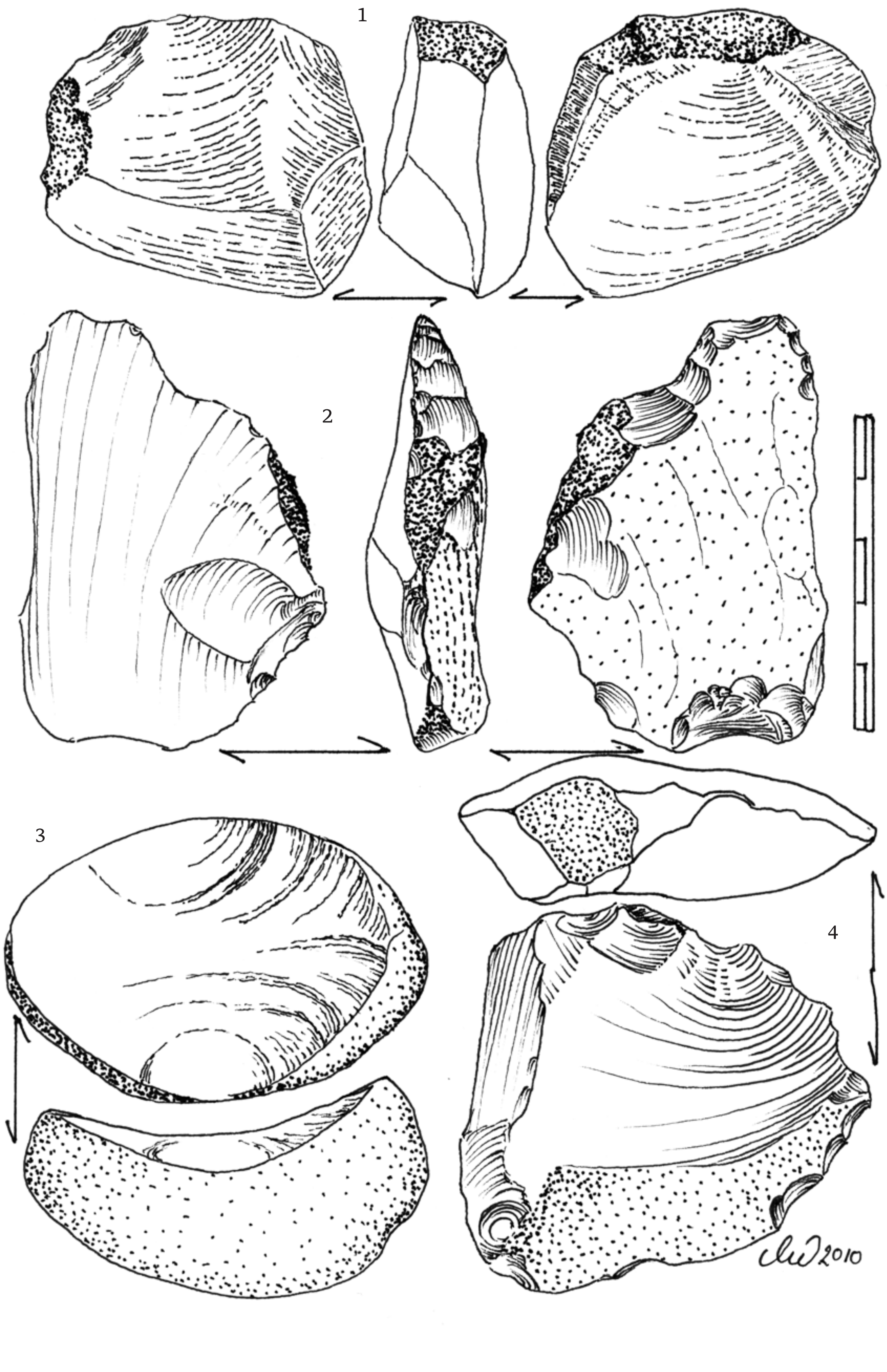
The settlement of cooler open biotopes like Happisburgh and the use of freehand or hand axe technique at the beginning of the middle Pleistocene was not yet an overwhelming success. The real success of the freehand or hand axe groups only started a quarter of a



▲ **Figure 3:** This attractive artefact from the East-Meuse (on Révinian quartzite) resembles a hand axe. Technically it is a flake struck in bipolar technique with retouches at an acute angle. Such tools are known as large cutting tools (LCTs, 30). Although such acute retouches can be experimentally reproduced in oblique bipolar technique (14), it seems more likely that this retouch was made in freehand technique. Sharp flake edges are strongly inviting to the use of freehand retouch. Therefore LCTs could certainly be the tool type that inspired hominids 1.5 Ma in Africa to begin making hand axes. The measuring-line is 5 cm.

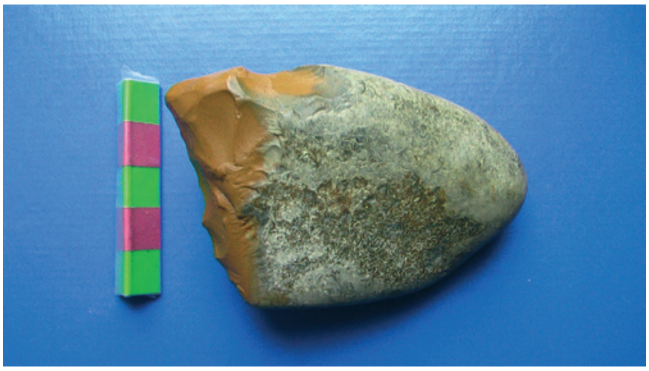


▲ **Figure 4:** East-Meuse: 1 quartzite cleaver 2 retouched flint flake with dorsal negative, this points to repetitive unidirectional flaking as is often seen in the early Pleistocene 3 Taunus-quartzite chopper 4 quartzite notch and steep denticulated scraper 5 quartzite notch-burin 6 quartzite proto-biface 7 freshwater quartzite chopper.

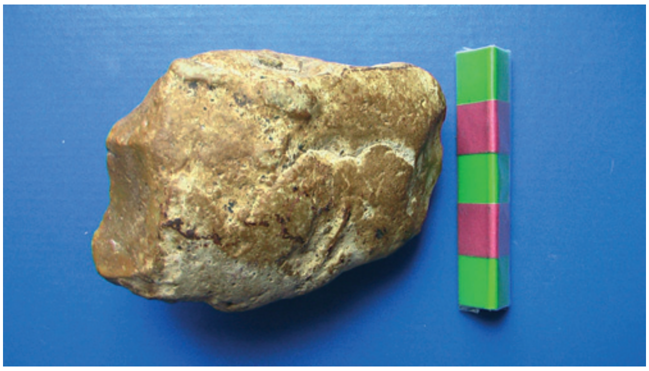


▲ **Figure 5:** East-Meuse: 1 quartzite flake with dorsal negatives, 2 flint flake with retouches, 3 jasper split-pebble, this is one of the very few instances where a bipolar fracture actually shows a bipolar ripple pattern, 4 flint flake with dorsal negative.

Quartz flake with dorsal negatives (see figure 5.1) and jasper split pebble (see fig 5.3)

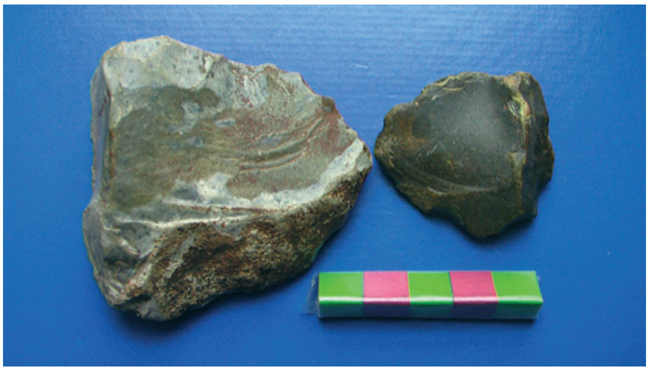


This Miocene-rolled flint scraper-notch was the first East-Meuse find

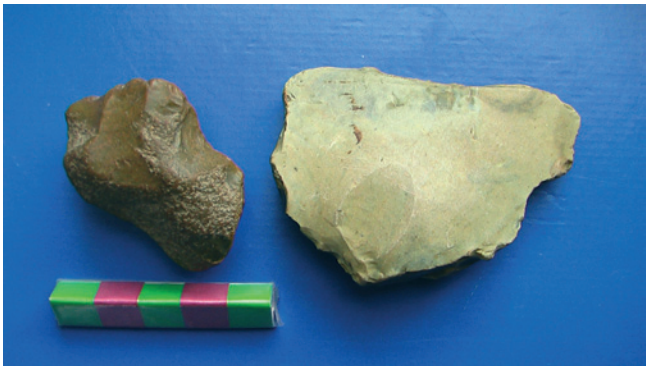


Freshwater quartzite double notched chopper (see figure 4.7)

Quartzite LCT, large cutting tool (see figure 3)



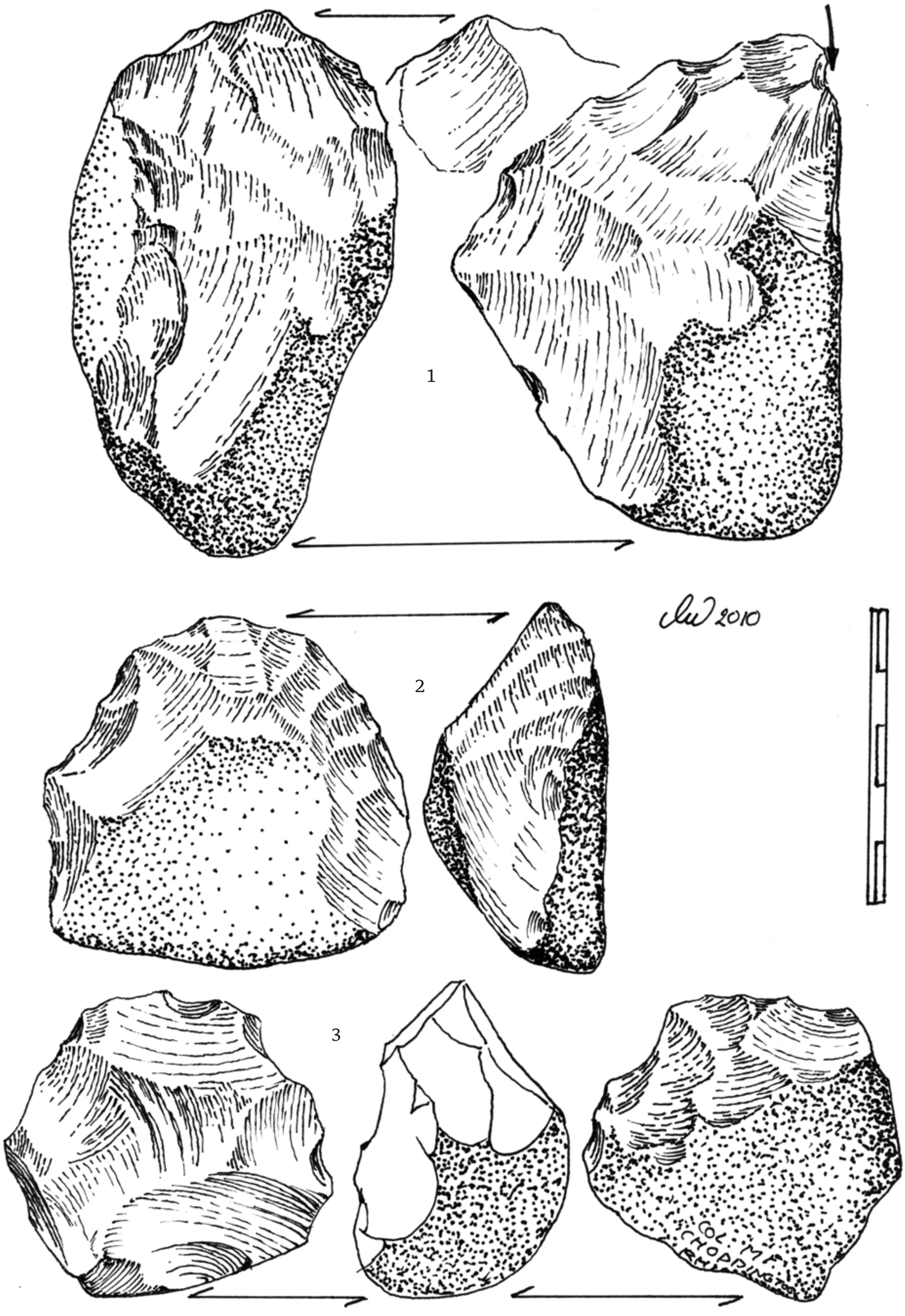
Flint flakes with dorsal negatives (see figures 5.4 and 4.2)



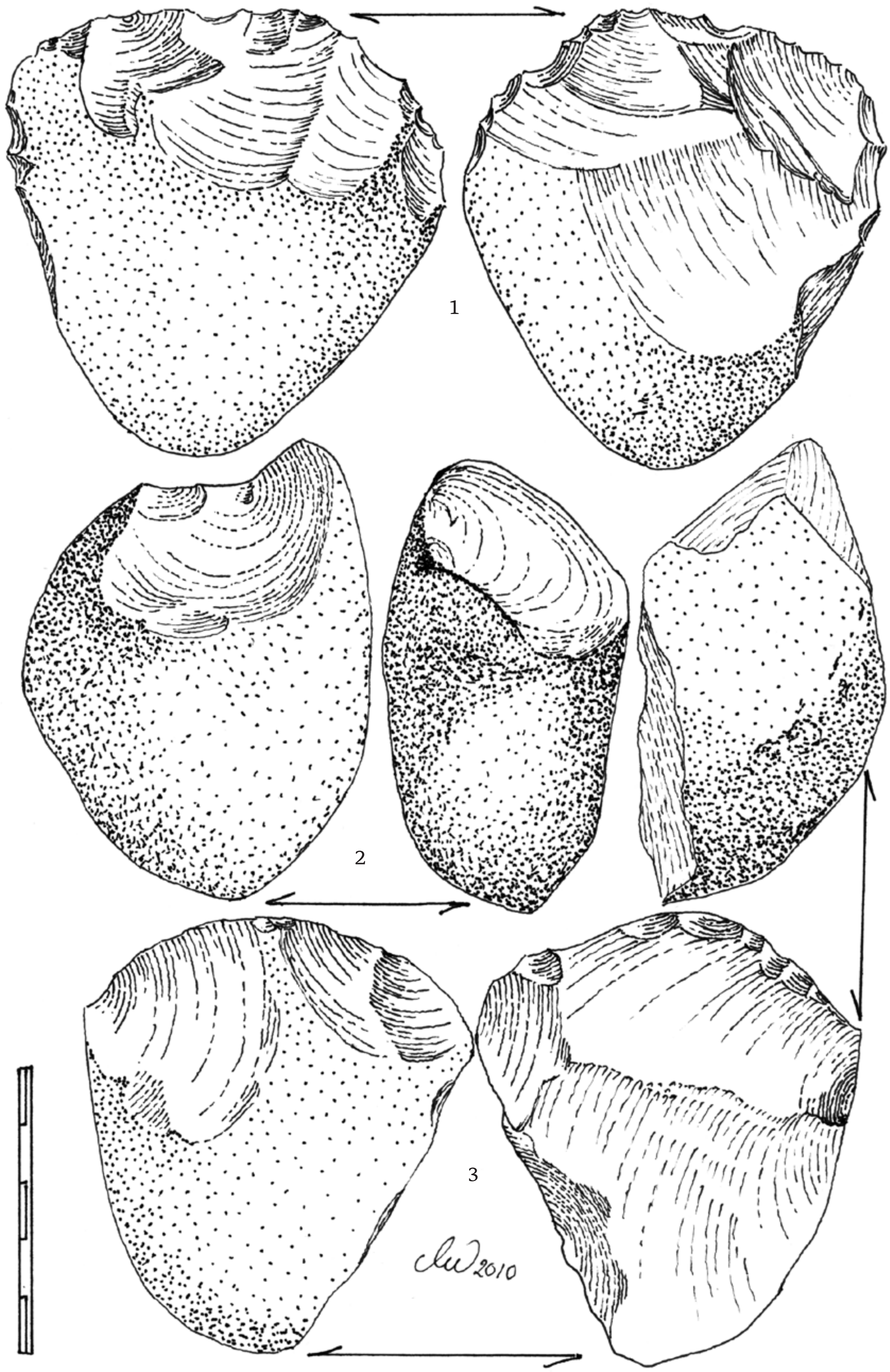
Flint convex-concave scraper and flake ventral-view (see figure 5.2)

Quartzite cleaver side-view with steep flaking (see figure 4.1)

Flint denticulate pointed scrapers or Tayac points



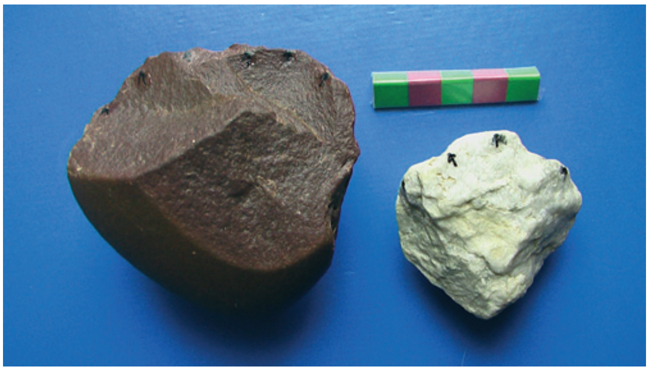
▲ **Figure 6:** Ice-pushed ridges: 1 quartzite chopper. This chopper can also be interpreted as a pointed scraper, the obtuse retouches at one edge of this scraper prove that bipolar technique was used. The sharp edge at the top was resharpened in burin style. 2 quartzite chopper. This chopper is best interpreted as a convex scraper 3 bifacial chopper-core, white vein quartz.



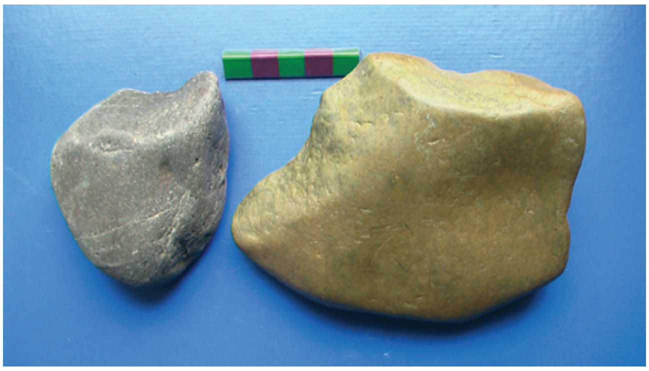
▲ **Figure 7:** Ice-pushed ridges: 1 quartzite bifacial chopper. The stepped fractures in the drawing on the right side show that the strike was directed into the stone. This means the core rested on an anvil as it was struck. Hand axes used freehand technique so bipolar choppers or bipolar proto-bifaces cannot be a first step towards a gradual development of hand axes. Gradual evolution from bipolar to freehand technique is impossible. 2 quartzite single-notch, this type of chopper is also indicative of bipolar technique 3 quartzite chopper on a bipolar pebble-segment.

Shaped bone fragment mammoth, possibly chopper

Quartzite convex scraper (see figure 6.2)

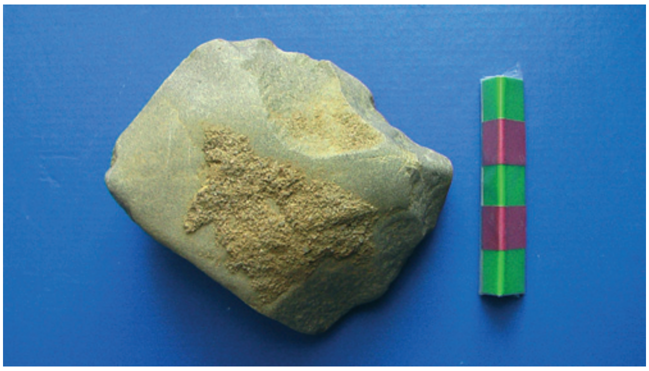


Quartzite chopper (see figure 7.1) and quartz chopper (see figure 6.3)



Quartzite single-notch (see figure 7.2) and porphyry denticulate

Quartz chopper, flake and LCT



Quartzite pointed scraper with original loam

Quartzite polyhedron or multidirectional core

Quartzite pointed scraper (see figure 6.1) million years later, around 600 Ka. This success seems to be linked to the second great 'out of Africa'. This of course makes me curious to the mechanism behind this success. Was African intelligence the answer, or advanced DNA[33]? Let us first try to figure out how 'great' this second great 'out of Africa' really was. At 600 Ka the Fauresmith[34] tradition had already developed in Africa. This tradition already had blades and points that were in Europe only developed in the Mousterian. Yet the 'out-of Africa' migration was not able to disperse this advanced technique into Europe. The assumed wave of migrants even left the Levallois technique behind; it took another quarter of a million years to reinvent the Levallois in Europe. To me, it seems very unlikely that a great wave of migrants would leave behind all their technical achievements. Therefore it is far more likely that only small groups of migrants came to Europe. These small groups of course only had a limited social memory capacity. And as they assimilated into the European population, their advanced techniques were soon forgotten. If neither the technical knowledge nor a numerically great wave of migrants turned the scale, there must have been another factor at 600 Ka. One possible answer is that clothes became standard assets around this time[35]. The use of clothes must have dramatically increased survival rates in the cool climate. Clothes and freehand flaking together were the ideal combination for the exploitation of the large biomass on the mammoth-plains. This large biomass now enabled a dramatic increase in the hominid population, starting out from the south along the Atlantic coast area. This multiplied the African immigrant DNA making it appear as if there were considerable numbers of migrants coming 'out of Africa'[33].

As the large biomass on the open plains was exploited by mode-2 industries, the mode-1 industries became outnumbered. This change from few mode-1 to many mode-2 finds was so dramatic that around 1990 most archaeologists believed Europe was not inhabited before 600 Ka[10]. What had further added to this idea was the fact that bipolar artefacts often show steep or obtuse flaking angles, steep or obtuse working edges and often do not show the diagnostic signals of conchoidal flaking[28]. Therefore mode-1 groups can be hard to distinguish from pseudo-artefacts and an atmosphere of doubt often surrounds them. To bring more clarity in the pseudo-artefact debate, I compared the 'Fagnian' pseudo-artefacts with bipolar artefacts and mechanically reduced flints[31].

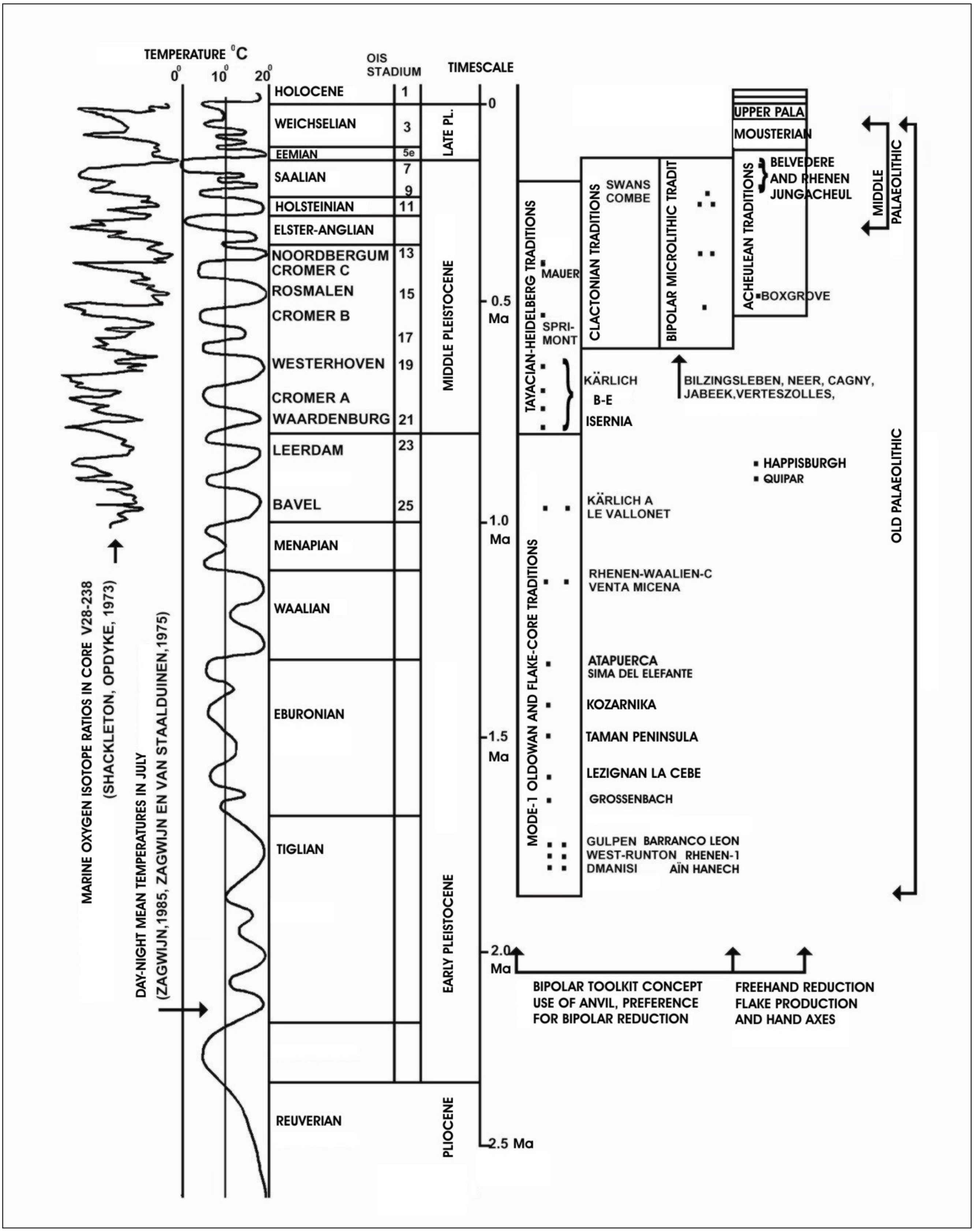
The European middle Pleistocene hominids that evolved after the second great 'out of Africa' are called Homo heidelbergensis. After 600 Ka the visibility of freehand traditions and the total number of freehand finds became so big that almost the complete attention of archaeologists is drawn to the life of hominids on the open plains. On the open plains, the freehand toolkit around 350 Ka developed the middle Palaeolithic Levallois technique. And because of the harsh conditions these hominids had to survive, the anatomy gradually developed the high metabolism features that we consider typical for Neanderthals.

But the bipolar traditions certainly did not disappear. They still populated the half open landscapes (with Buxus) and in sedimentation determined systems such as the Dutch river deltas, the quick and easy expedient bipolar technology remained the most economical strategy! Of course this expedient technique showed far less technical development but as is indicated in *figure 8* the variety did increase in the middle Pleistocene. For a good understanding it is important here to remember that the old definition of 'Clactonian flaking' technique is when an earlier reduction face is used as striking plain without further preparation of the core, in freehand style. But this old definition turns out to be very confusing, because the Clactonian tradition (as it was found in Mesvin and Clacton on Sea) actually is a bipolar tradition[14]! This complete technical contrast between the Acheulean and Clactonian explains why both traditions kept separate lines of development whilst they existed next to each other for about half a million years. The Clactonian never developed either genuine hand axes or Levallois technique because they used bipolar reduction. In the presence of good quality raw material, some flakes could have been struck from the free hand. But in general and as the conceptual basis for the toolkit, the Clactonian tradition used bipolar reduction. For instance the deep notches in Clactonian bill-hooks can only be reproduced in bipolar technique. And the flaking angle and place of the CF marks shows that most flakes were struck in oblique bipolar technique[14]. A special group is formed by the microlithic bipolar traditions such as Vértesszöllös (with micro-pebble tools) and Bilzingsleben (with micro-Clactonian tools). The fossils from Vértesszöllös and Bilzingsleben show some 'erectus' traits but factors like group size and climate-drive leave no doubt that European hominids in bipolar traditions were in the same gene-pool as 'heidelbergensis'.

5.3 LATE PLEISTOCENE

The Neanderthals are generally linked to Mousterian traditions (i.e. MTA, MMO, leaf-point groups) that are based on freehand reduction. And according to isotope studies in Neanderthal fossils, again these freehand traditions were linked to foraging on the open plains[37, 38]. On the other hand, there are also very young bipolar traditions; of Eemian age. In the Netherlands these have been found in Hilversum[39] Texel[40] and Schuilenburg[14]. There is no reason to believe that the hominids from these traditions were physically different from the Neanderthals on the open plains. Considering the small size of the total European gene-pool, and considering the many climate-induced migrations, it is highly unlikely that bipolar traditions had a separate gene-pool[41]. The persistence of the bipolar toolkit found its grounds in the relationship of the hominids to the environment and raw material.

The third great 'out of Africa' finally brought modern man to Europe and Neanderthals disappeared. Here again goes, that whenever developments are hard to explain the intelligence or improved DNA of African immigrants seems to be the easiest answer. As I have explained elsewhere[42] the correct answer lies in the differences in metabolism[43] and the use of tents[44] that created a micro-niche-climate. The era in which artefacts made by bipolar reduction (the bipolar toolkit) played a structural role in the hominid settlement of Europe, began as early as 1.8 Ma and finally ended around 40 Ka with the arrival of modern man.



▲ **Figure 8:** The European Palaeolithic. On the left side the Pleistocene geology is shown with a marine oxygen isotope curve and a temperature curve for the Netherlands. On the right side the Palaeolithic archaeology is shown with a partition in bipolar (left and middle columns) and freehand (right column) reduction technique. Because the bipolar toolkit does not hold Levallois the bipolar traditions from the upper half of the middle-Pleistocene can be considered old-Palaeolithic on typological grounds or middle-Palaeolithic on behalf of their age.