B. Demarsin & M. Otte (dir.). *Neanderthals in Europe*.
Proceedings of the International Conference held in the Gallo-Roman Museum in Tongeren (September 17-19th 2004).
Liège, ERAUL 117 - Tongeren, ATVATVCA 2, 2006, p. 107-114.

LEVALLOIS, QUINA AND LAMINAR REDUCTION AT VELDWEZELT-*HEZERWATER*

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Résumé: le site de plein air à Veldwezelt-*Hezerwater*, Belgique, riche de plusieurs niveaux du Paléolithique moyen, offre la possibilité de procéder à une étude diachronique des diverses occupations. Les traveaux technologiques permettent d'évaluer les caractéristiques techniques des assemblages, où se côtoient (1) une "Production Levallois Spécialisée de Tendance Laminaire" au site ZNB (Fin du Saalien), (2) une "Production Laminaire à partir de nucleus prismatique à débitage semi-tournant" avec des "petits outils" aux sites VLL et VLB (Fin du Saalien - Interstadiaire de Zeifen), (3) une "Production Levallois Récurrente Centripète" avec des outils bifacials au site VBLB (St. Germain II) et (4) une "Production Linéale à éclat Levallois Quadranulaire" et une "Production Levallois Récurrente Bipolaire" avec des outils de type "Quina" aux sites TL (Interstadiaire de Goulotte) et WFL (Interstadiaire de Pile).

Abstract: at the open-air site at Veldwezelt-*Hezerwater*, Belgium, several Middle Palaeolithic horizons have been discovered. This allowed the diachronic analysis of the various occupation levels. The technological analysis of the lithic assemblages showed that (1) "Specialised Levallois Blade Reduction" was employed at the ZNB Site (Late Saalian), (2) "Semi-rotating Prismatic Core Reduction" together with "small tools" were present at the VLL and VLB Sites (Late Saalian - Zeifen Interstadial), (3) "Recurrent Centripetal Levallois Reduction" together with medium-sized bifacial tools were found at the VBLB Site (St Germain II) and (4) "Lineal Levallois Reduction" and "Bipolar Recurrent Levallois Reduction" together with big "Quina" tools were present at the TL Site (Goulotte Interstadial) and at the WFL Site (Pile Interstadial).

Key Words: Veldwezelt-*Hezerwater*, Middle Palaeolithic, Levallois, Quina.

Introduction

The stretch of land on the left bank of the now dry *Hezerwater* valley in the *Vandersanden* brickyard quarry at Veldwezelt-*Hezerwater* (Province of *Limburg*, Belgium) has repeatedly been an advantageous location for human settlement during the late Middle and Late Pleistocene. The industrial exploitation by the *Vandersanden* brickyard, which exploited the loamy fill of the asymmetrical *Hezerwater* valley, started in 1993 and came to an end in 2002. In order to deal with the expected archaeological finds in a structured way, Prof. Dr. Pierre M. Vermeersch stepped in and started the "Veldwezelt-*Hezerwater* Project" in 1995. The six successive summer excavation campaigns at Veldwezelt-*Hezerwater*, which were mainly directed by Patrick M.M.A. Bringmans of the Laboratory of Prehistory (*e.g.*, Bringmans 2000, 2001; Bringmans *et al*. 2001, 2003, 2004a, b, c; Bringmans 2006), yielded more than 2,500 flint artefacts, 835 pieces of charcoal and 613 animal bones and teeth. These archaeological remains were excavated at 25 different *loci* [spots where concentrations of artefacts were found]. Only 6 of these *loci*, which yielded the bulk of the lithic artefacts, have been interpreted as *in situ* occupation sites [(1) "ZNB Site" (n=43), (2) "VLL Site" (n=795), (3) "VLB Site" (n=687), (4) "VBLB Site" (n=350), (5) "TL Site" (n=113) & (6) "WFL Site" (n=133)]. Indeed, Middle Palaeolithic humans were present at this spot in the *Hezerwater* valley at different times during the Late Saalian (late MIS 6), the late Last Interglacial *s.l.* (MIS 5a) and the first half of the Middle Weichselian (first half MIS 3).

Climate Change and the Northwest European Loess-soil Sequence

The Middle Weichselian (MIS 3) in Northwest Europe included several interstadials during which temperatures were up to 7°C warmer (*e.g.*, Dansgaard *et al*. 1993) than during the intervening cold spells [stadials]. At times, temperatures were only 2°C cooler than the local Holocene average (*e.g.*, Dansgaard *et al*. 1993). However, most of the Middle Weichselian warmer oscillations were short lived, of the order of *ca* 1,000-2,000 years. Nevertheless, at four points in the Middle Weichselian sequence, there is evidence for "complex" interstadials of more prolonged warming of *ca* 3,000-5,000 years. However, an oscillating climate was not only characteristic of the Weichselian, but appears to have characterised the Last Interglacial *s.l.* (MIS 5) and the Saalian ice age *s.l.* (MIS 8, 7 & 6) as well. The oscillating climate also left its traces in the European loess-soil sequences, which provide high-resolution terrestrial proxy archives of climate change. The sections show cycles of deposition of loess during cold stadials, alternating with landscape stabilisation and soil formation during warm interglacials and temperate interstadials. Not only the loess-soil sequence at Veldwezelt-*Hezerwater* (*e.g*., Gullentops & Meijs 2002; Meijs 2002), but also the loess-soil sequences in the nearby German Rhine valley (*e.g*., Schirmer 2000, 2002, Schirmer & Kels 2006) show that the Middle and Late Pleistocene climate in Northwest Europe was quite variable. However, pauses in loess accumulation lasted usually long enough for soils to develop. One extreme example of pedogenesis is the so-called "Rocourt Soilcomplex" at Veldwezelt-*Hezerwater*, which is the terrestrial equivalent of the Last Interglacial *s.l*. (MIS 5). As a record of Middle Palaeolithic occupation and climate change throughout the late Middle and Late Pleistocene, the "Veldwezelt-*Hezerwater* loess-soil climate calendar" is of particular interest.

Overview of the Core Reduction Strategies Attested at Veldwezelt-*Hezerwater*

In this paper, we will only briefly discuss the different core reduction strategies attested at the six Veldwezelt-*Hezerwater in situ* occupation sites. More detailed presentations of the Veldwezelt-*Hezerwater* data can be found in: Bringmans 2000, 2001; Bringmans *et al*. 2001, 2003, 2004a, b, c; Bringmans 2006. Core types at Veldwezelt-*Hezerwater* include "Levallois", "prismatic" and "opportunistic" cores, with single, opposed and multiple platforms (fig. 1). The "Levallois" core reduction strategy is typical of the Middle Palaeolithic in general, although of course many variants exist (*e.g*., Crew 1975; Boëda 1986, 1988; Mellars 1996; Brantingham & Kuhn 2001). At Veldwezelt-*Hezerwater*, "Levallois" products are abundantly present at the ZNB Site (late MIS 6), the VBLB Site (MIS 5a), the TL Site (first half MIS 3) and the WFL Site (first half MIS 3). “Levallois” products are completely absent at the VLL Site (MIS 6.01) and virtually absent at the VLB Site (MIS 6.01). An interesting phenomenon at several sites at Veldwezelt-*Hezerwater* is the surprisingly strong component of deliberate and highly specialised blade production: (1) "Levallois" blade core reduction (*sensu* Boëda 1988) was attested at the ZNB Site and at the WFL Site and (2) Non-Levallois prismatic "Upper" Palaeolithic core reduction (*sensu* Révillion & Tuffreau 1994) was present at the VLL Site and at the VLB Site. Especially the VLL and VLB lithic assemblages show an overall high degree of "bladeyness". At the VLL Site, prismatic core reduction strategies led to the total exclusion of "Levallois" core reduction. However, at the VLB Site, "Levallois" core reduction was employed alongside typical prismatic core reduction strategies. Thus, at Veldwezelt-*Hezerwater*, core reduction strategies included: (1) "Specialised Levallois Blade core reduction" at the ZNB Site (late MIS 6), (2) "Semi-rotating Prismatic core reduction" at the VLL Site (MIS 6.01), (3) "Semi-rotating Prismatic core reduction" together with "Recurrent Unipolar Levallois core reduction" at the VLB Site (MIS 6.01), (4) "Recurrent Centripetal Levallois core reduction" at the VBLB Site (MIS 5a), (5) "Lineal Levallois core reduction" and "Bipolar Recurrent Levallois core reduction" at the TL Site (MIS 3) and finally (6) "Lineal Levallois core reduction", "Bipolar Recurrent Levallois core reduction" and "Classical Levallois Blade core reduction" at the WFL Site (MIS 3).

Contextual Factors that Constrained Choice amongst Lithic Reduction Strategies

At Veldwezelt-*Hezerwater*, many different contextual factors seem to have influenced lithic variability. Some contextual factors we may never fully understand, such as the *ad hoc* response to local situations. Nevertheless, some general trends have been observed: (1) high raw material quality seems to have led to more formal core and tool designs, whereas (2) low raw material quality seems to have led to more informal designs. Indeed, it seems that at Veldwezelt-*Hezerwater*, humans varied their reduction strategies according to the initial shape and quality of the flint nodules. There is an apparent link between the exploitation of local low-quality raw materials, opportunistic and prismatic core reduction and the virtual absence of tools. On the other hand there is also a link between the exploitation of imported high-quality raw materials, "Levallois" core reduction and the presence of heavily retouched tools. The so-called "Lower Sites" (VLL Site & VLB Site) at Veldwezelt-*Hezerwater* were located on sources of low-quality flint. At these "Lower Sites", elongated low-quality flint nodules, which were unsuitable for centripetal core reduction, were used for prismatic reduction of small cores. This resulted in the production of small blades (4-5cm). These Late Saalian flint knappers deliberately searched the gravel-bed of the local "side-valley" of the *Hezerwater* brook for elongated flint nodules. On the other hand, at the Middle Weichselian TL and WFL Sites at Veldwezelt-*Hezerwater*, sources of local low-quality flint were also available. However, these local raw material sources were not exploited. Instead, fresh high-quality "*Lanaye* Flint" (source: 5 km) and translucent "*Hesbaye* Flint" (source: 35 km) were imported to the TL and WFL Sites (early MIS 3). The import of high-quality spherical flint nodules and the neglect of the locally available raw materials during the early Middle Weichselian led to "Levallois" core reduction and the production of large tools (up to 10 cm). The fact of the matter is that at Veldwezelt-*Hezerwater*, prismatic cores were always made of local, elongated low-quality flint nodules, whereas "Levallois" cores were made of "exotic" spherical high-quality flint nodules. So, it seems that the original morphology and quality of the flint nodules resulted in specific core and tool reduction sequences. Thus, the selection and (if required) the transport of raw materials with their specific characteristics and not the mere availability of (local) raw materials was of paramount importance.

There also seems to have been a great deal of "equifinality" in the processes by which these people reduced their cores and tools. Indeed, formal convergence in core and tool morphologies covering a broad chronological and geographical span must necessarily have been achieved unintentionally. Indeed, comparable but slightly different sets of contextual factors may unintendedly have led to "identical" core and tool forms. It seems that lithic toolkits may be designed to satisfy a whole range of demands, including technological

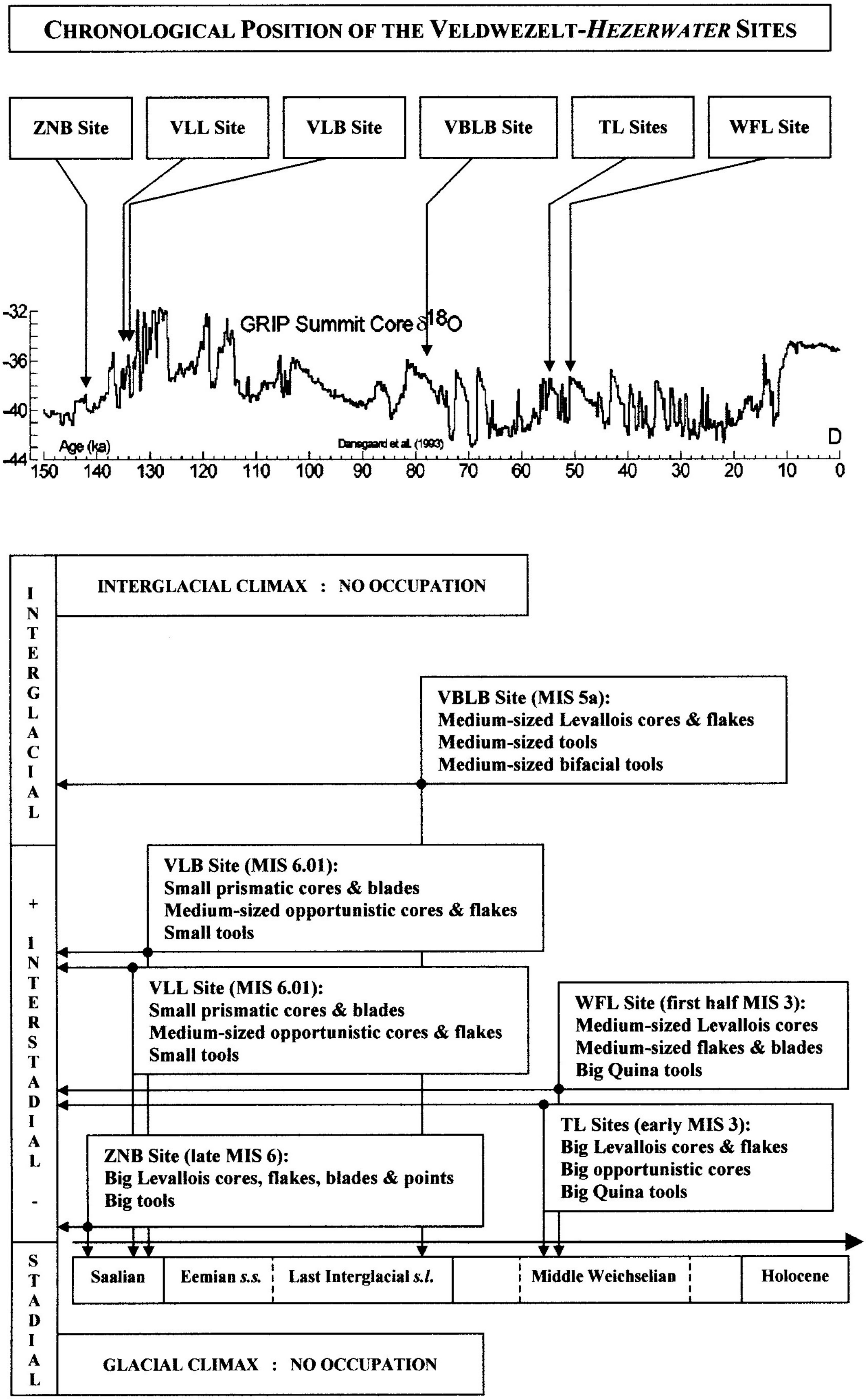

Figure 1. Chronological position and characterisation of the Veldwezelt-*Hezerwater* sites.

reliability, transportability, flexibility, maintainability and versatility (*e.g.*, Torrence 1989; Bousman 1993; Richter 1997; Brantingham & Kuhn 2001; Clark 2002a, b). Technological design is therefore seen as an optimisation problem of maximising one or more of these design attributes, while minimising the rate of raw material consumption. These and other design-concerns influenced both primary core reduction strategies and patterns of tool reduction. Indeed, any deviation from, for example, the ideal "prismatic" or "Levallois" core geometry resulted in significant declines in both raw material efficiency and productivity. What we now know as "prismatic" and "Levallois" core reduction just seems to have been the "optimal" solution to some of the potential costs associated with core reduction. This phenomenon resulted in the independent "convergence" on the basic core geometry in diverse contexts. Indeed, at Veldwezelt-*Hezerwater*, formal convergence seems to be conditioned by the size, shape and quality of the raw material nodules. Nevertheless, core and tool reduction is by necessity dynamic and flexible, since it must "manage" an ever-decreasing amount of raw material. So, flint knappers also had to cope with the irreversible consequences of subsequent removals and the often-unpredictable nature of stone fracture. Any mistake in the reduction process had to be paid cash on "delivery". Indeed, the ability to execute formal technological designs was severely limited by the quality of the raw material. As a consequence, toolkits based on high-quality raw materials are easier to design, because fracture is easier to control. While on the other hand, toolkits based on low-quality raw materials are more difficult to design, because stone fracture is more unpredictable and often results in irreparable errors during the reduction process.

We think that the overriding factor constraining choice amongst lithic core and tool reduction strategies is raw material quality. However, raw material quality is not a simple qualitative variable, but rather is composed of several potentially quantifiable properties, including raw material nodule size, shape and mineralogical structure. So, it is likely that these flint knappers had an optimal "plan" or "format" in mind about how to reduce a particular elongated (*e.g.*, "prismatic" core reduction) or spherical (*e.g.*, "Levallois" core reduction) volume of raw material (formal convergence). However, it is just not possible to predict exactly the nature of stone fracture (formal divergence). So, any deviation from the "planned reduction format" created "variability". In order to restore the "original reduction format", these Middle Palaeolithic flint knappers would have to react and adjust to the new situation. Flint knappers thus had to "calibrate" the core and tool reduction process on several occasions during the reduction sequence. However, the "adjustments", "corrections" and "reparations", which they would have needed in the course of the reduction process, were probably built into the "original reduction format". So, economic considerations (*e.g.*, flexibility, versatility, maintainability, portability, reliability, *etc.*) would inevitably push core and tool reduction strategies back towards the "planned reduction format". Independent occurrences of similar lithic core and tool reduction strategies covering a broad chronological and geographical span are thus not surprising. Not the "appearance" or the "reappearance" of certain core reduction strategies and their products, but the "recognition" of their usefulness in new environmental contexts is the "new" phenomenon that occurred.

The Simultaneous Presence of Levallois Core Reduction and Quina Tools

After usable tool blanks had been produced, retouch was usually applied to transform these tool blanks into formal tools. It appears that two major objectives lie behind the application of systematic retouch to the edges of the tool blanks (*e.g.*, Mellars 1964, 1996): (1) to secure the maximum possible length of working edge and (2) to impose a regular, smooth form on the working edge. Retouch was thus applied not merely to rejuvenate heavily worn and damaged edges, but as a deliberate policy to maximise the inherent potential of the available blanks for the specific functions envisaged. However, the "Dibble and Rolland Tool Reduction Model" (1992) was probably always working in the "background", but it cannot account for all variation in the tool forms. Retouch thus seems to have been applied essentially to enhance the functional aspects of the tools. It is obvious that, for example, most "transverse side-scrapers" can never have started life as conventional lateral forms. Indeed, the tool edges are frequently oriented at almost 90° to the main flaking axis of the original blank (*e.g.*, Turq 1989). Many of these transverse side-scrapers have been worked into so-called "Quina" transverse side-scrapers. Overall, the "Quina" techno-functional system (*e.g.*, Lenoir 1973; Turq 1989; Rolland 1996) seems to have emphasised (1) the preference for fine-grained lithic raw materials, (2) optimal tool sizes and (3) intensive tool retouching. However, the recurring need to manufacture thick, large blanks may in some cases have overridden a preference for fine-grained flint. Typical "Quina" transverse side-scrapers have been excavated at Veldwezelt-*Hezerwater*, only at the early Middle Weichselian TL and WFL Sites. The "Quina tools" (length: up to 10 cm), which were excavated at these sites, represented the biggest tools discovered at Veldwezelt-*Hezerwater*. The forms of these early Middle Weichselian "over-sized" and "over-designed" Quina tools, which were made of fresh flint, were probably influenced by the fact that they were used under "high-risk" cool climatic conditions. Indeed, lithic technologies that were employed in high-risk environments can be expected to be "over-designed", because flint knappers usually wanted to maximise core or tool use-life in dangerous circumstances. So, big and thick "over-designed" Quina tools guard against tool breakage. This may be explained as a technological risk-reducing response to relatively cool and "hostile" environments. In more temperate and "friendly" environments, most toolkits are casual and display little effort to extend tool use-life (*e.g.*, VBLB Site).

However, "Quina" assemblages were excavated in Late Pleistocene as well as in Middle Pleistocene contexts. Geneste *et al*. (1997) point to several autonomous "Quina" developments in different regions (*e.g.*, Les Tares 1, La Micoque 3, High Lodge, *etc*.). New research has claimed that for example the so-called "Charentian" assemblage at High Lodge (UK) is pre-Anglian in date, thus prior to MIS 12 (Rose 1992). These very old "Quina-like" assemblages are separated from Late Pleistocene "Quina" assemblages by time-gaps too substantial to indicate linear continuity. Evidence seems to point to multiple and independent developments by formal convergence. Notwithstanding this, one of the few tool forms of the Late Pleistocene that still seems to carry some sort of "chronological" information is the "Quina" tool. During MIS 4, a gradual shift from "Ferrassie" to "Quina" lithic assemblages is attested in Southwest France (Mellars 1969, 1986, 1996). However, "Ferrassie" and "Quina" assemblages do not seem to represent discrete "facies", but rather two etic "stages" in a continuum of decreasing "Levallois Index" (IL) percentages and increasing "Quina Index" (IQ) percentages. It appears that the Quina tools have replaced the Levallois blanks progressively during the first half of the Weichselian ice age. However, the progressive decrease in the Levallois component clearly cuts across the "Ferrassie-Quina" interface. The climate got colder and colder and the "Quina" tools became more and more important, while the "Levallois" blanks became less and less important. So, "Quina" tools have probably functioned as "*Ersatz*-Levallois-Blanks" under cool and "hostile" climatic conditions.

In the South of France during MIS 4 and in Northwest Europe during MIS 3, there seems to exists a clear nexus between "Levallois" core and "Quina" tool reduction, which actually seem to represent two complementary lithic reduction strategies. The integrated interaction between Levallois core and Quina tool reduction within a single subsistence system was the solution to the optimisation problem of maximising the tool design attributes (*e.g.*, flexibility, versatility, maintainability, portability & reliability), while minimising the rate of raw material consumption under cool climatic conditions (fig. 2). Indeed, in the *Aquitaine* Basin, France (*e.g.*, Mellars 1996; Rolland 1996), "Quina tools" largely correspond with the "stadial" climatic fluctuations correlated with MIS 4, which is characterised by the onset of more severe, continental conditions, the spread of steppe habitats and steppe faunal communities. These conditions created mosaic vegetational landscapes, which had a direct impact on Middle Palaeolithic technology, subsistence, land use and settlement organisation. At the TL and WFL Sites at Veldwezelt-*Hezerwater*, in the *Maas* Basin, the presence of "Quina tools" corresponds with the warmest phases of the interstadial climatic fluctuations during the first half of the Middle Weichselian (first half of MIS 3). It is important to keep in mind that the *Maas* Basin lies at higher latitudes than the *Aquitaine* Basin, which implies that in the *Maas* Basin the climatic conditions have always been cooler than in the *Aquitaine* Basin. In the *Maas* Basin repeated interruptions of Middle Palaeolithic occupation effectively occurred during fully stadial episodes. For instance, during the second half of MIS 4 and during the second half of MIS 3. During the cold interstadial and stadial periods of the Weichselian ice age, the *Maas* Basin was characterised by a cold climate, sparse tundra vegetation and low-density arctic fauna (*e.g.*, Cordy 1988). However, Middle Palaeolithic people were certainly present in Northwest Europe during the milder interstadials during the first half of the Middle Weichselian (first half of MIS 3). Given the latitude differences, there was a predominance of horse over reindeer in the *Maas* Basin.

The evidence from Veldwezelt-*Hezerwater* shows that there were at least two major Middle Palaeolithic interstadial occupation episodes during the first half of the Middle Weichselian (first half of MIS 3) with habitat conditions comparable to those of MIS 4 in Southwest France. The bio-climatic transition from intensely cold and dry stadial conditions (MIS 4) towards climatic amelioration (MIS 3) during the so-called "Goulotte" interstadial (Woillard 1975, 1978) is attested at Veldwezelt-*Hezerwater* at the TL Site. The Middle Palaeolithic occupation of the WFL Site under interstadial conditions could probably be correlated with the so-called "Pile" interstadial (Woillard 1975, 1978). The interstadial vegetation at these sites must have been characterised by a steppe environment with mainly pine and birch. At the WFL Site at Veldwezelt-*Hezerwater*, a typical steppe fauna was in place (Bringmans *et al*. 2003). The presence of the badger at the WFL Site during the Pile interstadial indicates that the climate was not cold, but for a short period of time, almost Holocene-like. Middle Palaeolithic humans must gradually have reoccupied Northwest Europe by "natural migration" during the "Goulotte" and "Pile" interstadials. In the *Maas* Basin, camps were mostly installed in caves (*e.g.*, Toussaint *et al*. 2001; Jehs 2004), however ephemeral open-air hunting and butchering stations were also attested (*e.g.*, TL & WFL Sites). Very often, low-quality flint is found in cave sites, whereas high-quality flint is attested in most open-air sites. Middle Palaeolithic humans probably combined semi-sedentary cave occupation during prolonged, cold winters, with warm season semi-nomadic mobility in the Northern *Maas* Basin. There, several game herd species were present together with opportunities for procuring fine-grained high-quality flint from Cretaceous limestone outcrops. Exploitation of imported high-quality flint in the base camps took place during the intensive winter occupation episodes. The repeated cave residence episodes and the frequent resharpening of thick tools resulted in the palimpsest accumulation of "Quina" tool assemblages at the cave sites. "Levallois" cores and "Quina" tools (fig. 2) were functioning alongside each other in the same subsistence system, because they were reliable safeguards against technological failure. "Levallois" cores and "Quina" tools were also exported to the ephemeral open-air hunting and butchering sites (*e.g.*, TL & WFL Sites at Veldwezelt-*Hezerwater*). "Levallois" and "Quina" reduction thus seem to represent two sides of the same coin. Finally, evidence of Middle Palaeolithic occupation in Northwest Europe decreases rapidly after 50.000 years ago. Stadial and even interstadial climatic conditions during the second half of the Middle Weichselian were probably no longer warm enough to allow humans to migrate from the southern *refugia* to the northern fringes of Europe.

Conclusions

At Veldwezelt-*Hezerwater*, the core and tool reduction strategies appear to change each time climatic changes occur. Indeed, at the Late Saalian ZNB Site (late MIS 6), "Specialised Levallois Blade Reduction" was employed. "Climatic-stress" seems to play a key-role at the VLL and VLB Sites (MIS 6.1), with in general the presence of semi-rotating prismatic core reduction and "small tools" (<5cm).

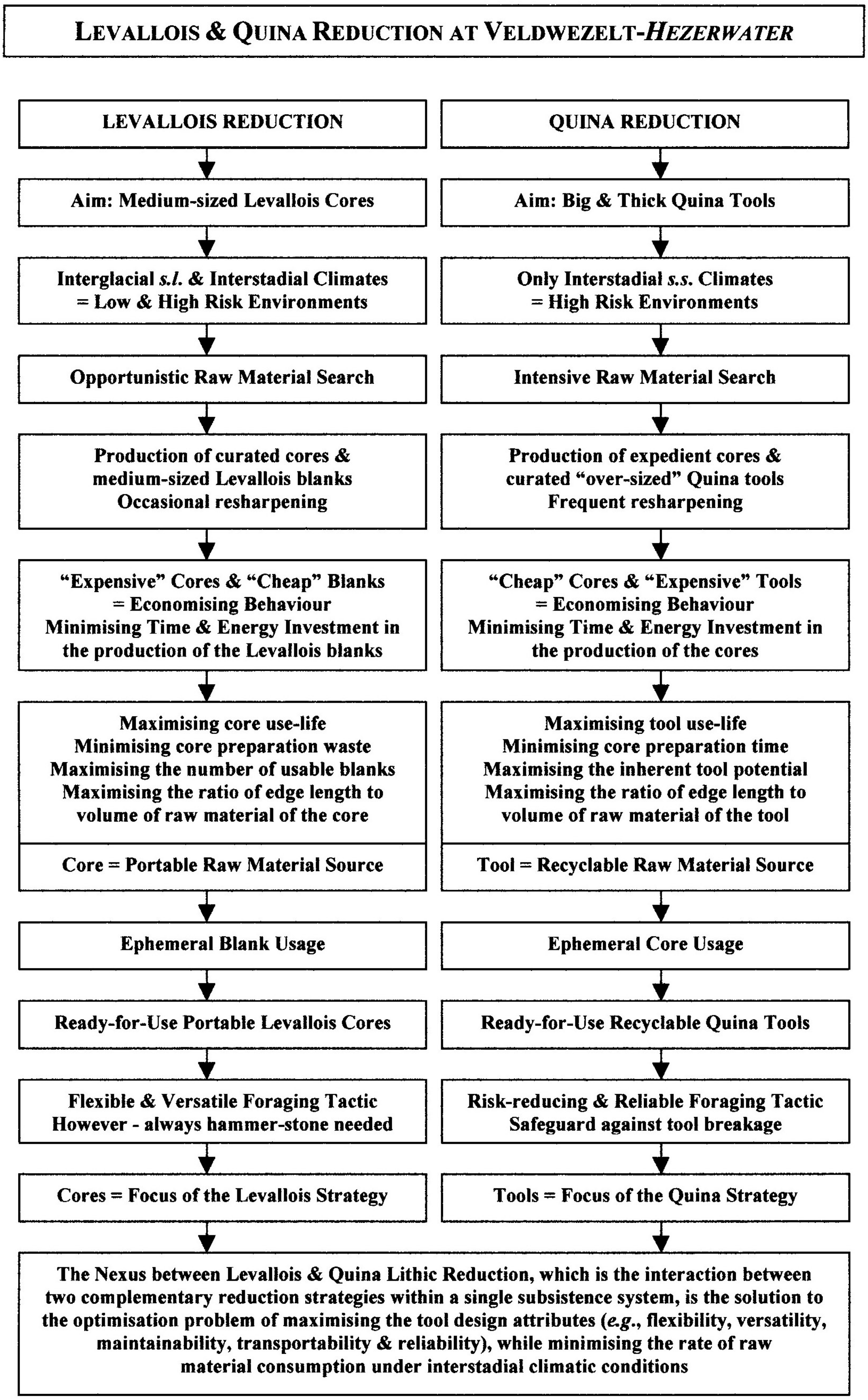

Figure 2. The nexus between "Levallois" and "Quina" reduction at Veldwezelt-*Hezerwater*.

In times of relative stable climatic conditions, for example during the late Last Interglacial *s.l.* (late MIS 5), lithic technology appears to be more "settled". This seems to be the case at the VBLB Site (MIS 5a) where a "typical" Levallois core reduction technology is present, together with larger unifacial and medium-sized bifacial tools. During the first half of the Middle Weichselian (first half of MIS 3), in relatively cool interstadial climatic conditions, we see in the lithic assemblages of the TL and WFL Sites the presence of in general large Levallois cores and flakes in association with very big Quina tools. There is thus a tendency to manufacture bigger risk-reducing tools under cooler and more "hostile" climatic conditions. Indeed, Middle Palaeolithic humans were forced to change their subsistence strategies when "climatic-stress" situations occurred. The only alternative they had, was to move to the South or to the East, leaving our regions deserted. This seems to be the case at Veldwezelt-*Hezerwater* during the warmest (MIS 5e) and coldest (second half of MIS 4 & second half of MIS 3) climatic phases, when no large herds of food animals seemed to be present. Human "evolution" and "culture" probably were relatively unimportant constraint on the character of core and tool reduction, being overridden in most contexts by mechanical constraints and economic, climatic and ecological processes. Lithic technology seems to represent only a limited range of options very broadly distributed in time and space, which were probably held in common by all contemporary humans and invoked differently according to context (Clark 2002a, b). Contextual factors (*e.g*., availability, size and quality of raw materials, mobility, anticipated tasks, flexibility, versatility, portability, reliability, *etc.*) seem to have constrained choice amongst lithic reduction options. Notwithstanding this, our approach considers Middle Palaeolithic humans as flexible agents, rather than passive recipients of optimised environmental conditions.

Acknowledgements

The "Veldwezelt-*Hezerwater* Project" has been made possible thanks to the generous support of the University of Leuven (Belgium), the University of Lethbridge (Canada) and the Institute for the Archaeological Heritage (*I.A.P.*) of the Flemish Community (Belgium). We are indebted to all the archaeology students for their hard work at the Veldwezelt-*Hezerwater* sites. We are grateful to Bradley Fairclouth (Georgetown University, Washington, DC, USA), Erik Becker (*Universität Mainz*, Germany), *Drs*. Dieter Jehs (*Universiteit Gent*, Belgium), *Dott*. Gaetano Colantuono (*Università degli Studi di Bari*, Italy), *Drs*. Floris van Oosterhout (*Universiteit Leiden*, The Netherlands), *Drs*. Elisabeth Schuurman (*Universiteit Leiden*, The Netherlands), *Drs*. Hylke N. De Jong (Bristol University, UK), Prof. Dr. Marcel Otte (*Université de Liège*, Belgium), Prof. Dr. Jürgen Richter (*Universität zu Köln*, Cologne, Germany), Prof. Dr. Paul Mellars (Cambridge University, UK), Prof. Dr. Klaus-Dieter Jäger (*Martin-Luther-Universität Halle und Wittenberg*, Germany), Prof. Dr. Wolfgang Schirmer (*Heinrich-Heine-Universität*, Düsseldorf, Germany), Prof. Dr. Geoffrey A. Clark (Arizona State University (ASU), Tempe, USA), Prof. Dr. Milford Wolpoff (University of Michigan, Ann Arbor, USA), Mrs. Jean M. Auel (Portland, USA) and Albert and Elly Bringmans-Jans (*Visetum Campi*, Belgium). We are grateful to Mr. Bart Demarsin for inviting us to participate in the excursion programme during the colloquium "Neanderthals in Europe" in the *Provinciaal Gallo-Romeins Museum* in Tongeren, Belgium. His enthusiasm brought together an international party of renowned palaeoanthropologists. The various presentations and discussions that took place in and outside the conference room made the colloquium a real milestone in Belgian Palaeoanthropological research. The excursion programme of the congress, which was organised on September 19, 2004 brought the participants to several important Belgian Neanderthal sites: *Grotte Scladina*, Goyet and Veldwezelt-*Hezerwater*.

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