UNIVERSITY OF SOUTHAMPTON

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Playing Hide and Seek with the European Lower Palaeolithic. A Critical Re-evaluation of the Spatial Distribution of Sites in Central and Eastern Europe

by

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ABSTRACT

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PLAYING HIDE AND SEEK WITH THE EUROPEAN LOWER PALAEOLITHIC. A CRITICAL RE-EVALUATION OF THE SPATIAL DISTRIBUTION OF SITES IN CENTRAL AND EASTERN EUROPE

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The pattern of spatial distribution of sites in Lower Palaeolithic Europe shows a significant disproportion of known find spots between the west and the central and eastern part of the continent. Early and Middle Pleistocene sites are very rare in Central and Eastern Europe, they do not come in clusters, and they do not seem to be associated with ancient river terraces like in the west. This is a robust pattern that has been previously recognized but not addressed as a distinct research topic so far.

It may represent either a real past phenomenon of different population densities in Lower Palaeolithic Europe or reflect a modern research bias. Three hypotheses explaining the dichotomy in site distribution were proposed so far: i) History of Research, ii) Dispersal Routes, and iii) Climate.

It is a common, although usually not loudly pronounced assumption that history of research accounts for the rarity of finds in Central and Eastern Europe. However, a thorough historiographic analysis reveals that archaeological research and especially Stone Age studies in the region started very early (Sklenar 1983) and were for most of the time generously supported by the authorities. Also, the results were widely disseminated and Central and Eastern European researchers were part of the international Palaeolithic community.

The second hypothesis, Dispersal Routes Hypothesis, was evaluated through an Agent-Based Model which showed that given the current understanding of the first 'Out of Africa' (starting point in Africa, faster dispersal over grasslands etc.) it is highly unlikely that the dispersal pattern would generate the dichotomy in site distribution.

Finally, the Climate Hypothesis can be largely challenged on the basis of current evidence regarding the Early and Middle Pleistocene environment of Europe. However, further research may bring more data supporting or refuting this hypothesis. Nevertheless the environmental impact is unlikely to be strong enough to generate a pattern as robust as the one observed.

Given the above, a new alternative was proposed to explain the phenomenon of the low density of Lower Palaeolithic sites in Central and Eastern Europe based on recent developments in geological mapping and taphonomic studies. It argues that an uninterrupted mantel of glacially derived silt (loess) seals interglacial soil levels potentially bearing Lower Palaeolithic sites at significant depths exceeding 5 metres throughout most of Central and Eastern Europe. It also highlights the potential for deeply stratified sites preserved in situ within an easily datable and already well-investigated environmental context.

Keywords: Lower Palaeolithic, Central and Eastern Europe, History of Research, Dispersal, ABM, Loess, Taphonomy

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Academic Thesis: Declaration of Authorship

I, Izabela Anna Romanowska declare that this thesis and the work presented in it are my own and has been generated by me as the result of my own original research.

[PLAYING HIDE AND SEEK WITH THE EUROPEAN LOWER PALAEOLITHIC. A CRITICAL RE-EVALUATION OF THE SPATIAL DISTRIBUTION OF SITES IN CENTRAL AND EASTERN EUROPE

I confirm that:

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Abbreviations Used

40Ar/39Ar	“Argon-argon Dating”
ESR	“Electron Spin Resonance Dating”
ESR-US	“Electron Spin Resonance combined with Uranium Series Dating”
IR-RF	“Infrared Radiofluorescence Technique”
ka	“thousands of years ago”
MIS	“Marine Isotope Stage”
Ma	“millions of years ago”
TL	“Thermoluminescence Dating”
U/Th	“Uranium-thorium Dating”

Introduction

Europe east of the Rhine is the *terra nova* for Lower Palaeolithic archaeology. Central and Eastern Europe is usually only briefly mentioned by western researchers as most published overviews concentrate on the western portion of the continent (for instance Howell 1966; Monnier 2006; Roebroeks 2001; Santonja and Villa 2006) despite the artificiality of this division stemming from a current geopolitical situation rather than any true geographical or environmental disparity between the eastern and western sides of the continent (Smith 1982; Valoch 1972). Clive Gamble (1999, fig. 5.12) drew attention to the dichotomy in the quality of the Palaeolithic record between northern and southern Europe. However, we could ask if the line of division is running only between south and north, or is there another invisible border separating west from east, conspicuously, following the line of the former Iron Curtain? And more importantly, what causes this distinction? Therefore the aim of this thesis is, firstly, to confirm the pattern of a low density of sites in Central and Eastern Europe, secondly to re-evaluate the previously proposed explanations, and finally to suggest an alternative hypothesis explaining the dichotomy in the site distribution in Lower Palaeolithic Europe.

Geographical scope

The geographical scope of this thesis is limited to Central and Eastern Europe. Due to the very nature of the discussed topic, however, it will be extended to the whole of Europe in order to provide a clear context to the reviewed issue. This approach seems to be even more practical given the elusive geographical definition of Central and Eastern Europe and especially its western border (Sinnhuber 1954). In this thesis the region will be defined as the territory of modern Poland, the central and eastern part of Germany, Czech Republic, Slovakia, Hungary, Moldova, Romania and northern Bulgaria, Ukraine and European Russia. Geographically this area is delimitated by the Baltic Sea, the Rhine, the Danube, the northern coast of the Black Sea, the Caucasus Mountains, the northern coast of the Caspian Sea and the Ural Mountains. The northern boundary of the region is defined by the extent of the Pleistocene ice sheets which removed all traces of Lower Palaeolithic human presence.

Thus there are no known Lower Palaeolithic sites from Scandinavia, Northern Russia, the Baltic Republics, Belarus, etc. This definition is in accordance with most of the commonly used topographical and geographical definitions of Central and Eastern Europe (Sinnhuber 1954).

Chronological scope

The time scope of this thesis is limited to the European Lower Palaeolithic defined as the period between the first human occupation of Europe currently believed to date to 1.8Ma (the site of Dmanisi, Georgia) (Ferring et al. 2011; Rightmire et al. 2006) or 1.2Ma (the site of Sima del Elefante) (Bermúdez de Castro et al. 2010; Pares et al. 2006; Rosas et al. 2006) and the onset of the Levallois technique spanning between approximately 250-300 ka (White and Ashton 2003). In geological terms it covers the later part of the Early Pleistocene (Calabrian Stage) and the early and middle parts of the Middle Pleistocene (Ionian Stage) and it corresponds roughly to the period between MIS 65/64 and MIS 7 (Cita et al. 2008; Gibbard and Cohen 2008).

Thesis structure

The structure of this thesis is as follows: in a brief overview of the current state of knowledge of the European Lower Palaeolithic I will highlight a number of issues regarding the first occupation of Europe, the spatial distribution of sites and the dichotomy in the record between the central/eastern and the western part of the continent. This will then be followed by a summary of the current state of knowledge of the Lower Palaeolithic of Central and Eastern Europe with an integrated literature review on the topic. The aim of this part of the thesis is to identify a pattern in the data and define the issue as closely as possible. In the subsequent, analysis, part of this thesis I will provide a detailed discussion and evaluation of the already suggested explanations for the pattern recognized in part one. Each chapter deals with one of the three most commonly cited hypotheses: i) the History of Research, ii) Dispersal Route, and iii) Climate. A number of complimentary approaches were used in this part of the thesis: historiography, literature review and computational modelling. Due to the fact that the latter is not commonly used in archaeology, it will be given a separate subchapter in order to introduce to the reader the general concepts and theoretical foundations of this technique. Finally an alternative model, the Loess Hypothesis, will be proposed, explained and evaluated.

The European Lower Palaeolithic

This chapter gives a brief overview of the European Lower Palaeolithic and the main research issues. No particular emphasis has been given to Central and Eastern European material as a detailed description of the current state of knowledge regarding the Lower Palaeolithic of that region will be given in the next chapter.

To the best of our knowledge the first human dispersal commenced from Africa and more particularly from Eastern Africa (for an overview: Holmes 2007, but compare Dennell and Roebroeks 2005). Current evidence indicates that the colonization of Europe began from the south east via the mountain chain of the Caucasus, sometimes called 'the gate of Europe' (Lordkipanidze et al. 2000). The site of Dmanisi, Georgia is situated within this region, and is the oldest European site currently known to researchers, dated to approximately 1.85-1.76 Ma (Ferring et al. 2011; Gabunia et al. 2001). It is located at the most south-eastern edge of the continent and it is believed to represent the very beginning of the first "Out of Africa". There seems to be a substantial time and space gap between Dmanisi and the chronologically subsequent group of European sites, which cluster in the meridional zone of Western Europe. This group includes the sites of Atapuerca (Sima del Elefante, Spain) a cluster of sites in the Orce basin (Spain) and perhaps also the French sites of Le Vallonet and Pont-de-Lavaud. All of these localities produced dates oscillating around 1.3-1.0 Ma (Bermúdez de Castro et al. 2010; Carbonell et al. 2008 Falguères 2003; Oms et al. 2000; Yokoyama et al. 1988). How this wave of hominids arrived in Europe is still open to question. Several hypotheses have been made usually indicating the three most probable routes: from the east via the Ukrainian Steppe, from the south-east via Turkey and the Balkans or from the west through the Gibraltar Strait. Another option, a sea crossing from Tunisia to Sicily, is considered less likely (for an overview see Villa 2001). All the aforementioned traces of early human presence in Europe concentrate along the southern perimeter of Europe below the 45° parallel, which may have a certain implication for the interpretation of hominids' cognitive and adaptive capabilities (Rodríguez et al. 2011).

As witnessed at Happisburgh and Pakefield (East Anglia) hominids progressed up north much earlier (i.e. approximately 950 - 700 ka) than was previously thought (see

Roebroeks and Kolfschoten 1994; 1995), although their presence was probably intermittent and might have been encouraged by favourable climate conditions (Parfitt et al., 2005 but see Parfitt et al. 2010 for evidence of human occupation during cooler climatic conditions). This newly found evidence of early human occupation north of the 45°N latitude represents a previously unknown episode of hominid dispersal, although the magnitude (i.e. the size of the population living in the far north and the stability of that population) are still unknown. After about 500 ka, human occupation is known across almost all of Europe with the exception of the northernmost boreal regions.

Up to about 500 ka all of the European sites were technologically and typologically classified as Oldowan or Mode I according to Clark's technological categories (Carbonell et al. 2010; Clark 1977). However, a recent report of new dates at the sites of Solana del Zamborino and Cueva Negra de Estrecho del Río Quípar (Scott, Gibert 2009) put into question this long held belief. Very early sites such as the Orce sites, TD6 at Atapuerca, Le Vallonnet or Happisburgh produced lithic assemblages similar to Dmanisi – dominated by choppers, simple cores and flakes (Falguères et al. 1999; de Lumley 2007; Oms et al. 2000; Parfitt et al. 2010; see Cauche 2009 for a full technological overview). However, similar assemblages described as pre-Oldowan, Oldowan or 'core and flake industries' continue through most of the Lower Palaeolithic and are not limited to the western part of the continent. Large assemblages dated to after 500 ka bearing some of the Oldowan features are found, for example, at El Aculadero (Querol and Santonja 1983), Cova del Bolomor (Peris et al. 1997), Santa Ana Unit 1 (Carbonell et al. 2005), La Grotte d'Aldène (Simone et al. 2002) or Cà Belvedere di Monte Poggiolo (Peretto et al. 1998) to name just a few. What is more, pebble tools and simple flakes and cores are present, often in relatively large quantities, at many Acheulean sites, for example at La Maya III (Santonja and Villa, 1990).

Until recently it was believed that the first dispersal into Europe was undertaken by a separate hominid taxon *Homo antecessor* represented by a fossil assemblage from Atapuerca (level TD6) and a calvarium from Ceprano, Italy (Ascenzi et al. 1996; Bermúdez de Castro et al. 20`04). However, after the latter was re-dated to approximately 430 - 385 ka (MIS 11) (Manzi et al. 2010) more fossils are needed to support this hypothesis (Wagner et al. 2010).

At around 500 ka Acheulean appears in Europe at a larger scale for the first time almost a million years after its first occurrences in East and South Africa (Konso-Gardula, Peninj and Wonderwerk) (Asfaw et al. 1992; Chazan et al. 2008; Isaac et al. 1974). This delay in the appearance of Acheulean in Europe remains poorly understood despite the academic effort invested in researching the topic (for an overview see: Foley 1987; Mosquera et al. 2012; Otte 2010; Santonja and Villa 2006; Villa 2001 among others).

There is a noticeable increase in the number of sites dated to 500 ka and after (see figures 2 and 3 in Bosinski 2006). Also, a number of new 'cultural advances' appear for the first time in the archaeological record such as the first well documented examples of the use of fire, including hearth structures (at the sites of Vértesszőlős (Hungary), Torralba and Abrona (Spain), Menez Dragan (France), Beeches Pit (UK), and Bilzingsleben (Germany) to name just a few (for an overview see: de Lumley 2006; Roebroeks, Villa 2011)). The presence of semi-permanent dwelling structures is a much more controversial topic and is supported by fairly weak evidence from Terra Amata (France), Bilzingsleben (Germany) and even less convincing stone 'pavements' from Bilzingsleben, Grotte d'Aldene, La Baume Bonne (France) and Isernia la Pineta (Italy) (Kolen 1999; Mania and Mania 2005; Otte 2012; Villa 1983).

The archaeological record of that time is dominated by the Acheulean technocomplex in the west (Santonja and Villa 2006) and what has been named 'Microlithic Industries' or 'Technocomplex with Small Tools' in the east (Burdukiewicz 2003; 2006; Burdukiewicz and Ronen 2004; Glaesslein 2009). This virtual absence of classical Acheulean west of Rhine presents a major challenge in our understanding of the European Lower Palaeolithic, which has only rarely been approached (Glaesslein 2009; Otte 2010; Svoboda 1987). On the other hand, the non-acheulean flake-dominated assemblages from Western Europe have been given a lot of attention, particularly in Great Britain. Sites such as: Clacton-on-Sea, Swanscombe (UK), Orgnac, Pointe de Saint Colomban or the Azé Cave (France) (Combier et al. 2000; Moncel 1998-9; White 2000) all share a common feature – the virtual absence of bifaces (for a full overview see: Fluck 2011). At some sites, the lack of handaxes is explained by the small size of the raw material (for instance at Cuesta de la Bajada (Panera 1996), Arago (Byrne 2004), Curson (Brochier 1976) or Isernia la Pineta (Anconetani et al. 1991). But this explanation is insufficient for several other sites where bifaces are rare despite good quality raw material, such as at San Quirce (Panera 1996; Santonja 1995), Swanscombe (Roe 1981), Complex Alpha at Notachirico (Belli et al. 1991; Piperno 1999) or most of the Central European assemblages (Burdukiewicz 2003; Glaesslein 2009).

In terms of human phylogenetics European fossil material from that time period is usually classified as *Homo heidelbergensis* (Rightmire 1990; 1998; 2001; Stringer 2012). Until recently it was believed that the most complete sample of that species was found in Atapuerca (Sima de los Huesos, SH)[1], however the phylogenetic attribution of the SH material was questioned a few months ago (Stringer 2012 but compare Bischoff et al. 2003; 2007). Nevertheless, the majority of human material from the period between 700 ka and 300 ka is attributed to *Homo heidelbergensis* or, rather poorly defined but speaking for itself, "pre-Neandertals" (for instance human remains from: Bilzingsleben, Steinheim, Mauer (type fossil), Boxgrove, Swanscombe) (Haidle and Pawlik 2010; Stringer and Hublin 1999).

The timing of the beginning of the Middle Palaeolithic is a widely debated issue in Palaeolithic archaeology (for an overview and the historiographical background of this debate see: Monnier 2006). In general it is agreed that the appearance of the Levallois technology approximately 250 – 300 ka (White and Ashton 2003) demarcates the onset of the Middle Palaeolithic, which is further supported by a continuous biological evolution of an increasingly "classical" Neanderthal morphotype (Tattersall 2007; Stringer 2012) and to some extent the genetic evidence (Noonan et al. 2006), however all of those processes are continuous which by its own nature fuels the debate.

1 See the special issue of Journal of Human Evolution devoted exclusively to human remains from SH: Journal of Human Evolution vol. 33 (2-3).

Lower Palaeolithic sites in Central and Eastern Europe

This brief overview of the current state of knowledge of the Central and Eastern European Lower Palaeolithic will provide a background for this thesis. The aim of this chapter is to critically assess the evidence for human presence in the region during the Early and Middle Pleistocene. It should provide a summary of the known sites necessary to establish the pattern of Lower Palaeolithic site distribution which will then be discussed in the following three chapters.

Central and Eastern Europe constitutes approximately two thirds of the surface of the continent. It can be divided on the basis of the variability of the landscape as well as the diversity of climate and ecological regions into four zones (Fig. 1): the Great European Plain – covering the temperate zone of Central and Eastern Europe, the Carpathian Mountains including the Pannonian Plain, the Steppe zone – covering predominantly the Ukrainian Plain east of the Carpathians, and the Caucasus. This chapter will include a brief but comprehensive overview of Central and Eastern European localities based on a literature review. Each entry will include: the dating (and dating method), description of the lithic assemblage including the raw material, environmental reconstruction of the surroundings (if available) and any outstanding features of the site such as human remains, traces of fire

Fig. 1 The spatial division of Europe followed in this thesis.

use (including hearths), dwelling structures or potential examples of art. The sites are listed in chronological order.

The Great European Plain

There are only a few sites in this zone mostly concentrated in the western part of the area i.e. Germany (Ariendorf I, Bilzingsleben, Mauer, Schöningen) and western Poland (Rusko, Trzebnica).

The site of **Mauer**, is the type-site for *Homo heidelbergensis*. It was dated to approximately 600 ka or MIS 15 by ESR-US combined with the IR-RF technique (Wagner et al. 2010). Apart from a mandible the site produced a small assemblage of 30 lithics. All of them are of small dimensions and of relatively simple technology. The knapping strategy was directed towards flake production. Butts are usually plain or cortical, and some of the pieces are partially covered in cortex. Cores are simple and the use of natural ridges on the nodules of raw material is noticeable. The flake tool assemblage consists of side-scrapers, end-scrapers, borers, becs and points de Tayac (Fiedler 1995).

Until recently the gravel pit at **Ariendorf I** was believed to belong to the Holsteinian interglacial or MIS 11 on the basis of TL and 40Ar/39Ar dating (Stremme 1989) and faunal remains (Turner 1998). However, after the announcement of the "New Chronology" by German geologists the age of Ariendorf I was questioned (Richter 2010). 126 lithics were found in the lower deposit of the gravel pit, i.e. Ariendorf I (Ariendorf II and III are dated to the Middle Palaeolithic). The raw material is of poor quality and it occurs in small blocks of quartz, siliceous slates and infrequently quartzite. Some of the pieces could be refitted which shows that the material has undergone only minor disturbance mostly caused by solifluction. Apart from one scraper and a few denticulates no formal tools have been found and most of the lithics were classified as simple flakes. These are rather large, often cortical and bear no traces of retouch. Most of the striking platforms are unprepared or cortical (Haidle and Pawlik 2010; Turner 1998). The fauna (including woolly rhinoceros, mammoth and lemming) indicates cool glacial conditions (Turner 1998).

Bilzingsleben (for a full overview see Mai et al. 1983 and Mania 1990) is undeniably

Fig. 2 The reconstruction of a dwelling structure at Bilzingsleben.

the most prolific Lower Palaeolithic site in Germany if not in the whole region. It has been interpreted as an open-air semi-permanent 'base' camp site on a shore of a shallow lake, which provided a source of freshwater and attracted a variety of animals (Mania and Mania 2005, 100). The site has produced large lithic assemblage, human remains (two skulls, a mandible and a handful of cranial fragments and teeth) (Vlček et al. 2000) as well as imprints of wooden fragments, perhaps spears and regular incisions on bones, interpreted by Mania as early examples of art (D'Errico and Villa 1997). The site is dated to MIS 11 or MIS 9 by U/Th and ESR techniques (Schwarcz et al. 1988). Lithic material is abundant (over 100,000 pieces). It shows a clear pattern of preferential selection of raw materials for different tool types, for example quartzite, quartz, shell-limestone, travertine and crystalline rocks served as blanks for pebble tools and hammer-stones whereas fine grain types of rock were used for flake production. Raw materials could be found in the immediate vicinity of the site although some stones were reported as transported from a distance of at least a few kilometres. Pebble tools are both uni- and bifacially worked. Lithics made on fine-grain blanks are of small size, i.e. 8 to 100 mm, although most of the specimens fall within the 20 to 30 mm range. Flake industry includes a wide variety of typological forms, for example, backed knives, scrapers, Tayac and Quinson points, denticulates, notches and borers

Fig. 3 Bilzingsleben material.

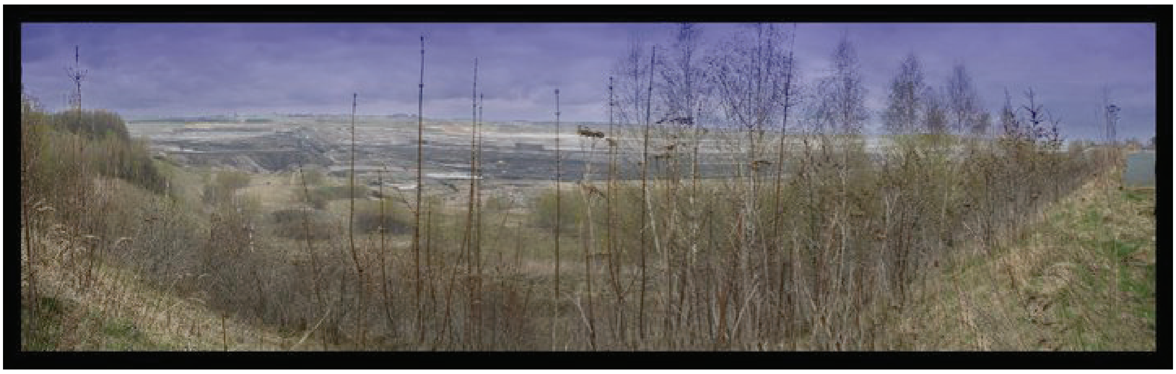

Fig. 4 The site of Schöningen.

(Brühl 2003; Mania 1990; Mania et al. 1999). A particular feature of the Bilzingsleben assemblages is the use of bone and antler for tool production. Long elephant diaphysis were used to produce scrapers, chisels and chopper-like tools (some of them knapped), while red deer antlers served as a material for picks and club-like tools. In addition, wooden spears or rather their imprints in travertine are reported (Mania et al. 1999; Mania and Mania 2005). D. Mania (2004) described three dwelling structures (Fig. 2) resembling Native American tipi or Asian yurts. However, this interpretation has been questioned on the basis of more detailed analysis of the spatial organisation of the site. It showed that the distinctive circular concentrations of blocks and stones seen by Mania disappear if all of the stones are plotted on the general plan of the site (Kolen 1999 but see Otte 2012)[2]. Bilzingsleben yielded enough fossilized plant remains to enable a detailed reconstruction of the surrounding environment and its changes within a climate cycle (Mai et al. 1983; Mania 2004). The landscape was dominated by a diluvial fan of a creek and the shore of a shallow lake with marshes, shrubs and wet meadows surrounding it (Mania 2004; Mania and Vlček 1987).

Schöningen is another travertine locality in Germany comprising of a series of sites (Schöningen 12 b, Schöningen 13 I and Schöningen 13 II) (Fig. 4) dated from 450 to 300 ka (MIS 11 – MIS 9) on the basis of geological and faunal correlations as well as TL dating (Thieme 2003; 2005). Despite the significance of the site the lithic assemblage has not been thoroughly described in any publications yet. From brief mentions in various publications (that for the most part concentrating on the faunal assemblage and wooden objects found on the site) one can deduct that the lithics are of small dimensions, knapped almost entirely of flint and they include simple flakes, scrapers, denticulates and points (Thieme 1997; 2003;

2 It is worth comparing the general plan of the site (in Mania 2004 fig.5.17 with the interpretation Mania 2004, figs 5.21, 5.22) which seems to be confirming the criticism voiced by Kolen (1999).

Fig. 5 A reconstruction of one of the Schöningen spears.

2005). In general, the assemblage is quite similar to what is known from Bilzingsleben with its typical small size of the lithics, extensive retouch and general lack of handaxes (Mania 2004). The site of Schöningen 13 II-4 is famous thanks to the exceptional discovery of wooden spears, well-preserved in the travertine. According to H. Thieme (1997) they are well balanced and could be used for throwing. However, Schmitt et al. (2003) pointed out that the spears are too heavy for hurling and not fit to penetrate the hard skin of large game suggesting that they may be thrusting rather throwing weapons (Fig. 5). Schöningen is also important for the on-going hunting vs. scavenging debate providing copious faunal evidence supporting the hunting model (Voormolen 2008). The environment reconstructed at Schöningen is warm, Mediterranean-like forest steppe (Thieme 2005).

The sites of **Mamleben**, **Wangen** and **Wallendorf** were dated to MIS 9 on the basis of their geological position (Eissmann 2002), although most of the authors date them to approximately 400 ka (Mania 1990; Weber 2004). The first two sites produced very small assemblages of lithics bearing many similarities with the Bilzingsleben artefacts, notably, flint as the dominant raw material, the small size of the artefacts and intensive retouch as well as dominance of simple flakes and rare scrapers and denticulates (Haidle and Pawlik 2010; Valoch 1968; Weber 2004). The lithic assemblage of Wallendorf is much larger, comprising of almost 1,000 pieces but the general characteristics are very similar. Interestingly, German authors classify the finds as 'clactonian' (Weber 2004). Also, the site of **Bad Cannstatt** has recently been re-dated which pushed back its chronology to the Holsteinian stage, i.e. approximately 400 ka (Haidle and Pawlik 2010).

Two Polish assemblages, from **Rusko** (Burdukiewicz 1996) and **Trzebnica**

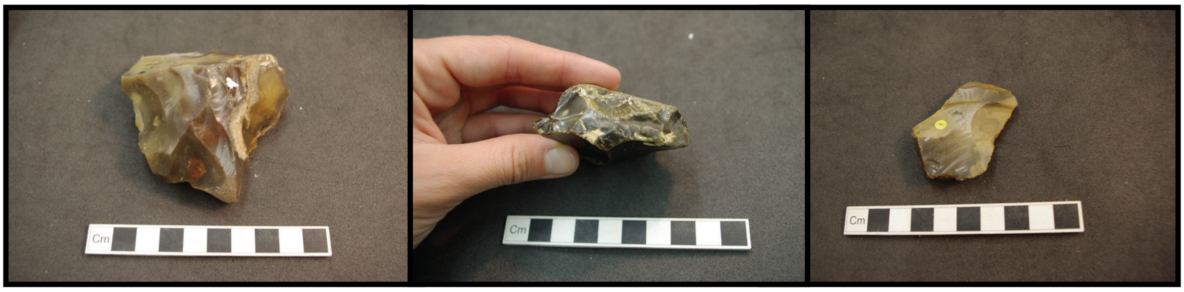

Fig. 6 Artefacts from Trzebnica.

(Burdukiewicz 1995), bear a number of similarities with the German sites, i.e. the small size of the pieces and intensive retouch which might have resulted from use rather than intentional re-sharpening[3]. Although the dating of Rusko and Trzebnica was geologically determined to MIS 13, it is just as likely that they fall into MIS 11 (Burdukiewicz 2003). The main raw material was flint. The lithic assemblage at **Rusko** 42 and 33 consists mostly of small, microlithic flakes, sometimes retouched with notches (including Clactonian notches) and denticulate retouch. Few side-scrapers, perforators and retouched flakes were also found. Retouch is often discontinuous and abrupt although there are a few pieces which bear well defined continuous retouch. Flakes were manufactured from uni- and multipolar cores, mostly only slightly prepared before the detachment of a flake (Burdukiewicz 1996). Burdukiewicz (1994) distinguished more than one cultural unit, arguing that although the artefacts from the site Rusko 33 may belong to so-called central European microlithic tradition, those from the second test pit – Rusko 31 are closer to, what he calls 'the typical Clactonian'. At **Trzebnica** the lithic occur in two levels. Both assemblages are clearly dominated by flakes. The most characteristic feature of the lithics in both units is their size. With the average size of 20 mm the lithics are well within the range of the Bilzingsleben artefacts. Most of the flakes were detached from unipolar, simple cores. The most common tool types include: denticulates, notches and becs although the assemblage contains a few carefully retouched side-scrapers and a few small choppers (Fig. 6) (Burdukiewicz 2006).

Two Polish sites, **Rozumice** (Foltyn 2001; Kozłowski 2004) and **Kończyce Wielkie** (Foltyn et al. 2010a) are highly controversial. The former has never been fully published apart from a brief field report (Foltyn 2001) and a few mentions in regional overviews (Foltyn 2010b). Both sites produced small quantities of flint fragments whose intentional nature has been questioned (K. Sobczyk, A. Wiśniewski pers. comm.).

3 Personal observation.

A number of important Lower Palaeolithic sites are located on the left bank of the Rhine river and therefore do not fall within the scope of this thesis, among them: Kärlich and Kärlich-Seeufer, (Gaudzinski 1998; Gaudzinski et al. 1996; van Kolfschoten and Turner 1996), Miesenheim I (Bosinski et al. 1988) and Kartstein (Haidle and Pawlik 2010). Also two German sites, Steinheim and Reilingen, produced human remains but no associated archaeological material (Street et al. 2006).

At present, there are no known Lower Palaeolithic sites in the temperate zone of the Great European Plain east of the Oder River Valley despite the continuity of the landscape and the lack of any substantial environmental differences between this region and the central and western part of the Plain.

The Carpathian Mountains

Compared with the other zones this one seems to be fairly prolific in Lower Palaeolithic material, although most of it is highly controversial. The most significant concentration of sites is located in the Moravian karst in the south-eastern part of the Czech Republic. The area is dotted with caves and rock shelters and rich in good quality raw material sources (Nerudova 2008; Oliva 2005).

The most representative of these sites is **Stránská Skála** (for a full overview of the site see Svoboda and Bar-Yosef 2003), although it is not free from controversy. Dated to MIS 14-16 on the basis of extensive faunal material and a detected polarity reversal within the stratigraphic column, the Middle Pleistocene levels of Stránská Skála would be one of the oldest in Europe (with an exception of Dmanisi). However, the artefactual character of the lithics is uncertain (Roebroeks and Kolfschoten 1994). The pieces are made on poor quality and severely weathered raw materials such as local flint, hornstone and, to a lesser degree, limestone. The number of artefacts is also very limited. The assemblage consists of a few flakes with bulbs of percussion and a few tools bearing an irregular, abrupt retouch and two choppers (Musil and Valoch 1968; Valoch 1999). Some pieces are described as side-scrapers, notches and even blades (Oliva 2005). Traces of fire have also been reported (Valoch 1999). This assemblage has been collected by selecting 'better looking' pieces from stone debris scattered around the site and most probably, together with other early Moravian sites, do not represent more than naturally fractured pieces of rock (Roebroeks and Kolfschoten 1994; Sobczyk pers. comm.[4]).

Other Moravian localities are even more controversial. Pebble-tools, mostly choppers, classified as Mode 1 assemblages, are known from **Brno Červený Kopec** and **Brno Černovice** (Oliva 2005, 8). The former site yielded a quartz polyhedron which is dated to the time prior to the Brunhes/Matuyama reversal (Valoch 1995). At **Brno Černovice** chert fragments were collected by an amateur who inspected the quarry for several years. All together seven pieces are reported, three of which seems to be more convincing (two flakes and a prismatic core) (Valoch 1995). Other supposedly Lower Palaeolithic artefacts are known from **Znojmo-Sedlešovice**, where a quartz pebble tool is dated to 460-300 ka, and **Dominikánské námestí** roughly dated to MIS 11 on the basis of its geological position (Oliva 2005). The latter is well known because of traces of a hearth present at the site. Also, four artefacts were found in the Lower and Middle Pleistocene levels in the cave of **Mladeč**: a quartz polyhedron, a limonite flake, a chert fragment and a quartz chopper with one negative scar (Oliva 2005). Only the polyhedron could possibly be regarded as artefactual (Valoch 1995). At the site of **Mušov**, several hundred pieces have been reported, mostly classified as unifacial pebble tools, although a few flakes were also found. The industry is described as possibly made by humans, but its artefactual nature remains highly dubious (Valoch 1995). In addition, a number of assemblages were classified as 'Clactonian' by Czech researchers. According to M. Oliva (2005) a flake manufactured with a hard hammer and without any previous preparation of the platform is present at the site of **Praha-Letky**. In addition, such sites as **Švédské Šance**, **Malá Klajdovka**, **Růženin Dvůr, Kladno-Krocehlavy** and **Modricich** yielded very small assemblages (of less than 10 pieces) consisting of atypical pieces coming from abandoned loam-pits (Oliva 2005; Sýkorová 2003; Valoch 2004). Some surface finds were collected along the Svratka River in such localities as **Přibice**, **Pravlov, Pohořelice-Nová Ve**s and **Holovec** by Václav Effenberger. Their cultural provenance is, however, dubious even though they contain what was classified as "proto-bifaces" (Oliva 2005).

4 Dr. K. Sobczyk had a chance to examine the assemblage in person, however the results have not been published.

At **Bečov** in Bohemia more than 300 artefacts were reported but since they were not published the interpretation of the finds is open to question. The site was placed within the Cromerian complex i.e. prior to MIS 13 on the basis of its geological situation (Valoch 1995). Similar chronology is proposed for the site of **Přezletice** where lyddite fragments together with quartz and quartzite pieces were described as a lithic assemblage. The assemblage is highly controversial due to the nature of lyddite which does not break conchoidally. The quartz and quartzite fragments seem to be more convincing but they still fall short of the expectations for an unequivocally human produced artefact (Kozłowski 2004; Roebroeks and Kolfschoten 1994). This, however, did not prevent researchers from interpreting the site as a dwelling locality with a fireplace indicated by burnt bones and a few charcoal fragments (Valoch 1986).

The site of **Račiněvec** (Czech Republic) has been recognized only recently (Fridrich and Sýkorová 2003). It is dated to the Holsteinian interglacial i.e. approximately 300 ka on the basis of its geological position (Schreve et al. 2007). However, the presence of Levallois-like material indicates that this date may be overestimated. Quartz pebbles were the main raw material. The assemblage consists of flakes and small choppers and a number of artefacts described as scrapers, burins and knives (Fridrich and Sýkorová 2003). It is interesting to note that the majority of finds fall within the 'microlithic' range of Bilzingsleben-like assemblages however given the uncertain dating of the site the assemblage may be comparable with microlithic assemblages from Taubach (Germany) or Tata (Hungary).

Altogether, Moravian karst and Bohemia may have a number of potential Lower Palaeolithic localities, although none of them is entirely convincing: either the dating is not unequivocal or the quality of the lithic material is far from satisfactory. There are no sites in the region which produced large collections within a stratified context, with faunal material and secure radiometric dates. All of the aforementioned assemblages share a number of characteristics that make their artefactual nature uncertain:

- A small size of the assemblages usually not exceeding 100 pieces but in many cases less than 10 pieces.

• Almost complete absence of flakes (B. Ginter pers. comm.). Most of the pieces are described by authors as 'core scrapers', 'chopping-tools' or 'polyhedrons' (see for example Oliva 2005; Valoch 1995).

• Lack of clearly visible bulb of percussion AND negatives of previous removals AND clearly defined striking platform; if any of these features is present the other two are usually missing (K. Sobczyk pers. comm., A. Wiśniewski pers. comm.[5]).

• Retrieval by collecting the 'best' pieces out of natural gravels often by amateurs (Roebroeks and Kolfschoten 1994).

The site of **Kozarnika Cave** in Northern Bulgaria (for an overview: Guadelli et al. 2005 and Sirakov et al. 2010) provides a wealth of both faunal and lithic evidence. On the basis of faunal material layers 13 and 12 are dated to biozones MNQ 17-18 (Fernandez, Crégut-Bonnoure 2007; Sirakov et al. 2010) which translates to 2.0-1.8 and layers 11b and 11c to the biozone MNQ 19 i.e. 1.6Ma (for an overview of the faunal chronological correlation see Guérin 2007 and Athanassiou 2002, fig. 2). These dates are considerably older than previously reported (Guadelli et al. 2005) 1.4-0.9 Ma for the layers 13-11c, *ca.* 800-600 ka for 11b and 600-400 ka for 11a based on micromammalian chronology and polarity reversal present within the sequence. Lithics are made on poor quality local material, mostly flint. The lower complex is dominated by flakes, knapped from simple, alternate and parallel cores, often showing a frequent rotation and change of the striking platform which was interpreted as an opportunistic strategy to minimize accidental fractures of the raw material (Sirakov et al. 2010). A number of denticulates and scrapers were found (Guadelli et al. 2005; Sirakov et al. 2010). The assemblage from the upper part of the Lower Palaeolithic horizon (i.e. from layers 11b and 11a) is very similar to the lower complex, although it does change towards the top of the horizon. First of all, the *chaîne opératoire* seems to be longer resulting in less cortical flakes and more exploited cores, some of which show a fixed perimeter. Also the side-scrapers are more frequent and occur in more diverse forms including transversal, déjeté, double and convergent (Guadelli et al. 2005; Sirakov et al. 2010). Bone fragment with a series of cuts from layer 12 was interpreted by the researchers

5 Both, dr K. Sobczyk and dr A. Wiśniewski had a chance to examine the Moravian and Bohemian assemblages.

as one of the first known instances of symbolic behaviour (Guadelli et al. 2005).

Korolevo in Transcarpatian Ukraine could be a pivotal locality for Central and Eastern European Lower Palaeolithic, unfortunately the initial classification of the archaeological material into units was based on the degree of weathering rather than the stratigraphic position of the finds[6], as a result of which some of the assemblages had to be discarded (Koulakovska et al. 2009). TL dating provided dates for different units, from 360 ± 50 ka for level 16 to 850 ± 100 ka for layer 25. Also, the Matuyama/Brunhes reversal has been detected between layers 21 and 22 (Adamenko and Gladiline 1989). However, the complex stratigraphic sequence of Korolevo and the even more complex history of research make it difficult to translate these dates into a chronology of archaeological units. The original cultural attribution of all of the assemblages is Acheulean, except for Complex VII (i.e. archaeological level VII, geologic unit 26) which was classified as Oldowan or Archaic Acheulean (Valoch 1995). However, this cultural attribution is highly controversial and probably misguided by the Ukrainian nomenclature (M. Otte pers. comm, P. Valde-Nowak pers. comm.[7]). Lithic assemblages at Korolevo are mostly composed of andesite, which is available in the immediate vicinity of the site, although other raw materials were also used, including quartzite, flint, schist and obsidian. The assemblage from level VI (Complex VI) is the richest one containing over 5000 pieces (9500 pieces in total, including some of an uncertain stratigraphic position). It is dated to MIS 14 on the basis of its geological position (Koulakovska et al. 2009). Most of the cores show parallel or simple unidirectional techniques for detaching flakes, sometimes with a change of core orientation (Koulakovska et al. 2009). Despite earlier reports (Adamenko and Gladiline 1989) no Levallois technique has been used (Koulakovska et al. 2009). Tools include scrapers (one example resembling a pradnik knife) and denticulates. Numerous quartz and andesite fragments are perhaps an evidence for the use of an anvil (Adamenko and Gladiline 1989). The assemblage from level VII is smaller than Complex VI. It contained over 1,500 artefacts (Adamenko and Gladiline 1989) before the provenance of most of them has been questioned (see above) limiting the number of artefacts found *in situ* to 33 (Koulakovska et al. 2009). The level lies below

6 It resulted in mixing artefacts coming from different test pits, surface collections together with finds found *in situ* within stratified units.

7 Ukrainian researchers use the terms 'Acheulean' and 'Lower Palaeolithic' as synonyms. Prof. Marcel Otte claims there are no bifacially worked pieces at Korolevo (personal observation) which is further supported by a similar observation of Prof. Valde-Nowak.

the Matuyama-Brunhes boundary detected in the stratigraphic sequence (Koulakovska et al. 2009). The finds are heavily weathered and as the authors admit "could be attributed to thermal fracturing" (Koulakovska et al. 2009, 128). Finally, an assemblage previously reported as Complex VIII (Adamenko and Gladiline 1989), containing 426 pieces including cores, flakes and retouched tools has been entirely discarded as lacking true artefactual material (Koulakovska et al. 2009).

At the site of **Vértesszőlős** the travertine sediments similar to those found at Bilzingsleben created an environment favouring good preservation of rich lithics, faunal and floral assemblages, traces of hearts and human remains (Dobosi 2003). The site is dated to MIS 11 with a wide range of radiometric methods (including: Th/U and ESR) and geological as well as faunal correlations (Pécsi 1990). Almost 9,000 artefacts coming from two localities Vértesszőlős I and Vértesszőlős III (Dobosi 2003; de Lumley 2006) were initially classified as Mode 1 or 'Buda' industry (Vértes 1968; 1990). However, given the average dimensions of the pieces falling between 26.4 and 28.1mm (Dobosi 2003) recently it has re-attributed to the so-called 'Microlithic industry' or 'Technocomplex with Small Tools' (Burdukiewicz and Ronen 2003). The raw material is mainly quartzite, chert used for manufacture pebble tools as well as less common quartzite, flint and radiolarite (Vértes 1990). Fragments of small stone pebbles split into two, four or more fragments make a significant portion (approximately 20%) of the assemblage. Interestingly, a similar technique of knapping was employed at the site of Isernia La Pineta (Italy) and interpreted as a response to severe raw material stress (Anconetani et al. 1991). The assemblage includes small pebble tools and heavy retouched flakes classified as side-scrapers and points (Bosinski 2006; Vértes 1990). One of the most interesting finds is a handaxe made of elephant bone knapped using techniques normally employed for stone material (Dobosi 2001).

A few small Lower Palaeolithic assemblages were reported from the Balkan Peninsula including **Tetoiu** (Romania), **Gajtan Cave** and **Baran (**Albania), although their dating and the artefactual nature of the pieces remain highly controversial (Darlas 1995).

Eurasian Steppe

The earliest evidence of human presence in the region is a camel metatarsal bearing clear cutting marks found at the paleontological site of **Liventsovka** and dated to approximately 2 Ma (Sablin and Girya 2010).

A number of sites have been recently reported at the Taman Peninsula, Russia. The sites of **Bogatyri/Sinyaya Balka** and **Rodniki** are broadly dated to 1.6-1.1Ma on the basis of faunal correlation and geological position (Derevianko 2009; Shchelinsky et al. 2010). Both assemblages are very similar. The lithics are made of a non-siliceous material naturally outcropping in slabs. They are heavily retouched and include a large number of pebble tools as well as scrapers, points and denticulates (Derevianko 2009; Shchelinsky et al. 2010). However, the artefactual nature of the finds remains controversial (Doronichev and Golovanova 2010). The environment surrounding the sites is reconstructed as forest-steppe at Bogatyri associated with a freshwater lake whereas at Rodniki with ancient beach deposits (Shchelinsky et al. 2010).

Only recently reported, the site of **Malyj Rakovets** in Ukraine is dated to approximately 300-400 ka on the basis of its geological position. The main raw material is local obsidian. The assemblage consists of flakes and rare flake tools. The presence of Levallois products undermines the proposed chronology (Ryzhov et al. 2009). At the site of **Maslovo**, a very small assemblage of less than 20 pieces was dated to MIS 11 on the basis of its geological position (Stepanchuk et al. 2010), Also, an equally small assemblage from **Medzhybozh** is dated to MIS 11 on the basis of faunal correlation and geological position (Rekovets et al. 2007). A number of surface finds (**Neporotovo VI**, **Cape Mayachny**, **Gaspra**) were also recently reported ranging in date from 900 – 300 Ma (Stepanchuk et al. 2010).

The site of **Gerasimovka** known since 1960 was broadly dated to the early phase of the Middle Pleistocene (Praslov 1995). The assemblage of 7 heavy rolled and abraded flint pieces includes a pebble that may be a chopping-tool and three side-scrapers (Bosinski 1996; Praslov 1995). The artefactual nature of the pieces is highly controversial (Doronichev and Golovanova 2010).

In Moldova, lithics have been recovered from three localities – **Pogreby (Pogrebya)**, **Dubossary 1 (Dubasari-1)** (Praslov 1995) and recently discovered **Bairaki** (Anisyutkin et al. 2012). None of the assemblages contains more than a handful of lithics, but also most of the pieces from Pogreby and Dubossary 1 were identified during surface prospection and therefore lack a controlled stratigraphic context. They are dated to MIS 11 on the basis of their geological situation (Praslov 1995). The assemblage (less than 10 pieces) from Bairaki's alluvial layer consists mostly of pebble tools and a few flakes. Its age was estimated to over 800ka on the basis of its geological position. The upper level produced a small assemblage of flakes and cores including a Quina-like scraper. It is dated to approximately 500 ka, again, on the basis of its geological position (Anisyutkin et al. 2012).

Caucasus

This region is more of a border of Eastern Europe rather than an integral part of it and followed a very distinct trajectory throughout the Palaeolithic, more closely associated with the Levant and the Middle East than Eastern Europe (Doronichev and Golovanova 2010; Lioubine 2000; for a full overview see Doronichev and Golovanova 2003). However, the sheer presence of sites dating from 1.8 Ma (Dmanisi) to 300 ka (Treugol'naya) shows that the regions neighbouring Central and Eastern Europe do not suffer from the absence of archaeological material. In a way, the Caucasus is bridging the gap between Asia and Western Europe.

The site of **Dmanisi**, Georgia produced an abundant lithic industry, a collection of human remains and large quantities of palaeoenvironmental data. It is dated to approximately 1.85-1.76 Ma with a number of radiometric techniques including TL, ESR, U/Th (Ferring et al. 2011; Gabunia et al. 2001)The rich (over 6,000 artefacts) assemblage (Lumley et al. 2005) was made with local raw materials including basalt and silicified volcanic tuffs as well as rhyolite, granite and quartz. The assemblage was classified as Oldowan or Pre-Oldowan and includes numerous pebble tools. Choppers either bear an isolated negative of a removal or a continuous usually regular cutting edge (Lumley et al. 2005). Cores were not extensively exploited; mostly unipolar they usually show a few single negatives. Generally, the exploitation took place on one and rarely on two faces, and multifacial cores or chopping tools are uncommon. The *chaîne opératoire* was aimed at small flakes which were then used for a variety of tasks as indicated by the use-wear analysis (Baena et al. 2010; Gabunia et al. 2001, Lumley et al. 2005; Mgeladze et al. 2010). The reconstruction of the environment at Dmanisi showed a volcanic landscape with a variety of different ecosystems and therefore a diversity of resources within close proximity of the site (Gabunia et al. 2000), which resembles conditions at contemporary sites in Eastern Africa. This similarity of environmental conditions could have facilitated the first 'Out of Africa' (King and Bailey 2006).

The site of **Treugol'naya Cave** in Northern Caucasus is dated to 600-350 ka on the basis of ESR dating (Blackwell et al. 2005; Doronichev and Golovanova 2010; Molodkov 2001) combined with faunal correlations (Hoffecker et al. 2003). Its lithic assemblages come in four separate units – assemblage IV (MIS 15) contains finds from layer 7a; assemblage III (MIS 10-13) comes from layers 5 a-c, assemblage II (MIS 9) is equivalent for artefacts from layer 4d and finally assemblage I (MIS 7-8) includes finds from layers 4a-c. The lowermost assemblage (IV) contains only 11 pieces including a few flakes, scrapers and a fragment of pebble. Assemblage III is not substantially larger, consisting of 18 artefacts including flakes, core-like pebble fragments as well as scrapers, limaces and a typical chopper. Assemblage II is richer than the previous ones. The main raw material limestone pebbles served as blanks for choppers with convex working edges and less often chopping-tools as well as other pebble tools. Flakes are uncommon (five pieces) and include scrapers, a flake with a Clactonian notch and two end-scrapers. Finally, the assemblage I is made on a non-local flint. Its *chaîne opératoire* was aimed towards the manufacture of simple small flakes. Retouch is generally marginal, probably resulting from use-wear and not from deliberate sharpening of the pieces. The flake inventory includes numerous scrapers (50% of the tools group), sometimes formed with Quina retouch as well as denticulates and notches, end-scrapers and others (Doronichev 2000; Doronichev, Golovanova 2010).

Other sites in the Northern Caucasus are much more controversial. Usually coming from surface exposure they lack reliable dating and the artefactual nature of the assemblages has also been questioned (Doronichev 2000; Doronichev and Golovanova 2010). At the site of

Azych dated to approximately 780 ka the lithic assemblage consists of pebble tools mainly made of quartz, siliceous limestone and chalcedony but it has been suggested that the pieces may be a result of natural factors (Bosinski 1996; Derevianko 2009). Similar concerns are related to the site of **Kudaro** where the assemblage made on quartzite, limestone, schist and flint, includes pebble tools and bifaces, denticulate, scrapers and points (Bosinski 1996). Other Caucasian sites such as **Kinjal, Muhkai, Ainicab, Darvagchai, Rubas** and **Tinit** are highly controversial (Doronichev and Golovanova 2010).

The aim of this chapter was to provide a brief but critical overview of the current state of knowledge regarding the Lower Palaeolithic of Central and Eastern Europe. Even from this fairly superficial summary it is clear that many of the sites described as Lower Palaeolithic can be questioned on the basis of ambiguous lithic assemblages and/or uncertain chronology. Hence, it is crucial to differentiate between the securely dated sites which yielded large unequivocally human made assemblages and more dubious sites which cannot be regarded with much confidence as traces left behind by Lower Palaeolithic groups. The pattern of site distribution described below and the hypotheses used to explain it are largely based on the data coming from the former group.

The Pattern: spatial dichotomy between east and west

The pattern of low density of sites in Central and Eastern Europe evidently stands out when compared with the data from Western European (Fig. 7). Approximately 100-130 stratified Lower Palaeolithic sites (surface finds are excluded) are known from Western Europe (estimate based on literature review in Romanowska 2009) compared to about one tenth of this number in the central and eastern part of the continent. Even a very generous count including highly debatable or very small assemblages such as Stránská Skála, Gajtan, Kończyce, Kudaro or Garasimovka (Doronichev, Golovanova 2010; Roebroeks and Kolfschoten 1995; Runnels 1995) brings the number to approximately 40 sites in Eastern Europe.

Considering that Central and Eastern Europe constitutes about two thirds of the continent this represents a robust pattern that has not incited much research so far. It has been mentioned in passing by various authors (Bosinski 2006; Darlas 1995; Dennell and Roebroeks 1996; Gamble 1986; Hopkinson 2007) but it has not been addressed as a distinct research topic. Little academic effort has been invested into understanding this phenomenon hence it is not clear if it represents a real pattern of the past (i.e. demographic disparity between different parts of the continent as suggested by Doronichev and Golovanova (2010)) or simply reflects a modern research bias.

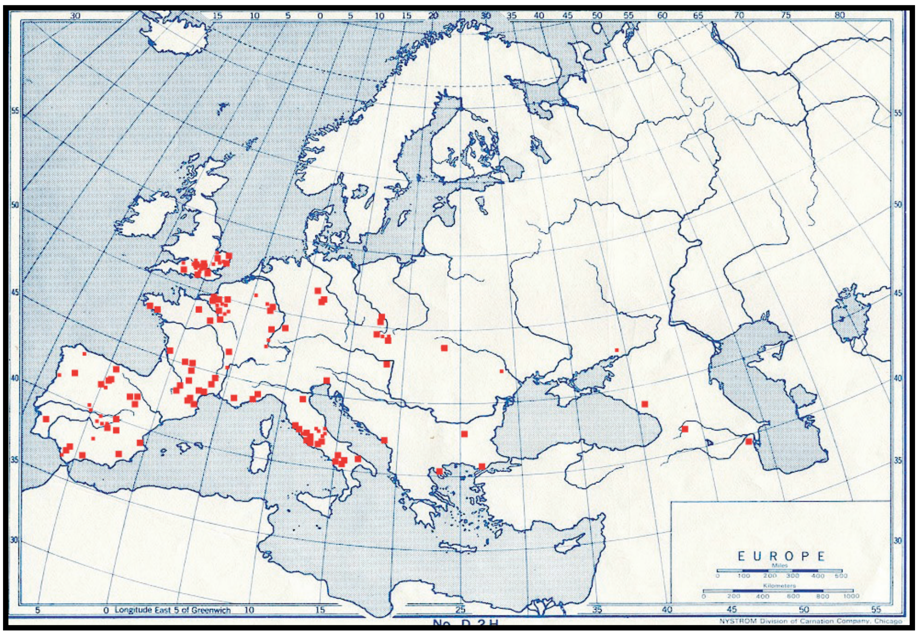

Fig. 7 Spatial Distribution of Lower Palaeolithic sites in Europe.

So far only three scenarios have been put forward in order to explain this dichotomy (Bar-Yosef, Belfer-Cohen 2011*;* Doronichev 2011; Martos 1994; Moncel 2010; Rolland 1998, 1995; Tourloukis 2010):

- State of the research;
- Climate;
- Dispersal routes and demography.

In this thesis all three will be examined and critically assessed in the subsequent three chapters. To the best of my knowledge no other re-evaluation of this type has been carried out before.

Palaeolithic research in the West and in the East

Even if often not explicitly stated it has been a long standing notion that archaeology in Central and Eastern Europe had a later start, was less intensive and often methodologically inferior compared to Western European standards (Bosinski 2006; Darlas 1995; Tourloukis 2010). Also, the limited personal contact between researchers on both sides of the Iron Curtain restricted by the post-war political situation is believed to contribute to lower trust levels towards data coming from the east (Gatsov 2001; Maday 1968; Marciniak 2006; Marciniak and Rączkowski 1991; Tabaczyński 2007) as well as general misunderstanding of the data[8]. This pattern was reinforced by the rarity of radiometric dates (Roebroeks 1994) and the 'oddness' of the finds making them difficult to fit into the current explanatory models (for instance Clarks' modes in the1970s) (Burdukiewicz 2003). Hence, the conviction that history of research accounts for the rarity of Lower Palaeolithic finds in Central and Eastern Europe.

Therefore, the aim of this chapter is to critically examine this hypothesis by trying to establish if the pattern of low density of sites reflects the current state of knowledge (i.e. nobody has been looking for archaeological sites) or if it is related to limited communication between Eastern and Western researchers (i.e. Palaeolithic sites may have been found, but the information is not widely available). The first issue can be broken into three components: i) was research delayed?, ii) was it not intensive enough?, and iii) was it flawed methodologically and/or theoretically?

In order to address these issues, a detailed account of the development of Palaeolithic studies in Central Europe will be given. After a brief summary of pre-World War II developments, the post-war period will be discussed in more detail as during that time the Palaeolithic research intensified and developed from semi-amateur fossil hunting into a scientific discipline. A special emphasis will be given to the intensity of the research, quality of field methods, and the impact of the dominating ideology, all of which could impact the amount and quality of recorded data. Because of the scope of this project it was deemed

8 See the crushing review of McBurney. 1975. *Early Man in the Soviet Union* by a Russian archaeologist (Dmitriyeva 1980).

unfeasible to trace all of the Palaeolithic excavations and research in the whole of Central and Eastern Europe. Therefore three countries, Poland, Czechoslovakia and Hungary, were chosen for a detailed overview which includes tracing different lines of influence, listing all of the significant sites and changes in the dominating methodological and theoretical foundations of the research. However, the general points raised in this chapter are relevant to the whole region and have been researched accordingly. The second part of this chapter tackles the hypothesis of limited communication between Eastern and Western researchers concentrating on the impact of the Iron Curtain on Central and Eastern European Palaeolithic researchers and the dissemination of data (Golomshtok 1933). I will argue that despite the obvious politically-driven limitations and restrictions, the inter-personal and inter-organizational contacts were frequent and that Central European, and to lesser extend Eastern European, researchers were very much an integral part of the international Palaeolithic research community. This is further supported by a notion (L. Lozny pers. comm.; Lozny 2011) that, despite the small number of Central European Palaeolithic researchers, they were better-known in the West than their colleagues specializing in later prehistory or the Middle Ages. This observation will be quantitatively evaluated through an assessment of the H-index academic impact measure (Hirsch 2005) on a selected group of scholars.

Establishing the discipline

Stone Age research in Central Europe has surprisingly long and strong roots reaching well into the 19th century. It can be argued that the 19th century empirical-positivist approach to science had a much bigger impact on researchers in the second half of the 20th century than any other theoretical paradigm, creating a solid cultural-historical framework in which Central and Eastern European archaeologists have been and still are conducting their research. The aim of this section is to show that there are little or no differences during the development of archaeology in the 18th and 19th century between the western and the eastern part of the continent and although Great Britain, France and Germany led the way in terms of new methodologies, theoretical consideration or field methods, Central and Eastern European archaeologists did not lag behind quickly integrating new methods, concepts and ideas coming from the west in their own research (Lech 1998; Montet-White 1996; Sklenář 1983; Svoboda et al. 1996).

The first examples of scientific evaluation of Palaeolithic material in Central Europe date to the antiquarian period when local legends and myths mixed with the Biblical interpretation of the history were still dominating. This first appreciation of the antiquity of stone tools in Central Europe (J.F. Esper in a report from the cave of Gaillenreuth in 1774) (Sklenář 1983) was roughly contemporary with the first announcement of Palaeolithic finds and their "pre-flood" interpretation in Western Europe (Frere 1797, published 1800; for an overview of the antiquarian tradition in Western Europe see McNabb 2012).

More empirically informed research soon followed and Central European archaeology thrived during the 19th century. Undeniably, the main force behind the research in Central and Eastern Europe was the drive to pursue the nationalistic agendas of emerging nation states and to prove the right of their own people to occupy certain territories (Lech 1998; Sklenář 1983). However, because of that the local ruling family and aristocracy generously supported the pursuits of local antiquarians, be it in form of learned societies, private collections or individual researchers – a trend which was continued up until modern times (Runnels 1995; Sklenář 1983).

A network of museums[9] and universities[10] with chairs dedicated to archaeology was established during the first half of the 19th century, complemented by numerous archaeological societies around the region (Bartosiewicz 2011; Bökönyi 1993; Chochorowski 2008; Kobyliński 2006; Sklenář 1983; Velkov 1993). Archaeology was extremely popular among the middle-class and the intelligentsia at that time, and as a result museums and private collections grew fast to provide even more data to be milled in artefact-oriented typo-chronological schemes.

This process closely mirrors the beginning of archaeology in Western Europe (McNabb 2012) where the first museums were opened (for instance, the British Museum in 1753) and

9 Museums with antiquarian expositions and the year of their openings: Puławy, Poland – 1800, Budapest, Hungary – 1802, Wilanów, Poland – 1804, Prague, Czech Republic – 1823, Zagreb, Croatia – 1821, Berlin, Germany – 1830, Belgrade, Serbia – 1844, Kraków, Poland – 1850, Vilnus, Lithuania – 1855, Poznań, Poland – 1857, Sofia, Bulgaria – 1892.

10 Archaeological chairs and the date of their establishments: Buda, Hungary – 1777, Vienna, Austria – 1849, Prague, Czech Republic – 1850, Kraków, Poland – 1863.

the first university chairs of archaeology established (Cambridge in 1883, Oxford in 1896) at roughly the same time as in Hungary, Poland or Russia (Miller 2007).

One of the most significant changes in Central Europe at that time was the emergence of new movement in Germany led by Gustav Kossina who replaced Rudolf Virchov as the leader of the national archaeology. This was one of the most unfortunate generation shifts which impacted archaeology up to the present day (see for instance Curta 2001). Virchov open to debate and very within the positivist movement pacified chauvinistic tendencies existing in the German archaeology in the first half of the 19th century. In contrast, Kossina based his ideas on the assumption that the superior Germanic ethos reaches back in time to Neolithic. His school of thought named Siedlungsarchäologie 'Settlement Archaeology' was only concerned with determining that artefacts belonged to the Germanic or Aryan realm therefore continuing and encouraging the nationalistic agendas present in Central and Eastern European archaeology since the very beginnings. Obviously, his conceptions were met with enthusiasm in the Weimar Republic drifting towards the Nazi rule and, unmistakeably, Kossina became '*public enemy number one'* for all the researchers in Slavic countries (Lech 1998). Archaeology became very political and remained so almost until the beginnings of the 21st century.

This had only limited impact on the Stone Age studies sturdily embedded in the empirical-positivist approach, a predecessor of the culture-historical framework substantiated in De Mortillet's system, which, given the minuscule base of finds, dates and contexts at that time suited them well. It was a great period of international data collection which provided a solid basis for later, better-informed interpretations. The main focus of Stone Age research was the quest for new sites, comparing and contrasting the assemblages with the industries from other parts of the world, and continued efforts to refine and correlate the geological framework with the dating of subsequent glacial and interglacial periods (for example Benet-Tygel 1944).

Moravia was traditionally the centre of Palaeolithic studies in Central Europe (for a full overview see Svoboda et al. 1996 and Oliva 2005). Jindřich Wankel and Karel J. Maška, probably due to the influence of William Buckland, began investigating the caves of the

Bohemian and Moravian Karst: Býčí skála (1867), Kůlna, Pekárna and Šipka (1880) and the open-air site of Předmostí (1880) (Svoboda 2005; Valoch 1970; 1996, 7-8). Their work even caught the attention of Abbé Breuil, who ventured there on a research trip in 1925. In his '*Remarks on a Paleolithic Trip to Central Europe*' (1925), Breuil recognized Acheulean and Mousterian in Pekárna, Kůlna, Šipka and Čertova Díra and Aurignacian in the Mladeč Cave (Svoboda et al. 1996, 6).

The most prominent Moravian figure of the first half of the 20th century was Karl Absolon, who, drawing on the legacy of Maška, introduced a more multidisciplinary approach to excavations, but also aimed to bring together lithics dispersed among numerous private collections. Professor at the Charles University in Prague, Absolon excavated Dolní Věstonice, Pekárna and Byčí Skála Caves, and Předmostí (Valoch 1996). Other researches were equally active, and a number of excavation projects were under way when the Second World War erupted (Svoboda and Valoch 2003; Valoch 1996).

Towards the end of the 19th century Oskar Fraas was excavating two palaeolithic sites of Schussenried and Munzingen and soon other investigations in Germany followed at such important sites as Taubach, Weimar and Munzingen (Sklenář 1983).

In Poland, most of the 19th and early 20th century Palaeolithic research concentrated near Kraków where Jan Zawisza and Godfryd Ossowski were exploring the caves of the Prądnik Valley. The most famous of the caves, Mammoth Cave, contained a sequence of deposits comprising Middle and Upper Palaeolithic assemblages rich enough to fuel research for many years (Benet-Tygel 1944). Later on, in the beginning of the 20th century, Erazm Majewski started his work on late Palaeolithic and Mesolithic assemblages (Kobyliński 2006). Majewski applied French typologies, especially the De Mortillet system, to local materials. He also coined most of the lithic terminology in Polish and trained a generation of Palaeolithic researchers who dominated the study for another 50 years, among them Stefan Krukowski, Leon Kozłowski, and Ludwik Sawicki (Kobyliński 2006; Lech 1998).

The archaeological survey of the caves in the Krakow area intensified at the beginning of the 20th century. A cluster of mostly Middle and Upper Palaeolithic sites close to the village of Piekary was successively excavated by Ossowski and Krukowski (Sachse-Kozłowska and S.K. Kozłowski 2004). L. Kozłowski reopened the Mammoth Cave, Albin Jura worked at Zwierzyniec and with Krukowski at the site of Sowiniec (Benet-Tygel 1944), and Krukowski excavated the caves of Okiennik and Ciemna. An equally high number of Upper Palaeolithic sites were discovered during that period, including Przemyśl, Sowiniec, Koziarnia, and Nietoperzowa Caves (Benet-Tygel 1944). A few research questions such as raw material provenance, transitional industries, or the definition of archaeological cultures emerged at that time only to be brought forward by a new generation of archaeologists after the Second World War.

In Hungary no traces of early human occupation were known until research by Ottó Herman at the beginning of the 20th century (Biró 2003). It was Ottokár Kadić, however, who for the first time demonstrated the unequivocal concurrence of stone tools and now extinct fauna during his excavations of the Szeleta Cave between 1906 and 1913 (Lengyel et al. 2009). At the same time, the well-known Middle Palaeolithic sites of Tata and Jankovich Cave and the early Upper Palaeolithic site of Istálóskő were excavated for the first time (Simán 2003). In the 1930s, the first Palaeolithic human remains were discovered in the Subalyuk Cave in the Bükk Mountains (Simán 2003).

In Russia the first half of the 20th century is sometimes called 'the golden age' of Archaeology (Koryakova 2001). It was during those years that a multidisciplinary approach was fashionable and a number of young scholars introduced rigorous scientific methodologies to their studies (for a full overview see Golomshtok 1933 and Vasil'ev 2002). In 1926 the Commission for the Study of the Quaternary Period was created concentrating on the environmental studies and Palaeolithic archaeology (Golomshtok 1933). A number of large scale multidisciplinary expeditions into less habited regions of Russia were send in the first few decades of the 20th century including the Bashkir region expedition, the Yakutsk Expedition or Buriato-Mongol expedition to name just a few. As a result several Palaeolithic sites have been identified including Gagarino and Malta (famous for their Palaeolithic figurines) discovered by S. N. Zamiatnin and M. M. Gerasimov (Janik 2012; Soffer et al. 2000) and the site of Kostienki discovered in 1931 by P. P. Ephimenko and subsequently excavated by P. Yefimenko and A. N. Rogatchev (Hoffecker et al. 2010; Sinitsyn 2007). By 1933 43 Palaeolithic sites were known from the territory of Russia (Golomshtok 1933, 315-316).

It was not until the beginning of the 20th century that the southern Central European countries began researching the Palaeolithic. Therefore, when F. Hofman brought some lithics to the Academy of Belgrade in 1882, they failed to draw any interest. In former Yugoslavia two important schools formed in Zagreb and Ljubljana thanks to the excavations of Krapina Cave. Research carried out at this Middle Palaeolithic site between 1899 and 1905 by Gorjanović-Kramberger and S. Osterman sparked local enthusiasm and led to the development of Palaeolithic archaeology in the region (Montet-White 1996). The end of the 19th century was a time of solidifying archaeological institutions in that part of the world a good example of which is the creation of Archaeological Institute in Sofia in 1982 which coordinated all archaeological research in Bulgaria (Velkov 1993).

Little indicates that archaeological research, and Palaeolithic studies in particular, in Eastern and Central Europe lagged behind those in Western European centres (for a similar view, see Vékony 2003, p.15). The picture that emerges is an international, stimulating environment where introducing new techniques, significant discoveries, and international communication were common. L. Kozłowski collaborated closely with Abbé Breuil in Portugal and in the Somme River terraces where they introduced a new division of the Acheulean into seven stages. V. G. Childe, who worked with L. Kozłowski on his site in Koszyłowice (present day Ukraine) (Lech 1998). Other examples of Central European contributions to the discipline include the identification of a new Middle Palaeolithic bifacial tool type *prądnik knife* (Jöris 2006, 297-99) by Krukowski, recognition of so-called “transitional cultures” marking the transition from Middle to Upper Palaeolithic (bohunicjan, jerzmanowicjan, seletian) (Svoboda 2003), and Krukowski’s recognition of the importance of conducting a functional analysis of a site before its cultural attribution as assemblages preserve different technological features depending on their function as a settlement, flint workshop, short-term hunting station, etc. Also, the Western typo-chronological frameworks, mostly De Mortillet’s system, were critically applied to Central European assemblages by prominent researchers such as Maška and Majewski (Benet-Tygel 1944; Kobyliński 2006; Lech 1998; Svoboda et al. 1996). Palaeolithic researchers adapted ideas coming from the West, including the type-fossil approach as well as terminology and field methodology to the local conditions creating frameworks more adequate to the industries found in the region (for example, Krukowski's cultural sequence of the Polish Palaeolithic), Czech and Russian meticulous field methodologies, and Majewski's terminology (Schild 1998; Svoboda et al. 1996; Vasil'ev 2002).

Under the shadow of ideology

It is estimated that Polish prehistory research lost between 20% and 40% of its professional staff during the Second World War (Gurba 2005), and other countries were not far behind in this sad statistic. The loss of archaeological materials, library collections, and academic equipment is beyond estimation, but undoubtedly one of the most significant disasters for Palaeolithic studies was the intentionally started fire at Mikulov Castle in Czechoslovakia, which housed the rich Moravian Palaeolithic collection including hominid remains from the Mladeč Cave (Oliva 2005; Svoboda 2005; Valoch 1996, 10).

The first post-war years witnessed an important political shift which initially had only minimal impact on the discipline, but soon the Soviet regime brought a new structure to the archaeological institutions, restrictions on contacts with the Western world and ideological pressure previously unknown in these parts of Europe (Bartosiewicz et al. 2011; Lech 1998; Neustupný 1993).

The post-war period (1945-1956) saw the introduction of Marxist-Stalinism, a barbarised version of Marxism implemented ruthlessly upon the society. During this period, strong administrative pressure was enforced to introduce new methodology, to cite the classic works of Marxist-Leninism, and to train students in the spirit of Marxist-Leninism. It influenced archaeology mostly through history departments which were targeted by the communist authorities trying to substantiate the dialectical materialism. Archaeologists were supposed to use both archaeological and ethnological data in order to distinguish the forces of production and relations of productions which were reflected in social and spiritual culture. Material culture was believed to reflect all aspects of human life providing enough proxies to reconstruct a full picture of past societies (Lech 1998; Neustupný 1993). After Stalin's death, the ideological influence slowly declined and in some countries it disappeared almost entirely by the 1970s. Slowly, researchers moved away from Marxism, but remained interested in the dominating themes of economy and society. From this moment on, contacts with the West flourished and a number of joint missions around the Mediterranean and in Africa were established (Lech 1998; Lozny 2011; Laszlovsky and Siklodi 1991; Neustupný 1991).

Even though after the Second World War most of the Central and Eastern European countries fell under the influence of the Soviet Union, it cannot be stressed enough that the nature and intensity of this influence varied significantly from one country to another. The strongest administrative pressure was exercised on researchers in East Germany, Bulgaria, Albania, and all of the countries directly bordering with Russia such as Ukraine, Belarus, or Moldova (see Bökönyi 1993; Gatsov 2001; Gringmuth-Dallmer 1993; Miraj and M. Zeqo 1993). The impact of the Soviet regime varied in time as well, illustrated by Czechoslovakia, which enjoyed relative freedom until the Prague Spring in 1968. The 1968 rebellion and the subsequent persecution, however, marked a turning point in many aspects of the political but also daily life which directly affected a lot of researchers. For instance, Jan Jelínek was dismissed from the position of a director of the Moravian Museum due to false political accusations (Frayer 2005).

In the whole Soviet Bloc, Marxism became a dominating, if not exclusive doctrine, heavily influencing academia and the social sciences in particular. However, even during the most severe period of Stalin's reign, most of the leading archaeologists in Central Europe did not surrender to the schematic implementation of doctrine, but rather tried to quietly hide in the cultural-historical paradigm where compiling long, typological sequences and distribution maps allowed them to steer well away from theoretical debates (Heather 2010, 102-3; Hodder 1991; Lech 1998; Laszlovsky and Siklodi 1991; Milisauskas 1998; Neustupný 1991). Likewise, the political situation might not have been as dire as sometimes depicted, particularly after 1956. For instance, among members of the newly founded by the communist authorities Polish Academy of Science were Włodzimierz Antoniewicz and Józef Kostrzewski who overtly regarded themselves as opponents to Soviet rule and were previously persecuted (Lech 1998). Their stories show how complex the manoeuvring between the authorities, academic centres, and colleagues was following the war (S. K. Kozłowski 2007). L. Bartosiewicz supports this observation reminiscing about his more silly than serious experience with censorship at the Hungarian Academy of Sciences Publishing House in 1978 (Bartosiewicz et al. 2011, footnote on page 292).

Although ideological training in Marxism was compulsory at all universities, it was often not taken seriously (Neustupný 1993), and even in Russia in the 1960s and 1970s, archaeology had a status of a place for free-thinkers and was considered less politicized than other disciplines within the Humanities (Koryakova 2001). In Romania, usually subjected to strong administrative pressure regarding the theoretical basis of archaeological research, Palaeolithic archaeologists managed to hide in ideologically neutral typologies and discussions on stratigraphic sequences (Gheorghiu and Schuster 2002). In East Germany, however, archaeology was much more affected by the political influences and the Marxist-Leninist Historiker-Gesellschaft still operated in the 1970s due to higher ideological pressure from authorities (Bökönyi 1993; Gringmuth-Dallmer 1993; Lech 1998). It seems that the political pressure on researchers depended on the time and place, and cannot be regarded as a homogenous phenomenon.

The 1960s witnessed a great paradigm shift in the Western, mostly Anglo-American, archaeology when the old culture-historical methodology was heavily criticised by the proponents of New Archaeology. Central European archaeologists were aware of this new methodological framework, but only a few individuals became influenced by ideas coming from the West (for a detailed overview, including interviews with Central European archaeologists see Suhr 2005). *New Perspectives in Archaeology* published by the Binfords, together with quantitative analysis of stone assemblages, were cited by a number of Central European researchers working on the final Palaeolithic. Works by Sackett, Binford, Clarke, and Renfrew were equally well known – researchers such as J.K. Kozłowski and R. Schild quoted them in their publications (Barford 2002; Lech 1998). Other examples of using Western methodologies exist, but they were not common. In the second half of the 1970s, J. K. Kozłowski and S. K. Kozłowski worked with P. Dolukhanov on a programme which applied Anglo-American New Archaeology to the analysis of classic concepts of research into the European Palaeolithic and Mesolithic. They wanted to verify the intuitive cultural classification of these two time periods using a classic typological scheme of lithic assemblages combined with Clarke's hierarchy of taxonomic units, factor analysis and palaeo-geographical characteristics (Lech 1998; Suhr 2005, 33). In the 1980s new waves of archaeological theory, such as processualism, reached Central Europe. Their impact, however, was even less important than that of New Archaeology and did not extend beyond the publication of "Unconventional Archaeology" edited by Schild in 1980 which gathered under one cover a collection of 'alternative' approaches (Lozny 2011). In general, Central European archaeology has always been dominated by the culture-historical approach sprinkled with Marxist vocabulary and the theoretical waves from the west, although known, did not leave a lasting impact on Central European researchers as much as they did on their western colleagues.

Thriving archaeology under the communist regime

Despite the political repression imposed by communism, the introduction of Marxism also had its good sides: it shook the established, dominating methodological framework, provided necessary resources for research (and a lot of them), and creating an inspiring, multidisciplinary environment for researchers gathered under one roof at the universities and Academies of Science. It also developed a network of museums which acted as local research centres, but above all it brought more funding to the discipline than ever before.

Firstly, the introduction of Marxism promoted a new way of looking at archaeology, more similar to the anthropological approach typical for the other side of the Atlantic. The newly introduced discipline of "the History of Material Culture" combined prehistory, classical archaeology, and Near Eastern archaeology with ethnography and historical studies in order to develop a more comprehensive approach to the human past (Tabaczyński 2007). The shift toward material culture had a positive effect in the creation of a new branch of heritage studies: museum studies. New archaeology museums were established in Brno, Wrocław, Gdańsk and Łódź, and older museums expanded in Kraków, Poznań, Prague and Budapest (Lech 1998), creating a network of important research centres (Lozny 2011; Milisauskas 1990).

This theoretical shift gave the younger generation of researchers an opportunity to rid themselves of the culture-historical school, with its endless compilations of cultures and chronologies. Indeed, in the second part of the 20th century, more social interpretation was placed on archaeological material. This new generation strongly criticized earlier researchers, accusing them of turning archaeology into a list of cultures with controversial names and unsubstantiated ethnic determinations that brought nothing but museum showcases filled with artefacts sorted according to various typologies.

Also, the quality of field methodology should not be underestimated, although as always it varied from one site to another. In 1948, Z. Hołubowicz published a critical analysis of excavation and documentation techniques where he postulated stratigraphic exploration, 3D recording, excavating within trenches separated by profile bulks, and more consistent methods of recording and publishing. These guidelines were mostly followed by researchers (S. K. Kozłowski 2007; Lech 1998). In Czechoslovakia and Russia the tradition of recording of the spatial distribution of lithics accompanied by detailed micromorphological and pedological analysis of the deposits continued after the war (Svoboda et al. 1996; Vasil'ev 2002). However, the great advancement came from the way in which archaeology was structured: the fieldwork was undertaken within large, multi-disciplinary institutions, universities and national academies of science, which allowed easy access to a wide range of specialists and a good research environment for relatively unrestricted flow of knowledge, exchange of ideas, and development and implementation of methodological innovations.

Finally and probably most importantly, archaeology during the second half of the 20th century drew from the communist authorities not only undesirable ideological attention but also a steady stream of funding (Heather 2010, 102-3; S. K. Kozłowski 2007; Lech 1998; Milisauskas 1986; 1990). Even if not overwhelmingly extensive at all times, communist regimes were feeding the research institutions with enough support to carry out substantial undertakings (Lech 1998; Milisauskas 1986; 1990). Large research projects conducted on a previously unknown scale provided researchers with jobs and enabled them to carry out their research for decades (the excavation of a Bronze Age cemetery at Kietrz, for example, lasted from 1956 to 1983) (Heather 2010, 102-3). The preparation for the "Millennium celebrations" (the 1,000th anniversary of the foundation of the Slavic states) alone created in Poland positions for 221 professional university-trained archaeologists employed by the Committee for Research on the Origins of the Polish State. Similar celebrations combining archaeological excavation with creation of museums and archaeological parks as well as raising awareness of the earliest history among the general public took place in Czechoslovakia, Bulgaria and other countries in the region (Velkov 1993). Probably one of the most extensive archaeological projects of that time, the AZP (Archaeological Photo of Poland), was launched in the 1970s. It combined results of individual field surveys undertaken by all archaeological institutions in Poland using one standardized template. By the end of 1997, 75% of the surface of Poland had been investigated, with thousands of sites recorded and detailed maps of settlements in different time periods collated (Konopka 1983; Ławecka 2000).

Large-scale research projects were not the only type of archaeological activity – due to undeveloped infrastructure, pre-development rescue excavations were common and sometimes covered large areas. The excavation of the site of Nowa Huta (suburbs of Kraków) covered approximately 100 km^2. From 1960 onwards about 300 sites were excavated each year in Poland. For example, in 1974 archaeologists excavated 323 sites, 55 of which were excavated by universities, 138 by museums, and the Academy of Science dug 31. Altogether, 111 of them were rescue excavations, whereas the rest were conducted as part of research projects (Lech 1998; Tabaczyński 2007).

This observation goes in line with the number of archaeologists working in Central and Eastern Europe at that time. Milisauskas noted in 1986: "Eastern Europe is saturated with archaeologists" (Milisauskas 1986, 779), and rightly so as there were four times more university-trained archaeologists per square km in Poland than in New York (Milisauskas 1986). Lozny (2011) provides more detailed information about the number of Polish archaeologists. With 1,362 archaeology graduates in the 32-year period between 1949 and

1980, Poland seemed to have enough hands to do the job. In comparison, currently the median number of archaeologists in an EU country is 754 people and the average 1,388 people (Aitchison 2009)[11].

Stone Age Research under communist rule

Objectives and institutions

Post-war Palaeolithic research in Central Europe focused on introducing new methods and refining the already existing typologies (Svoboda et al. 1996, 8). The use of geo-chronological systems and detailed studies of loess sequences with attempts to correlate them with the four glacial periods (Günz, Riss, Mindel, Würm) gave researchers a stable, pan-European chronological framework. Standing on the shoulders of such eminent figures as Absolon, Krukowski and L. Kozłowski, a new generation of researchers dominated the Stone Age research in the 1960s.

They postulated:

- Precise methods of excavation based on geochronology;
- A strong interest in palaeo-environmental changes;
- Detailed typological examination of flint artefacts (Lech 1998).

Although the type fossil approach has never lost its appeal, the system proposed by D. de Sonneville-Bordes, J. Perrot and F. Bordes heavily influenced the typology of stone artefacts used for classifying material (Bordes 1961). Most of the researchers, however, were critical in their adaptation of the Bordean system to local conditions (B. Klíma (1956) and K. Valoch (1965) in Czechoslovakia; B. Ginter and J. K. Kozłowski (1969) in Poland; L. Vértes in Hungary (Vértes 1965)), creating a strong typological framework for lithic analysis of the local Palaeolithic assemblages.

In 1953, the State Archaeological Institute in Moravia was incorporated into the Czechoslovakian Academy of Science. Palaeolithic research did not contradict the dominating historical-materialist doctrine and so it was included in its scientific programs. The Department of Diluvium of the Moravian Museum became the Anthropos Institute led

11 Data gathered in 2008; for more details see (Aitchison 2009). This data is heavily skewed by a high number of archaeologists working in the UK therefore the median is probably a more reliable indicator.

by Jan Jelínek – the only Central European institution devoted exclusively to Palaeolithic studies (Frayer 2005). The two traditional hubs of Palaeolithic research in Poland were always Kraków and Warsaw, with Wrocław emerging later, while other archaeological centres focused more on later epochs (for instance Poznań, see Prinke 1978). Palaeolithic research in Germany was conducted by local *Landesamts* (county archaeological units) but the research centre at the Tübingen University and the Palaeolithic arm of the Römish-Germanisches Zentralmuseum (Mainz) were particularly active. In addition, the interdisciplinary working group 'Probleme der Menschwerdung' funded in 1977 concentrated on the Human Origins research (Ullrich 1992). In Hungary, most of the Palaeolithic research was conducted at the Hungarian National Museum (Vértes 1961) whereas in Russia, the majority of Palaeolithic researchers were based in Moscow and St. Petersburg (Vasil'ev 2002).

The early post-war period

In Poland, Krukowski's work had the greatest influence on this first post-war generation of Palaeolithic archaeologists, including Waldemar Chmielewski, Bolesław Ginter, Janusz Krzysztof Kozłowski, Stefan Karol Kozłowski, Romuald Schild, Hanna Więckowska, Michał Kobusiewicz, and Zofia Sulgostowska, among others (Schild 1998). Ginter and J. K. Kozłowski, together with Schild, worked on evolving and clarifying the classification systems of Palaeolithic industries introduced by L. Kozlowski, Krukowski and F. Bordes (Lech 1998). Schild developed a dynamic technological analysis of chipped stone assemblages which first appeared in Krukowski's early works. Krukowski's ideas about directions and methods in the study of mines, flint workshops and raw material provenance were even more elaborated. Lithics were studied in association with the mechanisms governing distribution, the economics and social structures of the communities, and detailed studies on cultural systematics were undertaken (Schild 1998).

In Hungary, the Palaeolithic site Vértesszölös (Kretzoi and Dobosi 1990) was excavated between 1963 and 1969. However, research on the site came to an end when the head archaeologist, Laszlo Vértes, died. Vértes created a new archaeological unit, Buda industry, on the basis of the finds from Vértesszölös (Vértes 1965). He acknowledged the small size of the pieces as well as specific technological aspects of the assemblage. His ideas, however, did not meet with a wide acceptance, locally or internationally. He was also one of the pioneers of computing applications in archaeology. He "used mechanical edge cards (with holes around their edges, selectively slotted to indicate the presence/absence of traits), and sorted sets of Paleolithic stone artifacts by combined search terms enabling ‹faceted navigation›, *i.e.* choosing the order by which the hierarchy of categories was defined" (Bartosiewicz et al. 2011, footnote on page 295). Other important Palaeolithic sites in Hungary were opened at that time, for instance Érd in Transdanubia and Tata where the shell with a carved cross has been interpreted as an example of Neanderthal "art" (Chase and Dibble 1987).

Likewise, in Czechoslovakia, and particularly in Moravia, post-war fieldwork gained momentum. The Moravian Karst provided a few significant sites (for example the site of Kůlna), all of which have been identified by the team from the Antropos Museum in Brno (Valoch 1970). The spectacular Upper Palaeolithic finds from Moravia were well-known in the West and large-scale excavations of Gravettian sites such as Pavlov and Dolní Věstonice (re-opened in the 1970s) attracted a lot of attention in the west (for example, Marshack 1988). To some extent these spectacular discoveries overshadowed other Central and Eastern European Palaeolithic discoveries. This was especially the case of Hungary and Germany, where most of the assemblages conveniently fit into the dominating Central European framework not sparkling much of a debate (Dobosi 2003b).

In Russia, the main focus has been on functional studies which resulted in developing the microscopy for use-wear analysis, a method used until the present day. The work by Semenov (Prehistoric Technology published in 1957 and translated into English in 1964) and his colleagues has been crucial for the development of use-wear analysis (Grace 1996; Semenov 1964).

The thaw: 1970s and 1980s

During the 20-year period starting in the 1970s there was a noticeable increase in research concerned with technological aspects of lithics, including the introduction of refitting, studies in lithic raw material provenance, and the first attempts to apply dynamic analysis *sensu* R. Schild (Svoboda et al. 1996). Also, a number of important sites were excavated. In Poland, the site of Kraków-Spadzista raised questions about the nature of accumulated mammoth bones and their possible interpretation as human dwellings similar to the structures known from Mezhirich in Ukraine (for an overview see: Wojtal and Sobczyk 2005). Another specifically Central European phenomenon which sparkled intensive research at that time were the so-called 'Central European transitional cultures' (Bohunician, Szeletian, Jerzmanowicjan), marking the change from the Middle to Upper Palaeolithic (Svoboda 2003).

In the 1980s, field work at many important Palaeolithic sites re-opened, a large amount of critical discussion into the role of human behaviour in the morphology of lithic industries took place, and a few Western scholars visited Central Europe (Svoboda et al. 1996).

At Stránská skála in Czechoslovakia, the longest Palaeolithic stratigraphic sequence has been investigated between 1981 and 1988 bringing rich assemblages dating from the Early Upper Palaeolithic (Bohunician) to the epi-gravettian (Svoboda and Valoch 2003; Valoch 1999). In Poland, Paweł Valde-Nowak uncovered another long sequence spanning from the Middle to Upper Palaeolithic in the Obłazowa Cave (Western Carphatians) (Valde-Nowak et al. 2003). A bone boomerang found in the cave (Valde-Nowak et al. 1987) is one of the most outstanding finds from that time. At the site of Zwoleń, Schild and Sulgatowska excavated a large horse kill site (Schild 2005). The only two Lower Palaeolithic sites known from Poland, Rusko and Trzebnica, were identified in the late 1980s and early 1990s by Jan M. Burdukiewicz (2003) and excavated by his team from the University of Wrocław. Based on this work, Burdukiewicz differentiated a new cultural unit: 'Technocomplex with Small Tools' (J. M. Burdukiewicz 2003) representing a distinctively Central European phenomenon of assemblages characterized by the distinctively small size of lithics regardless of the size and quality of the available raw material. Similar Middle Palaeolithic assemblages were recognized elsewhere in Central Europe, for example Tata in Hungary, Taubach in Germany or Kůlna in Czechoslovakia, becoming yet another example of exclusively Central European phenomenon – Taubachian (Glaesslein 2009; Moncel 2001; 2003).

This short overview shows that the amount of Palaeolithic research conducted in the field in the second half of the century in Central Europe was as intensive as in the rest of Europe. Palaeolithic researchers were at the forefront of both field and lab methodological developments (field methodology, typological lists), and a number of distinctive archaeological phenomena were recognized and interpreted (transitional cultures, Taubachian). However, were the results effectively disseminated to scholars on the other side of Iron Curtain or did they remain confined to the local archaeological community?

Impermeable border?

A heated debate has taken place in Central European archaeology over the last two decades regarding the issue of isolation from Western influences in archaeology during the second half of the 20th century (Barford 2002; Lech 1998; Marciniak and Rączkowski 1991; Tabaczyński 2007). Although nobody denies that the Iron Curtain did not facilitate contact between researchers, the magnitude of its impact is highly contentious. Difficulties related to obtaining the necessary passports and visas, disparity in the values of currencies, and only limited formal international links between research institutions restricted research visits, data collection, literature review, and conference attendance (Hodder 1991; Krupic 2008; Marciniak and Rączkowski 1991). Equally hindering was the limited circulation of Western archaeological journals within the Soviet Bloc countries, and restricted accessibility to archaeological publications in general. This could have been further aggravated by language barriers and, to some extent, different disciplinary interests (Barford 1993; Maday 1968). It is, however, difficult to determine to what degree these limitations affected Central European researchers in real terms. Based on anecdotal evidence, restrictions varied depending on the institution and the people involved (see anecdotal evidence of close West-East friendships between researchers from both sides of the Iron Curtain in Frayer 2005 and Begun 2005).

Interpersonal contacts

An important factor preventing isolation were joint missions between Central European and Western institutions. A few of them were conducted during the second half of the 20th century, including the well-known mission by Fred Wendorf and Romuald Schild to the Eastern Sahara (Wendorf and Schild 1980; Schild and Wendorf 2002). Initially formed as a response to the 1960 Aswan Dam UNESCO appeal the international team of researchers developed into an American-Polish-Egyptian joint mission providing an extensive survey and salvage research of the Nile Valley and the Egyptian part of the Sahara, Sudan and

Ethiopia. It identified and excavated a number of Palaeolithic and Neolithic sites in the Eastern Sahara and became the source of a constant stream of new discoveries and publications related to the prehistory of the region, as well as a training ground for new generations of Stone Age archaeologists for over 40 years (see Schild and Wendorf 2002 for the exact breakdown of the research). Western researchers also joined their Central European colleagues to cooperate on excavations of Central European sites. For example, Alexander Marshack contributed to the interpretation of a possible example of early art from the Bacho Kiro Cave in Bulgaria excavated by a Polish team (Marshack 1982). Overall, however, most of the excavations in Central Europe with Western researchers were led by local archaeologists (for a full list of joint projects see Milisauskas 1986).

It would be a futile task to try to accurately estimate the participation of Palaeolithic researchers in international conferences. The aforementioned limitations (lack of funding, passport issues, etc.) most likely played a role in the accessibility of international conferences to Central European researchers. These factors would have affected early-career researchers differently compared to their more established colleagues. However, anecdotal evidence indicates that Central and Eastern European researchers did take part in international gatherings. For example, during the ninth congress of the International Union for Prehistoric and Protohistoric Sciences in Nice in 1976, at least three sessions dedicated to Palaeolithic studies were chaired by Central European archaeologists. Karel Valoch led the *Colloque VIII Les premiéres industries de l'Europe,* Bohuslav Klima the *Colloque IX Périgordien et Gravettien en Europe* while Janusz Krzysztof Kozłowski gathered many Central European archaeologists (nine out of 12 contributions) in the session *Colloque XVI L'Aurignacien en Europe* (Klima 1976; Kozłowski 1976; Valoch 1976). Also, the previous congresses took place in Central and Eastern Europe: in 1966 in Prague and in 1971 in Belgrade.

Academic impact

Paradoxically, it has been noticed that Central European archaeologists specializing in Stone Age studies are quite well-known in the West compared with their colleagues leading research in later epochs (Lozny pers. comm.). I say “paradoxically” because the number of Palaeolithic sites, the size of assemblages and the general quality of the archaeological record do not compare favourably to what is known in Western Europe (see chapter 2). Possibly as a direct result of this was the much lower number of graduates specializing in the Stone Age compared with other epochs (Lozny 2011). For later epochs, especially the Bronze Age and the Iron Age, the number of sites, the quality of the record, and the general understanding of how people lived in Central and Eastern Europe are much higher (Heather 2010). Nevertheless, archaeologists working on the later Prehistoric and medieval research were relatively less known within the international archaeological community. To test this anecdotal supposition, the H-index of Palaeolithic researchers mentioned in this paper has been obtained using the programme *Publish or Perish* (Harzing 2007). In order to provide a benchmark, which the results could be compared to, the same methodology has been applied to a large sample of Central European Iron Age researchers.

The H-index (Hirsch 2005) is a single-number measure of academic impact which takes into account both the number of papers and the number of citations to those papers (for a full overview see Bornmann and Daniel 2005; 2007). Its main advantage is that it is not biased by a small number of "high-hit" papers which can lift the indices based only on the total number of citations. It is also unaffected by a large number of rarely cited papers which would affect indices based only on the number of papers rather than their influence. The H-index therefore favours enduring performance both in terms of quality and quantity. It compares scholars relative to each other based on publications and citations recorded in Google Scholar and provides a handy proxy for assessing impact and/or recognisability in their field. It does have, however, a set of drawbacks which have to be critically assessed before more robust conclusions can be drawn. First of all, a logistic issue can occur during data collection: authors of the same name are usually lumped together giving a false result (Bornmann and Daniel 2007). To prevent this, a manual cleaning of the data has been performed. All publications used for calculation were individually checked to ensure that they all belong to the author in question. Secondly, Harzing (2008) points out several reasons for low citation metrics which may not reflect the real contribution of an individual to his or her field:

- Working in a small field (therefore generating fewer citations).
- Publishing in a language other than English - also limiting citations.

Palaeolithic Researchers	H-index
Karel Absolon	9
Boleslaw Ginter	7
Jan Fridrich	4
Bohuslav Klíma	10
Michal Kobusiewicz	8
Janusz Krzysztof Kozłowski	13
Stefan Kozłowski	9
Gábori Miklós	5
Martin Oliva	9
Ludwik Sawicki	4
Romuald Schild	22
Josef Skutil	5
Jiří Svoboda	14
Karel Valoch	14
László Vértes	11

Table 1. H-index of Central European Palaeolithic Researchers.

Average	**9.6**
Median	**9**
Standard Deviation	**4.63033476**

Iron Age Researcher	H-index
Kazimierz Bielenin	4
Anna Bitner-Wróblewska	2
Éva Bónis	3
Jaroslav Böhm	6
Miloš Čižmář	3
Jana Čižmářová	1
Sylwester Czopek	2
Petr Drda	4
Jan Filip	11
Kazimierz Godłowski	7
Eszter Istvánovits	2
Libuše Jansová	3
Fitz Jenő	9
Piotr Kaczanowski	5
Andrzej Kokowski	3
Jerzy Kmieciński	4
Valéria Kulcsár	2
Karel Ludikovský	1
Henryk Machajewski	2
Renata Madyda-Legutko	3
Magdalena Mączyńska	3
Jiří Meduna	4
Szabó Miklós	5
Karla Motyková-Šneidrová	2
Jerzy Okulicz-Kozaryn	2
Emanuel Šimek	4
Jaroslav Tejral	8
Andrea Vaday	3
Natalie Venclová	5
Jiří Waldhauser	3
Ryszard Wołągiewicz	2

Table 2. H-index of Central European Iron Age researchers.

Average	**3.806451613**
Median	**3**
Standard Deviation	**2.291912215**

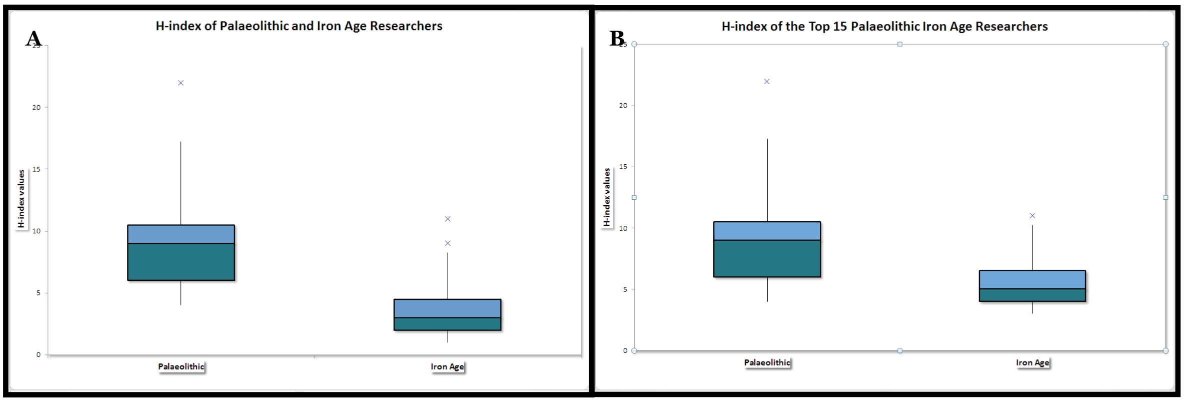

Fig. 8 Central European Palaeolithic and Iron Age researchers H-index values.

- Publishing mainly in books.

All three have an impact on the final results, however, in theory, they should affect all the Central European Palaeolithic researchers in the same way. All of them worked in the same small field (Stone Age Archaeology), none of them is a native English speaker (although see the comments below), and given their proximity in time and space (all spent their active research life in Central Europe mostly in the second part of the 20th century), their publishing behaviour (journals versus books) is likely to be similar.

Finally, the *Publish or Perish* software uses Google Scholar results which include a large corpus of monographs and therefore provides higher citation counts (i.e. has higher publication coverage) than ISI Web of Knowledge, especially for the fields of Social Sciences and Arts and Humanities which is particularly relevant in this case (Harzing 2008; Kousha and Thelwall 2008).

The results strongly confirm Lozny's intuitive observation (Table 1 and 2, Fig. 8). Compared to a test sample of Iron Age specialists, Central European Palaeolithic researchers have been quoted more extensively and their papers were more influential abroad, indicating that they had a higher direct impact (as measured by the H-index) on the discipline globally. This is not to say that researchers of other epochs produced any less impressive results – given the richness and importance of Central Europe in later prehistory this is certainly not the case. The H-index reflects the general awareness of Central European archaeology research in the West. The impact of the language of publication is clearly visible with the highest H-index recipient R. Schild, who published mostly in English, compared with the French and German publications by other authors (J.K. Kozłowski, K. Valoch). However, given that all of the remaining researchers (no matter if they studied the Palaeolithic or another epoch) did not use English as their first language, the final results are only slightly skewed.

The Matthew effect?

The identified pattern is statistically significant[12]. However, more than one factor might have contributed to this phenomenon.

First of all, the universal nature of Palaeolithic studies encourages a wide international exchange of data and ideas. Given the coarse granularity of the Palaeolithic data with its chronological error margins of thousands of years, it encourages research broad topics such as the biological, cultural and cognitive evolution of humans, the behavioural adaptation patterns, the relationship between hominids and the environment, the development of technology, hunting strategies, food processing, and social structures, this list being far from exhaustive. Regional and especially micro-regional studies so typical for later epochs are often regarded as a means to better understand the broad issues listed above rather than a goal in itself hence the research focus on global phenomena traversing modern regional and international borders.

With the wide adoption of the Bordean system (Bordes 1961) and the popularity of Clark's (1969) division of lithic technology into five modes, Palaeolithic researchers could work in a unified framework regardless of their location, bringing their data even closer together and concentrating on what is common rather than dissimilar. This encouraged comparative studies and international cooperation which would be reflected in the higher citation rates and general awareness of Central European research.

A second possible reason for the wide recognition of Central European Palaeolithic researchers was the overall popularity of Palaeolithic studies in the second half of the 20th century. "New Archaeology" had the greatest initial impact on Palaeolithic studies (Johnson 2010, 30), and Middle-range Theory and Ethnoarchaeology was developed in direct reference to the Palaeolithic record (Johnson 2010, 51). Even gender archaeology

12 The T-test was run on two sets of data: i) Palaeolithic researchers compared with a full sample of Iron Age researchers (Fig. 8a), and ii) Palaeolithic researchers compared with the top 15 Iron Age researchers (Fig. 8b). Both sets were well within the threshold for statistical significance.

seems to have used the caveman as a starting point (Johnson 2010, 125). Since the 1960s, Palaeolithic research has been at the centre of heated discussions and at the forefront of theoretical advances.

Finally, we might be dealing here with a good example of the "Matthew effect" in science. First recognized by Robert K. Merton (1968), the term refers to a passage from the Gospel of Matthew: "For to all those who have, more will be given, and they will have an abundance; but from those who have nothing, even what they have will be taken away." – Matthew 25:29.

In simple terms it can be referred to as the "rich get richer" effect. Put into the domain of academia it describes the phenomenon of more established, better-known scholars receiving more credit than their lesser-known colleagues for equal or even smaller contributions to the research (Merton 1968; 1988). Thus, they are more likely to spread their results wider and to have a higher impact on the discipline. The Matthew effect is widely recognized in all scientific disciplines (most of the research has been done on Nobel Prize winners; see Merton 1988 for a review). It could be argued, however, that Palaeolithic archaeology had an additional boost when it comes to creating a strong Matthew effect in the rarity of sites and the dearth of material to work on. For instance, in most of Central Europe the Lower Palaeolithic was for a long time largely ignored as a potential topic for research and lumped together with the Middle Palaeolithic (Milisauskas 1986, p.782). With only a few irregularly distributed Lower Palaeolithic sites there was not enough material to support but only a handful of specialists. As a result, only a limited number of archaeologists were drawn into Palaeolithic studies and those who did were exempt from the fierce competition that their colleagues working on later epochs faced.

For instance, between 1949 and 1980 only 69 graduates[13] in Poland specialized in the Palaeolithic, far behind other time periods such as the Bronze Age (170 graduates) or the Middle Ages (305 graduates) (Lozny 2011). This also meant that invitations to conferences, scientific collaboration and co-authoring would be shared within a smaller cluster of scholars creating a self-propelling positive feedback loop and strengthening the natural

13 The lowest number of graduates specialized in Historical Archaeology, which is not surprising given that until recently the topic was not commonly considered to be part of archaeology at all.

Matthew effect. A similar process regarding the publishing opportunities before and after the change of the political system in 1989 has been described previously by Milisauskas, who noted: “When only a small number of eastern European archaeologists received permission to publish in the west, the journals and publishing companies accepted their work enthusiastically. As the number of submitted articles and manuscripts increases, the selection process will be tougher.” (Milisauskas 1990, 285).

This, together with the aforementioned universal nature of the data and the high demand for Palaeolithic researchers in the second half of the 20th century, could have contributed to a better recognition of Central European researchers in the West, giving them more opportunities to collaborate, publish and spread their results in the international research community which would produce a higher H-index compared to their colleagues specializing in later epochs.

In sum, there is very little to suggest that Palaeolithic research in Central Europe during the second half of the 20th century would be unfamiliar to Western researchers. Quite the opposite, a number of important syntheses of the region were published in high impact journals and in widely available books by both local researchers (for example Kretzoi, Vértes 1965; Valoch 1968) and Western archaeologists who had a good understanding of the research in the region (for example Smith 1982; Soffer 1985).

Conclusions

At the beginning of this chapter we asked if the paucity of Palaeolithic sites in Central Europe could result from the insufficient quantity of research. We broke the issue into three components: i) was research delayed?, ii) was it not intensive enough?, and iii) was it flawed methodologically and/or theoretically? We also added the issue of limited communication between researchers on both sides of the Iron Curtain.

Out of the three components, the delay is the easiest to discount because the discipline developed in similar fashion in both Western and Central and Eastern Europe. From the mythical beginnings embedded in the Biblical interpretation of the world, to the first attempts to explain encountered objects as the works of people living in the past, to the slow emergence of archaeology as a modern, scientific discipline – archaeology in both parts of the continent went through similar stages of development at comparable time. We have shown that Central European researchers were an important part of the thriving international community of Palaeolithic archaeologists during the 19th century and the first half of the 20th century.

The remaining two hypotheses are much more difficult to assess because of their innate qualitative character. However, the picture that emerges from this short summary of Palaeolithic research undertaken in Central and Eastern Europe during the 20th century show that for the most part it was multidisciplinary, intense and of high quality. Eastern researchers were well-informed of Western methodologies. The availability of funding, stable research positions and legions of fully trained archaeologists made for good working environment and provided enough support to the researchers to conduct a high volume of fieldwork. A number of important sites has been identified and subsequently explored from the late 19th century onwards, although the fieldwork gained momentum in the second part of the 20th century.

Also, it has been repeatedly revealed that the dominating Marxist ideology had little or no effect on Central European archaeologists who predominantly steered clear of any theoretical debates and preferred to concentrate on more pragmatic tasks such as fieldwork or refining typological and chronological frameworks. Palaeolithic archaeologists were relatively safe from the dominating historical-materialist doctrine thanks to the age difference between their material and contemporary geopolitical situation. They were perhaps slightly more drawn towards theoretical issues than their colleagues working on more politically sensitive subjects. However, they worked mostly within Western theoretical frameworks such as the binfordian Middle-range theory. Marxism appeared infrequently in their publications, mostly as short mentions not relevant to the discussed topics and giving the impression of being an imposed quota of citations from the Marxist classics (see for example Ginter ans Kozłowski 1969, 8). In their daily methodology, Stone Age researchers also used Western schemes such as De Mortillet's system in the first half of the 20th century or Bordean typology list in the second half, but they critically adapted them to local assemblages often creating original regional frameworks.

Finally, the view of Central European researchers living in isolation is equally hard to support. Anecdotal evidence (Begun 2005; Frayer 2005), the international joint missions, publications in Western journals, conference attendance, and multiple citations of Western literature all indicate that Central European researchers were an integral part of the archaeological community despite institutionalized difficulties to contact the West. They had enough opportunities to disseminate their findings effectively. Furthermore, the H-index analysis shows that Central European Palaeolithic researchers were better-known abroad than their colleagues representing later epochs, perhaps at least partially because of their limited numbers.

Dispersal routes

Dispersal routes into new land have a potential to shape the pattern of population density on the meso- and macro- scales. To give a simple analogy, by the time the Neolithic wave reached the British Isles it was almost Bronze Age in south-eastern Europe, hence one would expect to find more Neolithic (and especially early Neolithic) sites in modern day Bulgaria than in Scotland. Thus, if the first wave of dispersal into Europe came from the west, it might be that by the time it reached Central and Eastern Europe the Middle Palaeolithic was already lurking round the corner. This argument, although not stated so explicitly, was raised several times to explain the pattern of spatial distribution of European Lower Palaeolithic sites (Bar-Yosef and Belfer-Cohen 2011; Doronichev 2011; Martos 1994; Moncel 2010; Rolland 1995, 1998; Tourloukis 2010). This chapter aims to critically evaluate this argument through an agent-based simulation exploring a range of possible dispersal routes from Africa into Europe.

Geographically, Europe can be considered a large Asian peninsula. It is mostly surrounded by substantial water bodies which, to the best of our knowledge regarding Palaeolithic seafaring (Bednarik 1999), would constitute significant barriers for the Early and Middle Pleistocene hominid dispersals. That leaves us with four to five possible routes into Europe (Fig. 9) (Harvati et al. 2008; Rolland 1995, 1998; Sánchez 2006; Tourloukis 2010; Villa 2001).

- **From the south-east**

The southern route via Turkey and the Bosporus crosses through the Balkan Peninsula following the direction of south-north orientated rivers and then the Danube corridor (Harvati et al. 2008; Rolland 1995; Sánchez 2006).

- **From the east**

There are two possible routes from the east, both taking advantage of the large expanses of steppe environment over the East European Plain. The southern one leads through the Caucasus along the eastern stretch of the Black Sea coast or the western coast of the Caspian Sea straight onto the Ukrainian plains. The second one, coming from Central Asia, involves

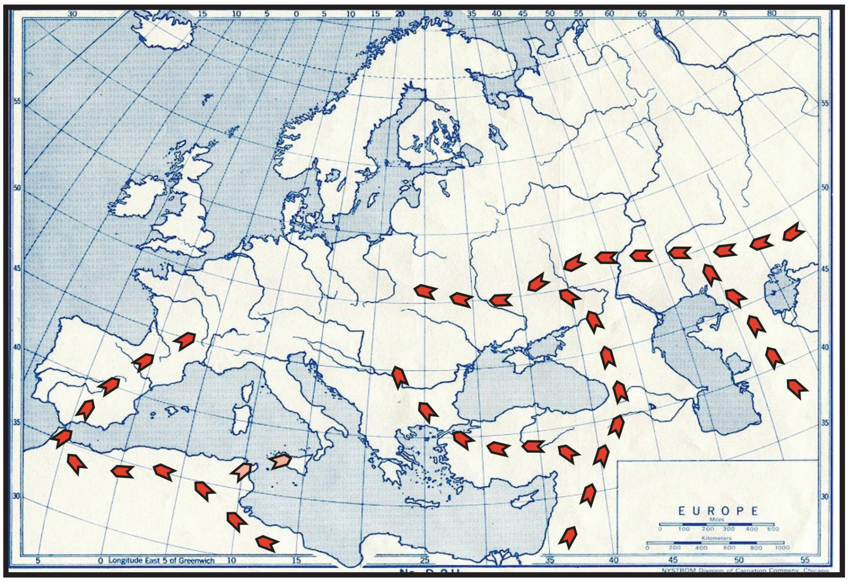

Fig. 9 Dispersal routes into Europe.

crossing the southern edge of the Ural Mountains, north of the Aral Sea and along the northern coasts of the Caspian Sea again onto the Ukrainian plains (Rolland 1995; Sánchez 2006). The eastern dispersal routes fall within a single biogeographical region which R. Dennell and W. Roebroeks (2005) termed 'Savannahstan'. Environmentally savannahstan is very similar to East Africa (large stretches of grassland with a mosaic pattern of the distribution of resources) and so did not require a radical change in adaptive strategies of the early hominids. Hence, the East European Plain and the Danube could easily act as fast-track dispersal corridors.

- **From the west via Gibraltar or, less likely, Sicily**

The western routes involve crossing more or less significant stretches of water which, in turn, implies certain cognitive capabilities indispensable even for the most rudimentary seafaring. For that reason the western direction of dispersal has been intensely debated (Bednarik 1999; de los Terreros 2000; Derricourt 2005). The current consensus seems to be that the Gibraltar route is plausible while the Sicily route is not (Villa 2001). However, some authors (Carbonell and Rodriguez 2006) pointed out the lack of animal migration via Gibraltar at that time which may be a good indicator of the relative difficulty of the crossing. They suggested that the pattern of early site distribution along the perimeter of the Mediterranean Sea is a reflection of the environmental conditions that early Europeans were happy to cope with rather than a genuine pattern of human dispersal coming from the southwest (Carbonell and Rodriguez 2006).

Why Modelling?

The current methodology in archaeology for the study of the first dispersal is largely based on qualitative considerations where common sense arguments are being thrown back and forth without quantitative validation or making sure that the assumptions are explicitly presented (for example Bar-Yosef and Belfer-Cohen 2001; Carabonell et al. 2010; Derricourt 2006; Moncel 2010; Palombo 2012 among many others). I believe that the discussion should be complemented with more quantitative approaches.

Simulation and geographical analysis are probably the only two quantitative approaches that have already been applied to this issue (Field et al. 2007; Holmes 2007; Mithen and Reeds 2002; Nikita and Nikitas 2005). However, geographical analysis can only incorporate a limited number of data types and has limitations for analysing a dynamic process such as dispersal. I would argue that, although geographical analysis is crucial for any study of dispersals, a combination of geographical and simulation approaches would be more fruitful as it would allow for an integration and confrontation of different types of information to validate the model.

Previous attempts to use modelling for human dispersal studies – for example, the 'Stepping out' model (Hughes et al. 2007; Mithen and Reeds 2002; Nikita and Nikitas 2005) – had very little impact on the academic community and focused largely on determining the likely arrival date of hominids at a given location.

In contrast, the model developed by the author is aimed at the following very specific research questions:

- Could the expansion into Central and Eastern Europe be delayed due to the relief/climate/vegetation cover affecting the dispersal routes?
- Are there any routes that would not promote dispersal through Central and Eastern Europe?
- Could climatic conditions prevent humans from populating Central and Eastern Europe?
- Does the pattern of Lower Palaeolithic site distribution reflect the dispersal routes of the first "Out of Africa"?

Agent Based Modelling (ABM) – modelling as a controlled environment lab

Agent Based Modelling (ABM) is a computational technique widely used in complexity science (Lewin 2000; Mitchell 2009). Contrary to equation-based modelling (EBM) where the modelled individuals are assumed to be homogenous and well mixed, it uses individual software entities (called agents) which can interact with the environment and with each other (Kowarik et al. 2008; Nguyen 2010; Parunak et al. 1998). ABM has been used in archaeology for over a decade. One of the first applications of ABM – the iconic model of the rise and collapse of Anasazi, a Native American culture (Axtell et al. 2002; Dean et al. 2000, but see Janssen 2009) led to the development of a new branch of complexity science - Artificial Societies. A number of applications soon followed including Bentley et al. 2005; Graham 2006; Graham and Steiner 2008; Griffin and Stanish 2007; Kohler and Gumerman 2000; Kowarik et al. 2010; Lake 2001; Mesoudi and O'Brien 2008; Premo 2006 (for a full overview see Kohler 2012).

ABM provides a unique platform for testing large scale hypotheses (Axtell et al. 2002; Epstein 2008; Macal and North 2010). It is particularly effective when dealing with the concept of movement, be it human expansion into new lands, cultural transmission over vast distances or animal migration (Castle and Crooks 2006; Steele 2009). The strengths of the ABM methodology become apparent during virtually every stage of constructing, testing and validating a scientific hypothesis. These strengths include (after Epstein 2007; 2008; Premo 2006):

1. Approaching the research issue:

- It allows to conduct "controlled, repeatable experiments within the context of «behavioural laboratories»" (Premo 2006, 92);
- It is independent of data produced by empirical observations;
- It encourages researchers to put all the model's assumptions on the table, even the most (supposedly) obvious ones;

2. Creating a dataset:

- Agent-based modelling is unique in its ability to integrate spatial data as a distinct entity which the agents can interact with;
- It enables researchers to reduce the world into easy-to-deal-with chunks in search of

large scale patterns and more fundamental rules governing the processes;

• It allows for the creation of abstract models which are then validated against real-world datasets;

• Its use of individual agents rather than a homogenous entity representing the entire population allows for more sophisticated and diverse modelling of the agent behaviour;

3. Interpreting results:

• The technique can highlight inconsistencies in the initial hypothesis;

• It allows to build models independent from the data, thus creating a virtual benchmark of how the data would be expected to look like;

• Finally, **it helps "to eliminate plausible scenarios that are nevertheless unlikely to have occurred"** (Premo 2006, 108);

SHEEP (Simulating Hominid Expansion in the Early Pleistocene)

The strengths of ABM introduced in the previous section make this method highly suitable for addressing the issue this chapter is concerned with. In this section the model (SHEEP) created by the author to quantitatively assess this issue and the decision-making process that led to its creation are described in detail. The model was created and run using the ABM software platform NetLogo (Railsback and Grimm 2011; Wilensky 1999). The code of this model is included in appendix 2.

Climate, relief and vegetation distribution are often quoted as crucial factors influencing large-scale human movement (King and Bailey 2006; Rolland 1998; van der Made 20011). This notion is particularly relevant for the first 'Out of Africa' dispersal (ca. 1.8 Ma) as it has been argued that this dispersal should be regarded as a home-range expansion of a large land mammalian species rather than a socially-driven human invasion of new territories (Holmes 2007 and references therein). The SHEEP model aims to use this deterministic climate/relief approach to evaluate potential routes into Europe and their impact on the pattern of site distribution on the continent.

In order to simulate dispersal one has to model three elements (Steele 2009): 1) population growth, 2) spatial spreading process and 3) the terrain.

1. Population growth:

The agents in this model reproduce according to two variables: 'Fertility' and 'Mortality'. Their values were generated from averaged fertility rates of modern hunter gatherers (Pennington 2001) recalculated to show 'chance of producing a child in a given year' (rather than the real fertility rate which describes an average number of children per female) and doubled to speed up the simulation.

2. Terrain:

The map (Fig. 10) was generated as a raster (x, y and vegetation values) map approximated from several data sources: Pliocene Research Interpretation and Synoptic Mapping project (PRISM 2) (Holmes 2007; van der Made and Mateos 2010), and the global vegetation model BIOME4 (Hughes et al. 2007). The following colours were used to represent differences in the vegetation cover.

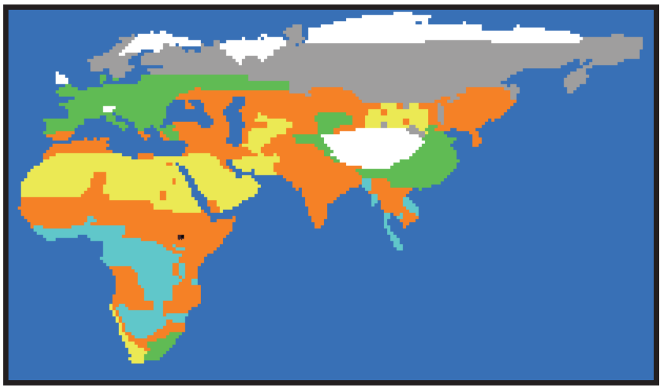

Fig. 10 The SHEEP model map of Early Pleistocene vegetation.

- Orange: steppe/savannah/grassland
- Yellow: dessert
- Light blue and green: forest
- White: polar or mountain glacial
- Grey: tundra
- Blue: water

3. Spatial spreading process

Dispersal rates for each type of vegetation cover are informed in the current understanding of the hominid adaptations to environment (Dennell 2003). Different vegetation types allow the agents to expand within different radiuses, i.e. quicker or slower depending on the environment. When on the Steppe/savannah/grassland patches[14] the agents can move by up to 5 steps, Forest by up to 2 steps, Dessert by 1 step and the remaining types by 0 patches.

In addition to these three elements the following rules were enforced in the model:

- **Starting Point and the Stop Condition**

The starting point is located in Eastern Africa. The model stops when an agent appears on one of the 'stopping patches' i.e. patch 23 85 (Southern France) or on the patch 36 93 (Northern Germany). In the results of each simulation this allows to determine whether the simulated dispersal happened from the west or from the east.

- **Agents**

Each agent represents a Boolean value (yes/no) of 'human presence' regardless if it is past or present. They do not represent individuals or human groups. Each new generation changes colour by a tone to visualize the expansion.

Testing the hypothesis

In order to test the hypothesis the model was iterated ten times for each of the following alternative scenarios: a) all dispersal routes into Europe are available for hominids (Fig. 11); b) the Balkan route is blocked out (Fig. 12); c) the Eastern route via the Caucasus is blocked out (Fig. 13); d) both Eastern routes are blocked out (Fig. 14); e) the Gibraltar route is blocked out (Fig. 15); f) both southern routes are blocked out (Fig. 16).

The SHEEP model uses a relative time scale, i.e. it does not generate exact arrival dates (such as in Mithen and Reed 2002 or Nikita and Nikitas 2005) but explores the question of how the availability of various dispersal routes into

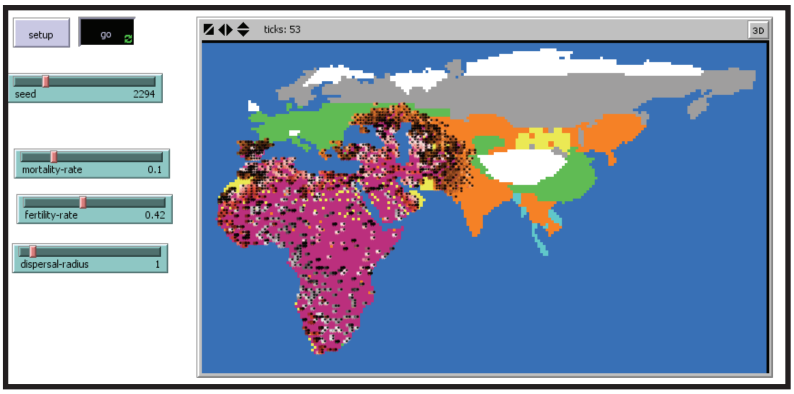

Fig. 11 The SHEEP model. All dispersal routes into Europe are available for hominids

14 In Netlogo jargon a patch is a pixel on the model world with an exact location determined by X and Y coordinates.

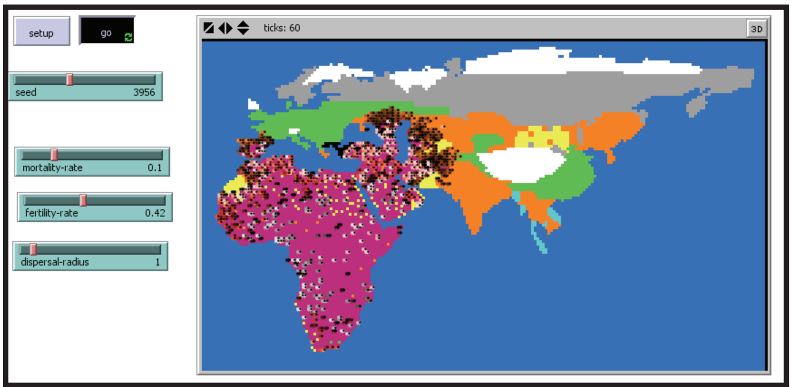

Fig. 12 The SHEEP model: The Balkan route blocked out.

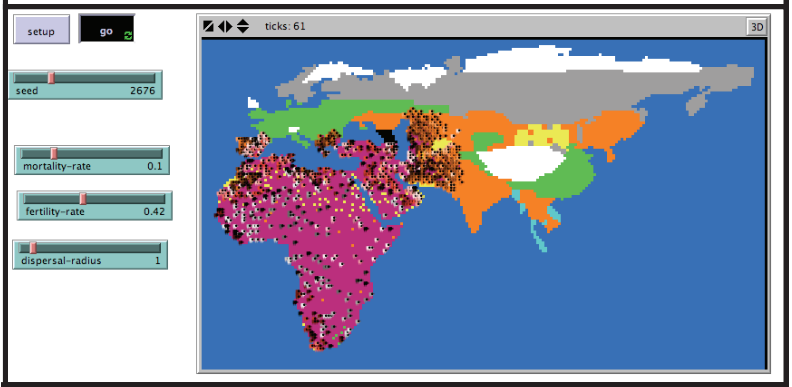

Fig. 13 The SHEEP model: the Eastern route via the Caucasus blocked out.

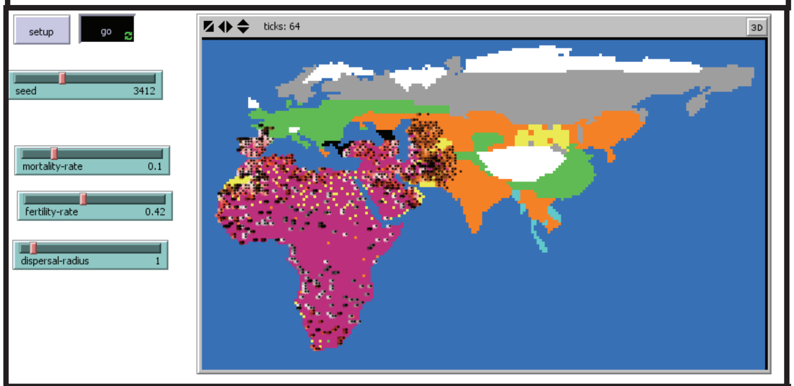

Fig. 14 The SHEEP model: both Eastern routes blocked out .

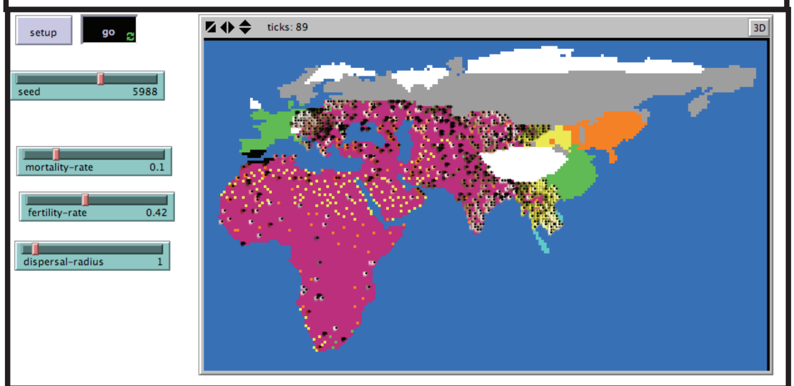

Fig. 15 The SHEEP model: the Gibraltar route blocked out.

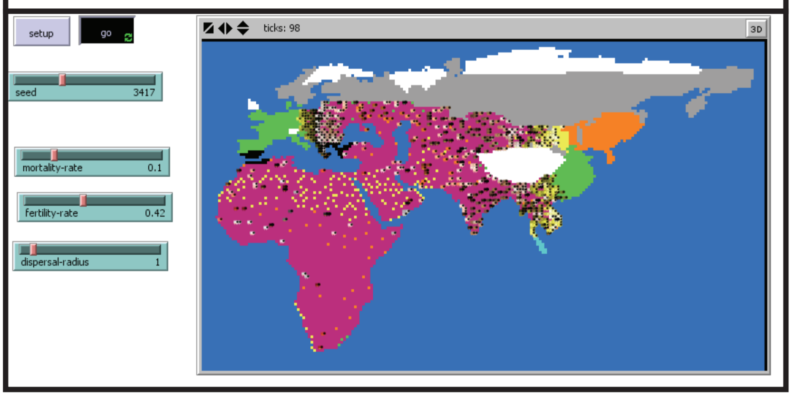

Fig. 16. The SHEEP model: both southern routes blocked out.

Europe affects the rate of dispersal into different parts of Europe.

Each time an agent appears on one of the 'stopping patches' the simulation stops and an image with the location of agents is generated. When interpreting this output particular attention was paid to how far the agents have dispersed into Europe and on which side of Europe the dispersal advanced most. This procedure allows one to assess for each scenario (i.e. different configurations of blocked and open routes) to what extent hominid's potential chance of reaching the central and eastern part of the continent was affected by the availability of certain routes.

Results

This model shows that under the conditions described above the dispersal into Central and Eastern Europe could not be affected by the dispersal routes to such an extent that no occupation at all occurred during the Lower Palaeolithic (Figs 11 to 16). If all the possible routes were passable, the expansion into Ukraine and further would happen at a similar time as the peopling of Spain and southern France (Fig. 11). A similar pattern occurs if one of the eastern routes is blocked out – the agents reach modern day Ukraine or the Balkans at the same time as they reach Spain and Southern France (Figs 12 and 13). Thus the null hypothesis (i.e. that the spatial distribution of known Early and Middle Pleistocene sites in Europe is a result of a particular configuration of dispersal routes) can be rejected.

As a by-product of the model several unanticipated patterns emerged:

- If the Gibraltar route was not available for dispersal, the final pattern closely resembles the archaeological record, showing a quick spread of hominids into the southern and south-eastern part of Asia (Dennell 2004; Swisher et al. 1994) and a substantial delay in the appearance of hominids in Europe (Fig. 15). Evidently, in this scenario Central and Eastern Europe would be occupied first, ahead of Western Europe.
- In almost all cases, Eastern Europe (and especially the Ukrainian steppes) is peopled before the Balkans. However, if the route via Turkey and the Balkans is the only eastern route available the expansion from the west is in 60% of cases quicker than from the east

(Fig. 13).

• In general, if the Gibraltar route is open the peopling of Europe is much quicker than if the expansion is coming via Asia (Figs 11 to 14).

However, it has to be noted that the observed patterns are very sensitive to small changes in the vegetation distribution. This highlights the need for more fine-grained palaeoenvironmental mapping if the results were to be considered robust. Alternatively, generating a 'confidence map' showing areas of better/worse quality of palaeoenvironmental data and combining it with Bayesian methods may be another solution (see for example Holmes 2007). This is sadly outside the scope of the current project.

This chapter provided a quantitative evaluation of the argument that the pattern of European Lower Palaeolithic site distribution is caused by dispersal routes through a simulation approach with few but explicitly stated assumptions and rules. The results stress that it is highly unlikely that dispersal routes caused this pattern and we should therefore turn our attention to other more likely hypotheses. The following chapter discusses the effects climate might have had on the creation of this pattern.

Climate

Climate and climate change have been one of the most significant factors impacting hominids during the early and middle Pleistocene (Stanley 1992) and large-scale human movement in particular (Holmes 2007; Trauth et al. 2005). A similar argument has been proposed to explain the pattern under examination here (Hopkinson 2007). It is therefore worth addressing environmental adaptations as a possible prime cause of a phenomenon (indeed, it is common practice to do so, e.g. de la Torre and Mora 2009) before approaching more complex explanations of observed patterns. Thus, the aim of this chapter is to evaluate if the differences in climate and topography might have caused the observed pattern of Lower Palaeolithic site distribution in Europe. In order to do so, two lines of enquiry will be pursued: i) the environmental diversity of Pleistocene Europe, and ii) the adaptability of hominids to different environmental conditions.

Pleistocene Europe

Topographically, Central and Eastern Europe share a number of landforms with Western Europe. The Great European Plain continues far beyond the Rhine and constitutes a large part of Germany, France and the British Isles. This plain was even more pronounced when the Southern North Sea/Doggerland landmass was not yet submerged (fig. 17) (Hijma et al. 2012). Given the preference of Pleistocene hominids for open landscapes and grasslands (Dennell 2003) this landform is of particular significance. Also, the Mediterranean zone

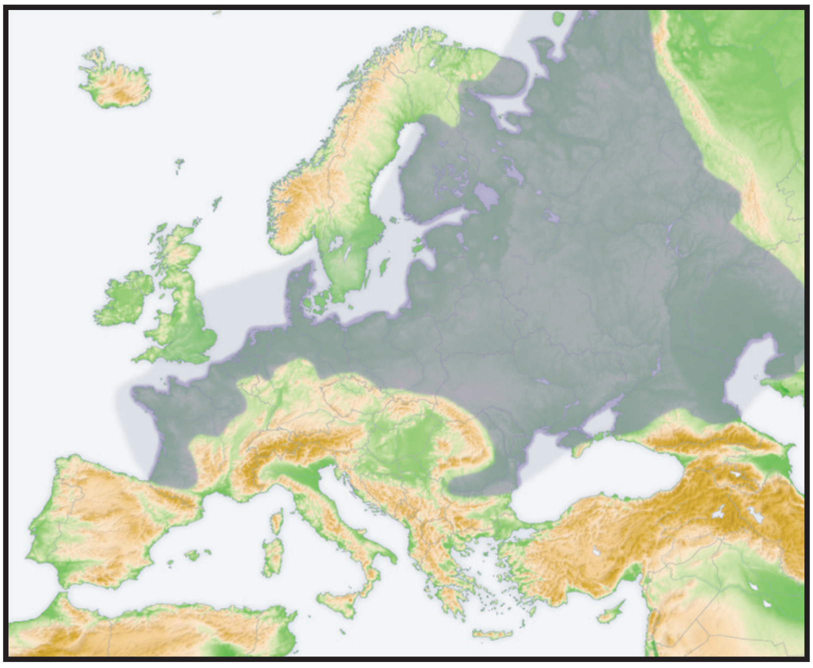

Fig. 17 The extent of the Great European Plain. (Source: http://en.wikipedia.org/wiki/File:European_plain.png)

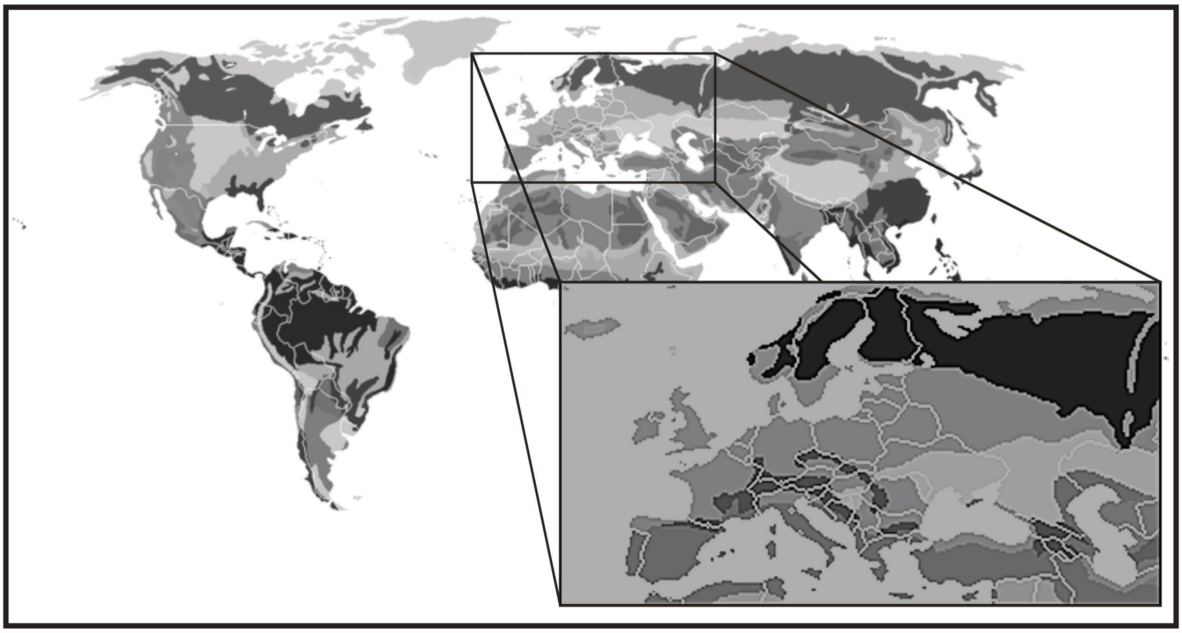

Fig. 18 Modern day biozones. (Source: en.wikipedia.org/wiki.File:Vegetation_Europe.png Modified)

continues from east to west along the coasts of Italy, France and Spain. The environment of the Carpathians is fairly similar to that of most European mountain chains, including the Alps, the Pyrenees and the Massive Central.

The modern-day biozones in Europe follow a latitudinal distribution (i.e. they stretch from east to west) (Fig. 18). In simple terms, the further away from the poles the warmer it becomes. This pattern to some extent overlaps with the oceanic versus continental gradient gradually changing from west to east. Hence, cold winters and warm summers in the Ukraine and 'one season' weather all year round in the British Isles or Northern France (Leroy et al. 2011; Vandenberghe et al. 2006). Nevertheless, the overall climate of most of the continent (apart from its northernmost fringes) belongs to the North Temperate Zone with only three dominant climate types: oceanic, Mediterranean and continental (Fig. 18). This is thanks to the East-West orientation of the Alps and the absence of other similar climate barriers which enables the winds blowing from the Atlantic Ocean to stabilize the inland temperature further east (Vandenberghe et al. 2006).

There exist no Global Circulation Models of good resolution for the Early and Middle Pleistocene, although on the basis of available evidence one can assume that the European climate was not vastly different during the Pleistocene from what it is now (Hughes et al. 2007; Leroy et al. 2011, fig. 5 & 7; Mania 2004; Vandenberghe et al. 2006; van der Made

Site	Local Environment	References
Mauer, Baden-Württemberg, Germany	warm, temperate; open	Wagner et al. 2011
Ariendorf I, Rhineland-Pflanz, Germany	cool, dry; open	Turner 1998
Bizlingsleben, Germany	temperate; open	Auguste et al. 2000
Schöningen, Lower Saxony, Germany	cool, temperate; forrest steppe	Thieme 2005
Wallendorf, Sachsen-Anhalt, Germany	cool; open	Weber 2004
Rusko, Lower Silesia, Poland	warm; forrest changing to cool, dry; open	Burdukiewicz et al. 1996
Trzebnica, Lower Silesia, Poland	warm, mosaic	Burdukiewicz 2006
Vértesszőlős, Komárom-Esztergom, Hungary	temperate, humid; mosaic	Kretzoi 1990; Skoflek 1990
Korolevo, Transcarpatian Ukraine	warm; cool, temperate, open	Adamenko and Gladiline 1989
Račiněves, Czech Republic	unknown	
Medzhybozh, Ukraine	warm; open	Rekovets 2007
Stránská Skála, Moravia, Czech Republic	temperate, humid to dry, steppe; open	Svoboda, Bar-Yosef 2003
Treugol'naya cave, Georgia	cool,dry; warm, humid; cool, humid	Doronichev 2000
Kozarnika, Bulgaria	temperate, mosaic	Guadelli et al. 2005
Dmanisi, Kvemo-Kartli, Georgia	warm-temperate, mosaic	Gabunia et al. 2000
Malyj Rakovets, Ukraine	unknown	
Rodniki, Ukraine	beach	Shchelinsky 2010
Bogatyri/Sinyaya Balka, Ukraine	forest-steppe	Shchelinsky 2010

Table 3. The environment recorded at Central and Eastern European sites.

and Mateos 2010). The repetitive cycle of glacial onset, expansion and subsequent retreat dominated the European climate during the Pleistocene, forcing the biozones to move south or north, but largely preserving their latitudinal pattern. The interglacial climatic conditions caused the deciduous forest to expand over most of the continent, often even including the southernmost areas. The onset of glacial, on the other hand, triggered changes to more open and steppe like landscapes (Adams 1997; Adams and Faure 1997; Leroy et al. 2011; Mania 2004). All of these processes would affect both Western and Central and Eastern Europe in a similar way and most of the current reconstructions of the temperature, precipitation or vegetation during the Pleistocene do not show any dramatic differences between the east and the west of the continent (Holmes 2007; Hughes et al 2007; van der Made and Mateos 2010).

It has been suggested that the oceanic/continental gradient may be responsible for a lack of human presence during the Early and Middle Pleistocene in Central and Eastern Europe (Hopkinson 2007). However, the environmental data coming from the known Central and Eastern European sites (Table 3) as well as environmental models (Leroy et al. 2011) do not indicate that this difference was pronounced enough to prevent a peopling of the region. The mammalian fauna indicates that South-eastern Europe could offer hominids favourable environmental conditions at all times whereas Central and Eastern Europe from 1.2 Ma onwards showed prolonged periods of decreased continentality, hence encouraging dispersal into the region (Kahlke et al. 2011).

Due to the increased continentality, open and forest-steppe habitats in Central and

Eastern Europe lasted existed longer than in the Western part of the continent (Kahlke et al. 2011). Given that these are habitats to be preferred, providing favourable conditions for hominid survival (Leroy et al. 2011), one would expect higher population densities in the region. It is difficult, however, to assess if high seasonality could outweigh the benefits of these open landscapes.

Hominid adaptation patterns

The exact range of climatic conditions that hominids were adapted to at a given time is a highly debatable topic (see for example Roebroeks et al. 1992). The 45° parallel seems to be a substantial barrier for the early peopling of Europe between 1.6 and 1.2 Ma (Rodríguez et al. 2011) limiting human occupation to the Mediterranean zone (which does include south-eastern Europe). However, after 500 ka more than intermittent hominid occupation reached Northern Europe as well. The environmental reconstructions of a number of Lower and Middle Pleistocene sites (for example Ariendorf or Happisburgh (Coope 2006; Turner 1998)) show hominids coping with very diverse climatic conditions including dry and cold (see Table 4) (Kahlke et al. 2011).

Technological prostheses such as fire, clothing or shelters could significantly enhance the ability to survive in diverse environments, allowing hominids to occupy a wider range of habitats. Early traces of fire and structured hearths are highly controversial, although from 400 ka onwards there is good evidence for habitual use of fire (de Lumley 2006; Roebroeks and Villa 2011) which would further improve the adaptability to harsher environments. Clothing and dwelling structures are more difficult to detect in the archaeological record and hence the timing of their first appearance in Europe is controversial (Kolen 1999; Otte 2012).

In conclusion, there is some potential for climate and particularly the oceanic/ continental gradient to explain some of the variation in the spatial distribution of Lower Palaeolithic sites in Europe. However, at the moment most of the discussion is based on speculations ranging from the estimations of the climatic range hominids could cope with, their technological adaptations or preference for certain habitats. Furthermore, the palaeoenvironmental record for that time period is patchy at best, and it is common to extrapolate widely spaced datasets or data coming from much more recent time periods (Kahlke et al. 2011; Leroy et al. 2011; Rodríguez et al. 2011).

Finally, if the increase of continentality was to fully explain the dichotomy in the distribution of Lower Palaeolithic sites between east and west we would expect a gradual decrease in the number of sites from west to east rather than a currently observed sudden change in site density not corresponding with any particular landform. Therefore the climate hypothesis falls short from being able to account for the robustness of the currently observed pattern. More research in this direction may be able to provide enough evidence in the future to support or refute this model.

The Loess Hypothesis

All of the discussed hypotheses (History of Research, Dispersal Routes, and Climate) fail to convincingly explain the spatial pattern of site distribution in Lower Palaeolithic Europe. Some of the aforementioned factors did not play any role in the creation of the pattern we observe (such as the history of research), others may have had some impact on human settlement and the distribution of sites (like the climate) but none of them is strong enough to generate a pattern as robust as the one observed. Thus, a new alternative is needed to explain the phenomenon of the low density of Lower Palaeolithic sites in Central and Eastern Europe. The latest developments in geological mapping of the region and advances in our understanding of taphonomical processes affecting the Pleistocene record may bring the answer.

Loess formation

One of the major characteristics of the landscape in Central and Eastern Europe is a thick loess mantel (Zeuner 1935). Loess is commonly defined as well-sorted eolian sediment consisting for 60-90% of silt (50-2µm-diameter particles) (Davies 1972; French 2007; Muhs 2007). Its formation is closely associated with the palaeoclimatic cycles and follows a recurring pattern throughout the Pleistocene:

1. Glacial grinding produces large quantities of fine sediments which are then deposited with meltwater.

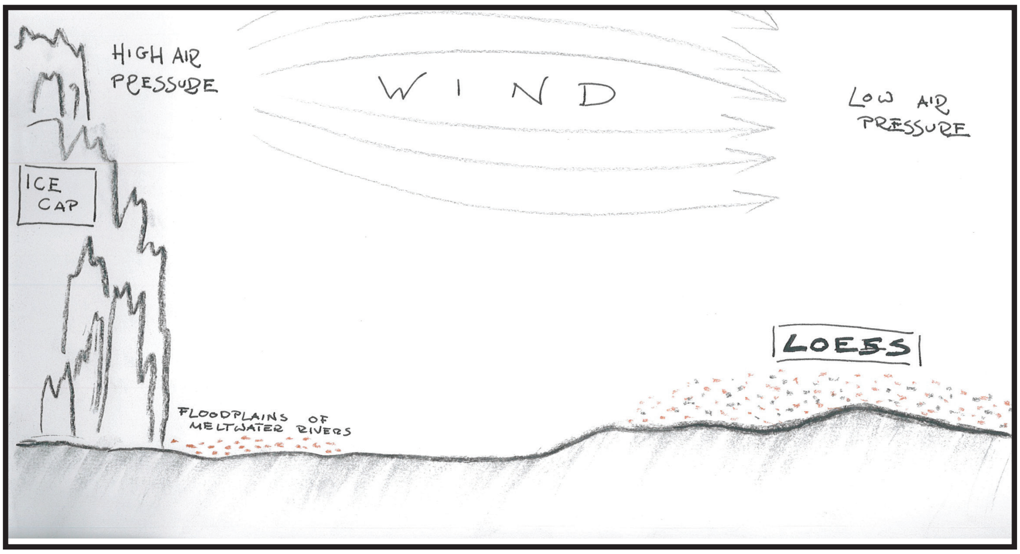

Fig. 19 Loess Formation Process.

2. Periglacial conditions at the margins of ice sheets result in high air pressure systems forming over them which in turn generate katabic winds blowing steadily outwards.

3. These cause the deflation of large quantities of fine grained silty material derived from the large outwash plains at the margins of the retreating glacial front and braided channel systems,

4. which is then deposited in front of the retreating glacial (Fig. 19).

Since deflation is most intense when not constrained by vegetation this process is believed to be almost exclusive to the full glacial steppe-like conditions. As a result, a thick coat of loess interstratified with thinner layers of interglacial soils forms a continuous sequence of glacial/interglacial sediments marking subsequent palaeoclimatic cycles of every Pleistocene glacial/interglacial period (Davies 1972; Muhs 2007; Rousseau et al. 2007).

The highest rates of loess deposition have been recorded during the Middle Pleistocene probably forced by more pronounced long palaeoclimatic cycles which dominated the global climate after the Matuyama/Brunhes reversal approximately 780 kya (Dodonov et al. 2006). Loess deposition occurred during each and every one of the major glacial events, although the rate of sediment deposition, the number of interstratified interglacial soils, the thickness of layers and the erosion rates varies significantly between microregions and depends on local conditions and relief. Geologists are still far from establishing an interregional framework which will allow for correlation between loess sequences in different parts of the world (Boguckyj et al. 2009; Dodonov et al. 2006), however recent years saw substantial progress in this field (see for instance Gibbard and Cohen 2008).

Loess extent

Loess, being a common mid-latitude phenomenon, occurs throughout Europe between 40° and 60° parallel north (Muhs 2007). However, for reasons not entirely understood yet (Jary 2009; Smalley et al. 2009), its thickest form is observed in Central and Eastern Europe where it is also reaching its widest uninterrupted extent (Fig. 20) (Haase et al. 2007;

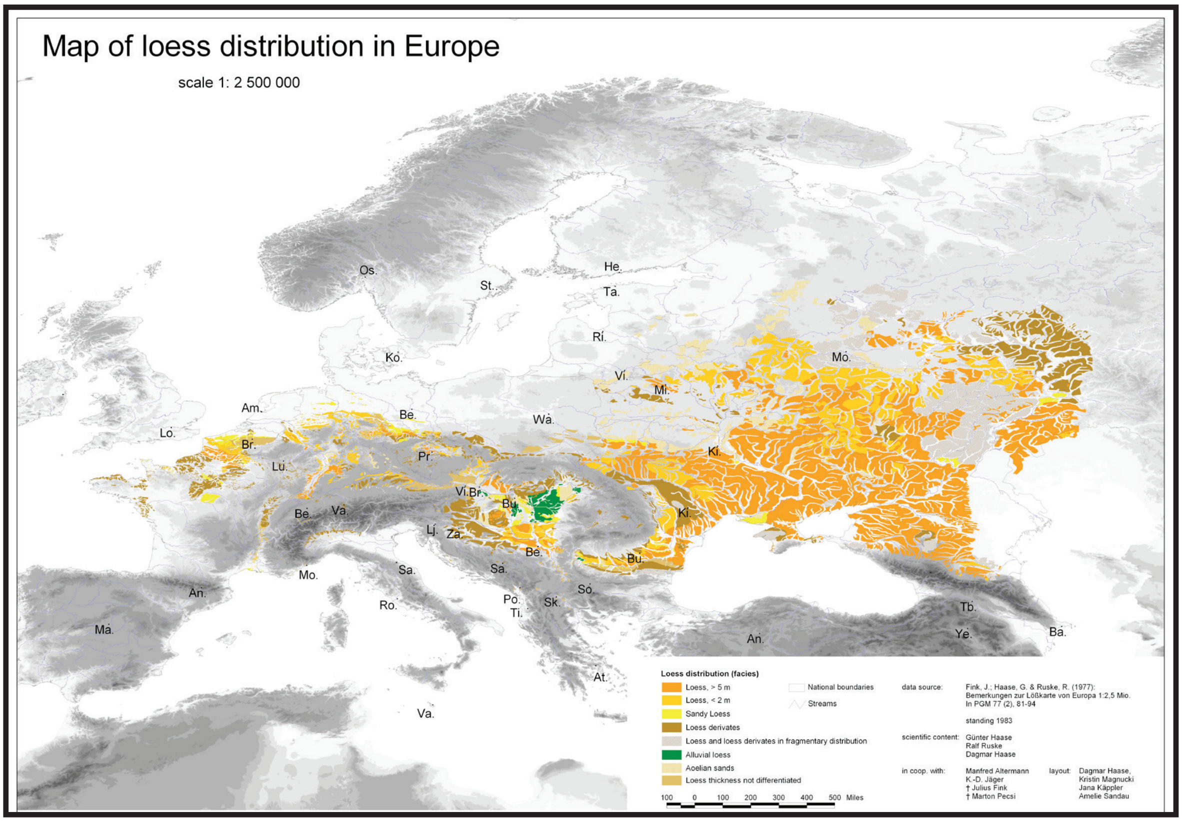

Fig. 20 Loess distribution map after: (Haase et al. 2007)(Reproduced with permission of the authors).

Rousseau et al. 2007). A good example of this is the Ukraine where 70% of all territory is classified as flat land (plains) almost completely covered with loess (Bokhorst et al. 2009). Due to the flat morphology of the region the loess cover is evenly spread out and can attain a substantial thickness exceeding 5 metres on average but in places reaching over 50 metres in depth. A similar situation occurs in other areas in the region. For instance, in the Pannonian and Dacian Basins (Bulgaria and Romania) loess cover was recorded over large areas reaching in places considerable depth of tens of metres. A few boreholes in Northern Bulgaria provided loess sequences over 100 metres deep (Dodonov et al. 2006). Overall, the loess mantel effectively covers Central and Eastern and South-Eastern Europe with a steady uninterrupted sediment layer on average more than 5 metres thick (Haase et al. 2007, fig.9) (Fig. 20).

Implications

Since loess and loess derived sediments are deposited in front of the ice sheet margins (Davies 1972; Muhs 2007) everything north of its currently known extent must have been subjected to the damaging force of the retreating glacial which effectively destroys all traces of human activity. Everything south of the ice sheet front was covered by between 5 to 50 metres, and in some cases 100 metres, of stone-hard eolian sediments, which for the construction industry are treated as bedrock. This means that the interglacial soils bearing potential for Lower Palaeolithic finds sandwiched between the loess sediments are never disturbed by agricultural activities and erosion, and very rarely exposed for development purposes. As a result most of the Lower Palaeolithic sites in Central and Eastern Europe may be buried deep underground.

It is worth stressing the potential that this deeply buried record has for Palaeolithic Archaeology. As much as the loess hides traces of the past it also preserves them and their contexts really well. Z. Jary (2009, 124) neatly puts it: 'Nowadays there is no doubt that stratigraphic loess–palaeosol sequences represent one of the most complete, climate-controlled, terrestrial records of interglacial–glacial cycles'. This context is easily datable using the Thermoluminescence method (Berger et al. 1992). On a smaller scale quick loess deposition can often preserve flint scatters *in situ* or at least significantly limit the post-depositional disturbance (Händel et al. 2009). Hence Central and Eastern Europe holds a high potential for Lower Palaeolithic artefacts conserved *in situ* within an extensive and well understood environmental and chronological context.

Testing the hypothesis

Testability of new hypotheses is one of the cornerstones of modern science. Probably the ideal methodology to test the loess hypothesis would involve stripping large areas of loess in Central Ukraine and recording in detail all the sites found in the process. However, this may prove a bit problematic logistically. Therefore a different strategy, based on currently available data, was designed in an attempt to validate the model.

A simple compilation of all currently known sites in Central and Eastern Europe dated to the Lower Palaeolithic with their immediate topographical location revealed some indicative results (Table 4). Out of 18 sites 11 are located in quarries (i.e. were found in levels situated several metres underground) and 3 in the sheltered environment of caves. If the more controversial sites are included the proportions change to about 40% of sites situated

Site	Quarry	Cave	Other
Mauer, Baden-Württemberg, Germany	X		
Ariendorf I, Rhineland-Pflanz, Germany	X		
Bizlingsleben, Germany	X		
Schöningen, Lower Saxony, Germany	X		
Wallendorf, Sachsen-Anhalt, Germany	X		
Rusko, Lower Silesia, Poland	X		
Trzebnica, Lower Silesia, Poland	X		
Vértesszőlős, Komárom-Esztergom, Hungary	X		
Korolevo, Transcarpatian Ukraine	X		
Račiněves, Czech Republic	X		
Medzhybozh, Ukraine	X		
Stránská Skála, Moravia, Czech Republic		X	
Treugol'naya cave, Georgia		X	
Kozarnika, Bulgaria		X	
Dmanisi, Kvemo-Kartli, Georgia			Erosional Spur
Malyj Rakovets, Ukraine			Volcanic Ridge
Rodniki, Ukraine			Ancient Beach
Bogatyri/Sinyaya Balka, Ukraine			Dislocated Site

Table 4. The immediate topographical situation of Lower Palaeolithic sites in Central and Eastern Europe

in quarries and about 30% in caves. In both cases this constitutes the vast majority of sites, which means that only a fraction of all the sites are being found close to the present ground level[15]. The rarity of sites and find spots located within large ancient river terraces is another phenomenon in which Central and Eastern Europe differs from the pattern common in Western Europe. Contrary to sands and gravels often associated with fluvial sequences loess has no commercial value except for developing into highly fertile soils perfect for non-invasive agriculture and therefore is rarely subjected to quarrying activity. It should be also noted that the rarity of cave sites is probably directly related to the lack of caves in general, as they are not a common topographic feature in Central and Eastern Europe and are mostly restricted to a few spots within the Carpathians such as the Moravian Karst.

The conclusion of this analysis is that almost all currently known Lower Palaeolithic sites in Central and Eastern Europe have been found either during industrial activities that went down to depths of several (or more) metres under the present ground level before reaching the artefact bearing soils or were recorded inside caves where only limited loess deposition could occur. As much as this does not constitute an evidence for the presence of Lower Palaeolithic sites in the region, these results are highly indicative and correspond to the pattern predicted by the Loess hypothesis.

15 In fact all of them have rather unusual locations, for example Dmanisi is situated in high mountains.

Conclusions

The aim of this thesis was to critically assess the pattern of low site density in Central and Eastern Europe during the Lower Palaeolithic. Even a short overview of the current state of knowledge regarding this topic shows that this pattern is robust enough to merit more research than has been done before now. With approximately 10 to, perhaps, 20 Central and Eastern European sites that can be ascribed to the Lower Palaeolithic with a high degree of confidence compared to over one hundred in Western Europe there is little room for doubt that one or more factors are affecting the data.

The most common, and from the author‘s experience almost immediate, reaction to this pattern is to attribute it to the history of research. For that reason a thorough historiographical analysis of the history of Palaeolithic research in Central and Eastern Europe has been conducted paying particular attention to such issues as the quantity and quality of fieldwork, the theoretical and methodological foundations of the research and, finally, the dissemination of the data. The results of this analysis are unequivocal. Nothing indicates that the quantity, the quality or the dissemination of Central and Eastern European research in the Lower Palaeolithic was of a lower standard than that of Western Europe.

The second explanation of this pattern, the dispersal routes into Europe, has been evaluated by means of computational modelling. Again, the results have been unambiguous: given our current knowledge regarding the first 'Out of Africa' nothing indicates that Central and Eastern Europe should have been peopled later than the western part of the continent. This result has to be taken with a pinch of salt since it depends on a number of assumptions such as the starting point in Africa, quicker dispersal rates over open landscapes or, in fact, the dependence of the dispersal on environmental factors such as vegetation/climate. Although none of these are particularly controversial at the moment, history teaches us that often long held beliefs can be erroneous. Nevertheless, the general impression remains that the first dispersal into Europe probably happened via one or more parts of Central and Eastern Europe regardless of the availability of the western route.

Finally, the last explanation of the observed pattern i.e. the climatic variability of Europe does not stand to close scrutiny. To the best of our knowledge the Early and Middle

Pleistocene climate and landscape was not dramatically different to the current one which is dominated by longitudinal biozones running from the western coasts of Spain and France all the way into the plains of Russia. Even a quick glance at the history of our continent shows that there are no significant natural barriers between Western and Central Europe that would prevent large groups of people from crossing it, be it Tatars, the Napoleonic army or German tanks, and there is no indication that such a barrier existed during the Lower Palaeolithic. The sudden drop in Lower Palaeolithic site numbers observed in the data does not corroborate with the only pattern of climate difference between Western and Eastern Europe – the gradual increase in continentality towards the east. Also, the scope of hominid adaptability to diverse environmental conditions indicates that the climate argument may be somewhat misguided.

It is widely acknowledged in archaeology that what is regarded as a high/low density of early settlement may in fact represent areas with favourable/unfavourable sedimentation and erosion conditions which allowed better preservation and subsequent history of discoveries of archaeological material. I argued in this paper that it is highly likely that this is the case in this instance. The poor knowledge of the Lower Palaeolithic of Central and Eastern Europe and the pattern of low density of site distribution might have been heavily influenced by sedimentological and geological factors namely the destructive power of the retreating glacial coupled with thick loess cover sealing vast areas south of the glacial front with up to tens of metres of solid rock-hard sediments rarely disturbed by commercial human activity.

Moreover, I hope this thesis has made a strong case against the all-too-common issues in contemporary archaeological practice: i) to the issue of archaeological representation in large scale studies i.e. using the 'dots-on-a-map' approach and taking site distribution maps at face value before discounting modern and past biases, and ii) the explanation of the rarity of sites in a given region by a low intensity of archaeological field work and a relatively underdeveloped archaeological infrastructure in the region before a historiographical analysis is conducted.

Finally, it is worth stressing that intensive large-scale multidisciplinary research projects involving geologists, faunal specialists and archaeologists (perhaps similar to the one conducted by Haesaerts and colleagues (2003)) are needed in Central and Eastern Europe. It was argued that the loess may be protecting well stratified, largely preserved *in situ* sites within easy to date and well controlled environmental contexts. More fieldwork conducted in the region would broaden our understanding of the complicated geological and archaeological history of this area which in turn is more than likely to shed light on issues currently being the bone of contention in the west, such as the Clactonian debate. The potential of Central and Eastern Europe to make a crucial contribution to our understanding of our most remote past is extremely high.

Appendix 1. Catalogue of European Lower Palaeolithic Sites

dating from	dating to	Country	Site Name	N	E	Industry	dating quality
9	9	Spain	Ribeira da Ponte de Pedra	39.44	-8.46	Acheulean	1
7	10	Spain	Portomaior	42.07	-8.42	Acheulean	3
13	13	Spain	Cabo Busto	43.34	-6.29	Acheulean	3
13	13	Spain	el Aculadero	36.58	-6.26	Oldowan	3
6	10	Spain	Santa Ana	39.31	-5.99	Oldowan, Acheulean	3
9	11	Spain	La Maya	40.68	-5.59	Acheulean	3
11	11	France	Menez Dregan	47.98	-4.47	Clactonian	1
5	8	Spain	Cueva del Ángel	37.40	-4.40	Upper Acheulean	1
8	11	Spain	Pinedo	39.88	-3.98	Acheulean	2
11	13	Spain	San Isidro	40.40	-3.72	Acheulean, Upper Acheulean	3
11	13	Spain	Terraces of Manzanares	40.36	-3.68	Acheulean	3
13	13	Spain	San Quirce	42.19	-3.59	Clactonian, Acheulean	3
8	12	Spain	La Galeria	42.38	-3.49	Acheulean	1
12	12	Spain	Sima de los Huesos	42.38	-3.49	Acheulean	1
18	18	Spain	Gran Dolina	42.38	-3.49	Oldowan	1
18	18	Spain	Sima del Elefante	42.38	-3.49	Oldowan, Acheulean	1
7	7	Great Britain	Pontnewydd	53.22	-3.48	Upper Acheulean	1
9	9	Spain	Aridos	40.40	-3.48	Acheulean	2
7	7	Spain	Solana del Zamborino	37.38	-3.11	Upper Acheulean	2
11	11	France	Saint-Colomban	47.57	-3.09	Clactonian	1
13	13	Great Britain	Westbury-sub-Mendip	51.24	-2.71	Acheulean	3
7	7	Spain	Torralba del Moral	41.13	-2.50	Acheulean	2
0	0	Spain	Barranco León	37.72	-2.46	Oldowan	1
0	0	Spain	Fuente Nueva 3	37.71	-2.40	Oldowan	1
9	11	Spain	Ambrona	41.09	-2.29	Acheulean, Upper Acheulean	1
7	7	Spain	Irikaitz	43.24	-2.25	Acheulean	3
13	13	France	Saint-Malo-de-Phily	47.88	-1.79	Oldowan	3
9	10	Great Britain	Wolvercote Channel	51.78	-1.29	Acheulean	3
9	11	Great Britain	Red Barns	50.84	-1.14	Acheulean	1
5	6	Unknown	Cuesta de la Bajada	40.35	-1.11	Tayacian	3
13	13	Great Britain	Caversham Ancient Channel	51.47	-0.95	Acheulean, Clactonian	3
11	13	Great Britain	Farnham	51.21	-0.79	Acheulean	3
10	11	Great Britain	Furze Platt and Baker's Farm	51.53	-0.75	Acheulean	3
13	13	Great Britain	Boxgrove	50.85	-0.71	Acheulean	1
6	6	Great Britain	Caddington	51.86	-0.45	Acheulean	3
7	9	Spain	Cova del Bolomor	39.04	-0.26	Tayacian	1
9	9	Great Britain	Stoke Newington	51.56	-0.07	Acheulean	3
9	9	Great Britain	Purfleet	51.48	0.24	Clactonian, Acheulean	2
11	11	Great Britain	Swanscombe	51.44	0.30	Clactonian, Acheulean	1
11	11	Great Britain	Southfleet Road	51.44	0.31	Clactonian	2
9	11	Great Britain	Little Thurrock	51.48	0.33	Acheulean, Clactonian	3
8	10	Great Britain	Cuxton	51.37	0.45	Acheulean	3
8	8	France	Fontéchevade	45.68	0.47	Tayacian	3
13	13	Great Britain	Warren Hill (Mildenhall)	52.35	0.52	Clactonian, Acheulean	3
11	11	Great Britain	Beeches Pit	52.40	0.62	Acheulean	1

11	11	France	La Terrase	43.22	0.63	Acheulean, Upper Acheulean	2
11	11	Great Britain	Elveden	52.38	0.67	Acheulean	1
11	11	Great Britain	Barnham	52.37	0.75	Acheulean, Clactonian	1
13	13	Great Britain	High (Warren) Lodge	52.28	0.91	Acheulean, Tayacian	3
9	9	France	La Micoque, level E	44.95	1.00	Tayacian, Upper Acheulean	1
11	11	Great Britain	Clacton-on-Sea	51.78	1.13	Clactonian	2
11	11	Great Britain	Foxhall Road	52.05	1.18	Acheulean	3
11	11	Great Britain	Hoxne	52.35	1.19	Acheulean	2
6	6	France	Combe Grenal	44.80	1.20	Upper Acheulean	3
11	11	France	Point-aux-Oies	50.78	1.61	Clactonian, Acheulean	3
9	9	France	Coudoulous	44.46	1.65	Oldowan	1
11	11	France	Igue de Rameaux	44.15	1.75	Clactonian	2
11	11	France	Saint-Acheul	49.88	2.32	Upper Acheulean	3
9	9	France	Cagny l'Épinette	49.86	2.34	Acheulean	1
10	10	France	Cagny Ferme de l'Épinette	49.86	2.34	Acheulean	2
11	11	France	Cagny Cimitière	49.86	2.34	Acheulean	2
12	12	France	Cagny La Garenne 2	49.86	2.34	Clactonian	1
12	12	France	Cagny La Garenne 1	49.86	2.34	Acheulean, Upper Acheulean	1
11	13	Unknown	Chelles	48.88	2.63	Acheulean, Upper Acheulean	3
5	5	France	La Grotte d'Aldène	43.32	2.71	Acheulean	2
10	10	France	La Grotte d'Aldène	43.32	2.71	Tayacian	2
12	12	France	La Grotte d'Aldène	43.32	2.71	Tayacian	2
12	12	France	La Caune de l'Arago	42.81	2.74	Tayacian, Acheulean	1
12	12	France	La Caune de l'Arago, level D	42.81	2.74	Upper Acheulean	1
13	13	France	La Caune de l'Arago	42.81	2.74	Acheulean	1
14	14	France	La Caune de l'Arago	42.81	2.74	Acheulean	1
14	14	France	La Caune de l'Arago. level P	42.81	2.74	Acheulean	1
12	12	France	Gouzeaucourt	50.05	3.12	Acheulean	3
9	9	France	Soucy 6	48.24	3.32	Clactonian	1
9	9	France	Soucy 1	48.24	3.32	Acheulean	1
9	9	France	Soucy 5, level II	48.24	3.32	Acheulean	1
9	9	France	Soucy 3	48.24	3.32	Acheulean	1
9	9	France	Soucy 5, level I	48.24	3.32	Acheuelan	1
13	13	France	Mas de Caves (Lunel Viel)	43.68	4.09	Oldowan	2
9	9	France	Orgnac 3	44.34	4.26	Acheulean, Upper Acheulean	1
10	11	France	Azé	46.39	4.74	Clactonian	2
11	11	France	Curson	45.05	4.92	Clactonian	3
13	13	Belgium	La Belle Roche	50.48	5.59	Clactonian	3
9	12	France	Baume Bonne	43.70	6.03	Tayacian	2
9	9	Unknown	Wallendorf	49.88	6.29	Acheulean	3
11	11	Germany	Kärlich-Seeufer	50.24	7.21	Acheulean	1
6	6	France	Lazaret	43.69	7.28	Acheulean	2
11	11	France	Terra Amata	43.69	7.28	Acheulean	1
12	12	Germany	Ariendorf I	50.53	7.30	Clactonian	1
13	13	Germany	Miesenheim	50.40	7.41	Tayacian	1
13	13	France	Achenheim	48.57	7.62	Oldowan, Acheulean	3
5	9	Italy	Colombo cave	44.13	8.20	Clactonian	1
13	13	Germany	Mauer	49.33	8.79	Tayacian	2
9	9	Italy	Sa Coa de sa Multa	40.82	8.84	Tayacian	3
11	11	Italy	Collinaia	43.52	10.34	Oldowan	3
5	5	Italy	Bibbona	43.26	10.59	Oldowan	3
11	11	Unknown	Schöningen	52.14	10.97	Tayacian	2

11	11	Germany	Bilzingsleben	51.28	11.06	Tayacian	1
9	9	Unknown	Geiseltal	51.30	11.81	Clactonian	2
0	0	Italy	Cà Belvedere di Monte Poggiolo	44.19	12.04	Oldowan	1
11	11	Italy	Torre Pagliaccetto	41.91	12.21	Upper Acheulean	2
9	9	Italy	Castel di Guido	41.90	12.28	Acheulean	1
12	13	Italy	Malagrotta	41.86	12.32	Clactonian	2
9	10	Italy	La Polledrara di Cecanibbio	41.92	12.46	Tayacian	1
9	9	Italy	Torre in Pietra	41.91	12.53	Acheulean	1
7	7	Italy	Casal de' Pazzi	41.93	12.56	Clactonian	3
6	10	Italy	Monte delle Gioie, Sedia del	41.92	12.57	Clactonian	3
7	7	Italy	Valle de Pô	43.93	12.63	Acheulean	3
13	15	Italy	Quarto delle Cinfonare	41.51	12.77	Tayacian	1
11	11	Italy	Fontana Ranuccio	41.76	13.10	Acheulean	1
18	18	Italy	Colle Marino	42.33	13.26	Oldowan	3
18	18	Italy	Castro dei Volsci	41.50	13.40	Oldowan	3
11	11	Italy	Cava Pompi	41.58	13.41	Tayacian	1
8	8	Italy	Colle Avarone	41.53	13.48	Upper Acheulean	2
13	13	Italy	Fontana Liri	41.60	13.50	Clactonian	3
11	11	Italy	Isoletta	41.52	13.50	Acheulean	1
18	21	Italy	Ceprano	41.54	13.51	Oldowan	1
11	11	Italy	Lademagne	41.50	13.55	Acheulean	3
18	18	Italy	Arce	41.59	13.58	Clactonian	3
11	11	Italy	Mont Conero	43.55	13.60	Clactonian	3
10	13	Italy	Visogliano	45.77	13.64	Tayacian	1
9	9	Italy	Pontecorvo and Lademagne-	41.45	13.66	Acheulean	3
11	11	Italy	Svolte di Popoli	42.28	13.90	Acheulean	1
9	11	Unknown	Valle Giumentina	42.16	14.00	Clactonian, Acheulean	3
16	17	Italy	Isernia la Pineta	41.59	14.23	Tayacian	2
11	11	Italy	Terraces of Dittaino and Simeto	37.56	14.46	Oldowan	3
6	10	Italy	Grotte del Poggio	40.67	14.78	Tayacian	3
11	11	Italy	Marina di Camerota	40.00	15.37	Upper Acheulean	3
7	9	Italy	Rosaneto	39.93	15.78	Upper Acheulean	3
0	0	Italy	Notachirico	40.59	15.80	Acheulean, Clactonian	1
11	11	Italy	Notachirico, level alpha	40.59	15.80	Acheulean	1
11	11	Italy	Venosa Loreto B	40.59	15.80	Tayacian	2
13	13	Italy	Notachirico, level F	40.59	15.80	Acheulean	1
13	13	Italy	Venosa Loreto A	40.59	15.80	Tayacian	2
13	15	Poland	Rusko 42	50.99	16.46	Tayacian	3
12	12	Italy	Casella di Maida	38.90	16.58	Oldowan	3
14	16	Czech Republic	Stránská Skála	49.22	16.60	Oldowan	2
13	11	Poland	Trzebnica	51.30	17.05	Tayacian	3
11	11	Hungary	Vértesszőlős	47.60	18.38	Tayacian	1
0	0	Ukraine	Korolevo	48.15	23.13	Oldowan	3
11	11	Unknown	Treugol'naya cave	44.00	41.00	Tayacian	1
0	0	Georgia	Dmanisi	41.31	44.35	Oldowan	1

Appendix 2. SHEEP model code

```
globals [flag1  flag2]

patches-own [elevation]

 ;;;;;;;;;;;SETUP;;;;;;;;;;;

 to setup

  __clear-all-and-reset-ticks

   random-seed seed

   ; First, read the vegetation data from file

  file-open “map11_xyz_text.txt”

  while [not file-at-end?]

  [

    let next-X file-read

    let next-Y file-read

    let next-elevation file-read

    ask patch next-X next-Y [set elevation next-elevation]

  ]

  file-close
```

```
;;SETTING UP THE WORLD

ask patches

[

  if elevation  = 1

[set pcolor blue]

  if elevation  = 2

[set pcolor yellow]

  if elevation  = 3

[set pcolor green]

  if elevation  = 4

[set pcolor orange]

  if elevation  = 5

[set pcolor cyan]

  if elevation  = 6

[set pcolor white]

  if elevation  = 7

[set pcolor gray]

 if elevation  = 8

[set pcolor black]

]
```

```
; create turtles
  crt 20
  [
    set color 131

    set size 2
    set shape «sheep»
    setxy  56  47
  ]
 end


;;;;;;;;;;;; TO GO PROCEDURE ;;;;;;;;;;;;
to go


;; POPULATION GROWTH
  ;;reproduction
  ask turtles
  [
    if random-float 1 <= fertility-rate
    [
      reproduce
```

```
    ]
  ]

  ;;mortality
  ask turtles
  [
    if random-float 1 <= mortality-rate
    [
      die
    ]
  ]

;; STOPPING CONDITION
 ask patch 23 85 ;; Spanish-French Border
  [
    if count turtles-here = 1
  [
    set flag1 1
  ]
  ]
  if flag1 = 1
  [
     export-interface (word "results " random-float 1.0 ".png")
```

```
     stop
    ]

ask patch 36 93 ;; Northern Germany
  [
    if count turtles-here = 1
  [
    set flag2 1
  ]
  ]

  if flag2 = 1
  [
    export-interface (word “results “ random-float 1.0 “.png”)
    stop
    ]

  tick
  plot count turtles
end
```

```
;;SPATIAL SPREADING PROCESS

to reproduce



    if any? patches with [count turtles-here = 0 and pcolor = yellow] in-
radius 1

    [

      let empty-patch one-of patches with [count turtles-here = 0 and
pcolor = yellow ] in-radius 1

      hatch 1

      [

           ask patch-here [set pcolor magenta ]

        setxy [pxcor] of empty-patch [pycor] of empty-patch

        set color [color] of myself + 1]

    ]



    if any? patches with [count turtles-here = 0 and pcolor = orange] in-
radius 4

    [

      let empty-patch one-of patches with [count turtles-here = 0 and
pcolor = orange ] in-radius 4

      hatch 1

     [ ask patch-here [set pcolor magenta ]

        setxy [pxcor] of empty-patch [pycor] of empty-patch

        set color [color] of myself + 1
```

```
    ]

    ]

        if any? patches with [count turtles-here = 0 and pcolor = green or pcolor = cyan] in-radius 2

    [

      let empty-patch one-of patches with [count turtles-here = 0 and pcolor = green  or pcolor = cyan ] in-radius 2

        hatch 1

        [

      ask patch-here [set pcolor magenta ]

        setxy [pxcor] of empty-patch [pycor] of empty-patch

        set color [color] of myself + 1

        ]

    ]

end

;;13.11 final running version - page 4
```

Bibliography

Adamenko, O. M., V. N. Gladiline. 1989. "Korolevo. Un Des Plus Anciens Habitats Acheuléens Et Moustériens De Transcarpatie Soviétique." *L'Anthropologie* 93: 689-712.

Adams, J. M. 1997. *Global land environments since the last interglacial*. Accessed: 07/06/11 http://www.esd.ornl.gov/ern/qen/nerc.html.

Adams, J. M., H. Faure. 1997. *Review and Atlas of Palaeovegetation: Preliminary land ecosystem maps of the world since the Last Glacial Maximum*. Accessed: 10/06/11 http://www.esd.ornl.gov/ern/qen/adams1.html.

Aitchison, K. 2009. *Discovering the Archaeologists of Europe. Transnational Report*. Reading: Institute for Archaeologists.

Anconetani, Patrizia, Gianni Giusberti, Carlo Peretto. 1991. "Nuovi contributi allo studio della fratturazione intenzionale dei reperti paleontologici del giacimento di Isernia La Pineta (Molise)." In *Isernia la Pineta. Nuovi contributi scientifici*, ed. Carlo Peretto. 43-47. Roma: Istituto Regionale per gli Studi Storici del Molise «V.Cuoco».

Anisyutkin, N. K., S. I. Kovalenko, V. A. Burlacu, A. K. Ocherednoi, A. L. Chepalyga. 2012. "Bairaki – a Lower Paleolithic Site on the Lower Dniester." *Archaeology, Ethnology and Anthropology of Eurasia* 40 (1) (March): 2-10. doi:10.1016/j.aeae.2012.05.002.

Ascenzi, A., I. Biddittu, P. F. Cassoli, A. G. Segre, E. Segre-Naldini. 1996. "A calvarium of late Homo erectus from Ceprano , Italy." *Journal of Human Evolution* 31: 409-423.

Athanassiou, A. 2002. "Neogene and Quaternary faunas of Thessaly." *Annales Géologiques des Pays Helléniques* XXXIX (A): 279-293.

Asfaw, Berhane, Yonas Beyene, Gen Suwa, Robert C. Walter, Tim D. White, Giday Wolde Gabriel, Tesfaye Yemane. 1992. "The earliest Acheulean from Konso-Gardula." *Nature* 360 (24/31 December): 732-735.

Auguste, Patric, Anne-Marie Moigne, Jan van der Made. 2000. "Les faunes du Pléistocène moyen en Europe septentrionale et en Europe centrale: Bilzingsleben, Cagny l'Epinette, et Biache Saint Vaast." In *Communication for the conference: Les premiers habitants de l'Europe*, 61-62. Tautavel.

Axtell, R. L., J. M. Epstein, J. S. Dean, G. J. Gumerman, A. C. Swedlund, J. Harburger, S. Chakravarty, R. Hammond, J. Parker, M. Parker. 2002. "Population growth and collapse in a multiagent model of the Kayenta Anasazi in Long House Valley." *Proceedings of the National Academy of Sciences of the United States of America* 99 (Suppl 3): 7275-7279.

Baena, Javier, David Lordkipanidze, Felipe Cuartero, Reid Ferring, David Zhvania, Diego Martín, Teona Shelia, Giorgi Bidzinashuili, Marta Roca, Daniel Rubio. 2010. "Technical and technological complexity in the beginning: The study of Dmanisi lithic assemblage." *Quaternary International* 223-224 (September 1): 45-53. doi:10.1016/j.quaint.2010.01.019.

Barford, Paul. 1993. "Paradigms lost: Polish archaeology and post-War politics." *Archaeologia Polona* 31: 257-270.

Barford, Paul. 2002. "Reflections on J. Lech's vision of the history of 'Polish' archaeology." *Archaeologia Polona* 40: 171-184.

Bartosiewicz, L., Mérai, D., Csippán, P. 2011. "Dig up – Dig in: practice and theory in Hungarian archaeology." In *Comparative Archaeologies*, ed. Ludomir R. Lozny. 273-337. New York: Springer. doi:10.1007/978-1-4419-8225-4.

Bar-Yosef, Ofer, Anna Belfer-Cohen. 2001. "From Africa to Eurasia — early dispersals." *Quaternary*

International 75 (1) (January): 19-28. doi:10.1016/S1040-6182(00)00074-4.

Bar-Yosef, Ofer, Anna Belfer-Cohen. 2011. "Following Pleistocene road signs of human dispersals across Eurasia." *Quaternary International* in press (August). doi:10.1016/j.quaint.2011.07.043.

Bednarik, Robert G. 1999. "Maritime navigation in the Lower and Middle Palaeolithic." *Comptes Rendus de l'Académie des Sciences-Series IIA-Earth and Planetary Science* 328 (8): 559-563.

Begun, D. R. 2005. "Miklós Kretzoi, 1907-2005." *Evolutionary Anthropology* 14 (4): 125-126. doi:10.1002/evan.20072.

Belli Giancarlo, Giorgio Belluomini, Pier Francesco Cassoli, Silvana Cecchi, Mauro Cucarzi, Lauretta Delitala, Gino Formaciari, Francesco Mallegni, Marcello Piperno, Aldo G. Segre, Eugenia Segre-Naldini. 1991. "*Découverte d'un femur humain acheuléen à Notachirico (Venosa, Basilicate).*" *L'Anthropologie* 95 (1): 47-88.

Benet-Tygel, S. 1944. "Paleolithic period in Poland." *American Anthropologist* 46: 292-316.

Bentley, Alexander R., Mark Lake, Stephen Shennan. 2005. "Specialisation and wealth inequality in a model of a clustered economic network." *Journal of Archaeological Science* 32 (9) (September): 1346-1356. doi:10.1016/j.jas.2005.03.008.

Berger, G. W., Pillans, B. J. Palmer, A. S., 1992. "Dating loess up to 800 ka by Thermoluminescence." *Geology* 20(5): 403.

Bermúdez de Castro, Jose María, María Martinón-Torres, Aida Gómez Robles, Leyre Prado, Eudald Carbonell. 2010. "New human evidence of the Early Pleistocene settlement of Europe, from Sima del Elefante site (Sierra de Atapuerca, Burgos, Spain)." *Quaternary International* 223-224 (September): 431-433. doi:10.1016/j.quaint.2009.07.024.

Bermúdez de Castro, J. M., M. Martinón-Torres, E. Carbonell, S. Sarmiento, A. Rosas, J. van der Made, M. Lozano. 2004. "The Atapuerca sites and their contribution to the knowledge of human evolution in Europe." *Evolutionary Anthropology* 13 (February 12): 25-41. doi:10.1002/evan.10130.

Bornmann, L., H.-D. Daniel. 2005. "Does the h-index for ranking of scientists really work?" *Scientometrics* 65 (3): 391-392. doi:10.1007/s11192-005-0281-4.

Bornmann, L., H.-D. Daniel. 2007. "What do we know about the h-index?" *Journal of the American Society for Information Science and Technology* 58 (9): 1381-1385. doi:10.1002/asi.20609.

Biró, K. 2003. "Introduction." In *Hungarian Archaeology at the Turn of the Millenium*, ed. Z. Visy, M. Nagy and Z. B. Kiss, 77-78. Budapest: Ministry of National Cultural Heritage.

Bischoff, James L., Donald D. Shamp, Arantza Aramburu, Juan Luis Arsuaga, Eudald Carbonell, J.M. Bermudez de Castro. 2003. "The Sima de los Huesos Hominids Date to Beyond U/Th Equilibrium (>350kyr) and Perhaps to 400–500kyr: New Radiometric Dates." *Journal of Archaeological Science* 30 (3) (March): 275-280. doi:10.1006/jasc.2002.0834.

Bischoff, James L., Ross W. Williams, Robert J. Rosenbauer, Arantza Aramburu, Juan Luis Arsuaga, Nuria García, Gloria Cuenca-Bescós. 2007. "High-resolution U-series dates from the Sima de los Huesos hominids yields : implications for the evolution of the early Neanderthal lineage." *Journal of Archaeological Science* 34 (5) (May): 763-770. doi:10.1016/j.jas.2006.08.003.

Blackwell Bonnie A. B., Sisi Liang, Lubov V. Golovanova, Vladimir B. Doronichev, Anne R. Skinner, Joel I. B. Blickstein. 2005. "ESR at Theugol'naya Cave, Northern Caucasus Mt., Russia: Dating Russia's oldest archaeological site and paleoclimatic change in Oxygen Isotope Stage 11." *Applied Radiation and Isotopes* 62: 237-245.

Boguckyj, A. B., Lanczont, M., Lacka, B., Madeyska, T., Nawrocki, J. 2009. "Quaternary sediment sequence at Skala Podil'ska, Dniester River basin (Ukraine): Preliminary results of multi-proxy analyses." *Quaternary International 198* (1-2): 173-194.

Bokhorst, M. P., Beets, C. J., Markovic, S. B., Gerasimenko, N. P., Matviishina, Z. N., Frechen, M., 2009. “Pedochemical climate proxies in Late Pleistocene Serbian-Ukranian loess sequences.” *Quaternary International* 198 (1-2): 113-123.

Bökönyi, S. 1993. “Recent developments in Hungarian archaeology.” *Antiquity* 67 (254): 142-145.

Bordes, Francois. 1961. *Typologie du Paléolithique ancien et moyen*. Bordeaux : Delmas, Publications de l’Institut de Préhistoire de l’Université de Bordeaux, Mémoire n° 1.

Bosinski, Gerhard. 2006. “Les premiers peuplements de l’Europe centrale et de l’Est.” *Comptes Rendus Palevol* 5 (1-2) (January): 311-317. doi:10.1016/j.crpv.2005.09.004.

Bosinski Gerhard, Thijs van Kolfschoten, Elaine Turner. 1988. “Miesenheim I. Die Zeit des Homo erectus.“ *Andernacher Beiträge* 2.

Brochier J. E. 1976. “Les civilisations du Paléolithique inférieur dans la Basse Is*ère*.” *La Préhistoire Française. Civilisations paléolithiques et mésolithiques*, ed. Henry de Lumley, 875-878. Paris: Editions du C.N.R.S.

Brühl, Enrico. 2003. “The small flint tool industry from Bilzingsleben – Steinrinne.” In *Lower Palaeolithic Small Tools in Europe and the Levant,* ed. J.M. Burdukiewicz and A. Ronen, 49-63. BAR International Series 1115. Oxford: Archaeopress.

Burdukiewicz, Jan Michał. 2003. *Technokompleks mikrolityczny w paleolicie dolnym środkowej Europy*. Wrocław: Wydawnictwo Werk.

Burdukiewicz, Jan Michał. 2006. “Paleolityczna skarbnica w Trzebnicy.” *Archaeologia Żywa* 2 (36): 3-9.

Burdukiewicz, Jan Michał. 2005. “Microlithic Technology in the Stone Age.” Journal of the Israel Prehistoric Society 35: 337-351.

Burdukiewicz, Jan Michał. 1996. “Dalsze badania stanowiska dolnopaleolitycznego Rusko 42, Gm. Strzegom.” *Śląskie sprawozdania archeologiczne* 37: 7-19.

Burdukiewicz, Jan Michał. 1995. “Badania archeologiczne na Winnej Górze w Trzebnicy w 1993 roku.” *Śląskie sprawozdania archeologiczne* 36: 7-17.

Burdukiewicz, Jan Michał. 1994. “Nowe stanowiska dolnopaleolityczne z okolic Strzegomia, woj. Wałbrzyskie.” *Śląskie sprawozdania archeologiczne* 35: 39-54.

Burdukiewicz, Jan Michał, Avraham Ronen. 2003. *Lower Palaeolithic Small Tools in Europe and the Levant*. BAR International series 1115. Oxford: Archaeopress.

Byrne, Louise. 2004. “Lithic tools from Arago cave, Tautavel (Pyrénées-Orientales, France): behavioural continuity or raw material determinism during the Middle Pleistocene.” *Journal of Archaeological Science* 31: 351-364.

Carbonell, Eudald Xosé Pedro Rodriguez. 2006. “The first human settlement of Mediterranean Europe.” *Comptes Rendus Palevol* 5 (1-2): 291-298.

Carbonell, Eudald, Robert Sala Ramos, Xosé Pedro Rodríguez, Marina Mosquera, Andreu Ollé, Josep María Vergès, Bienvenido Martínez-Navarro, and José María Bermúdez de Castro. 2010. “Early hominid dispersals: A technological hypothesis for ‘out of Africa’.” *Quaternary International* 223-224 (September 1): 36-44. doi:10.1016/j.quaint.2010.02.015.

Carbonell, Eudald, José M Bermúdez de Castro, Josep M Parés, Alfredo Pérez-González, Gloria Cuenca-Bescós, Andreu Ollé, Marina Mosquera. 2008. “The first hominin of Europe.” *Nature* 452 (7186) (March 27): 465-9. doi:10.1038/nature06815.

Carbonell Eudald, Antoni Canals, Isabel Sauceda, Nova Barrero, Ángel Carbajo, Óscar Díaz, Isabel Díaz, Roberto Fernández, Francisco J. García, Luna Pena, Marcos García, Miriam García, Juan Gil, Santiago Guerra, Luz M. León, Silvia Mancha, Eva Mancha, Dolores Mejías, Rosa M. Merino, Manolo Morano, Abel Morcillo, Laura Munoz, Antonio Rodríguez, Ramon Julia, Santiago Giralt, Christophe Falguères. 2005. "La grotte de Santa Ana (Cáceres, Espagne) et l'évolution technologique au Pléistocène dans la Péninsule ibérique." *L'Anthropologie* 109: 267–285.

Castle, Christian J. E., and Andrew T. Crooks. 2006. *Principles and Concepts of Agent-Based Modelling for Developing Geospatial Simulations*. Working Papers Series. London : UCL.

Cauche, Dominique. 2009. "Les stratégies de débitage dans les industries lithiques archaïques des premiers habitants de l'Europe." *L'Anthropologie* 113: 178-190. doi:10.1016/j.anthro.2009.01.012.

Chase, P. G., and Dibble, H. 1987. "Middle Paleolithic Symbolism: A Review of Current Evidence and Interpretations." *Journal of Anthropological Archaeology* 6: 263-296.

Chazan, Michael, Hagai Ron, Ari Matmon, Naomi Porat, Paul Goldberg, Royden Yates, Margaret Avery, Alexandra Sumner, and Liora Kolska Horwitz. 2008. "Radiometric dating of the Earlier Stone Age sequence in excavation I at Wonderwerk Cave, South Africa: preliminary results." *Journal of Human Evolution* 55 (1) (July): 1-11. doi:10.1016/j.jhevol.2008.01.004.

Chochorowski, Jan. 2008. "Archeologia na Uniwersytecie Jagiellońskim. Droga ku integracji." *Alma mater* 1: 4-8.

Cita, Maria Bianca, Luca Capraro, Neri Ciaranfi, Enrico Di Stefano, Fabrizio Lirer, Patrizia Maiorano, Maria Marino. 2008. "The Calabrian Stage redefined." *Episodes* 31 (4): 408-419.

Clark, Grahame. 1977. *World Prehistory in New Perspective*. Cambridge: Cambridge University Press.

Combier Jean, Claire Gaillard, Marie-Hélène Moncel. 2000. "L'industrie du Paléolithique inférieur de la Grotte d'Azé (Saône et Loire) – Azé *I-1*." *Bulletin de la Société Préhistorique Française* 97 (3): 349-370.

Coope, Russell G. 2006. "Insect faunas associated with Palaeolithic industries from five sites of pre-Anglian age in central England." *Quaternary Science Reviews* 25 (15-16) (August): 1738-1754. doi:10.1016/j.quascirev.2006.01.015.

Curta, F. 2001. "Pots, Slavs and `Imagined Communities': Slavic Archaeologies and the History of the Early Slavs." *European Journal of Archaeology* 4 (3): 367-383. doi:10.1177/146195710100400301.

Darlas, A. 1995. "The Earliest Occupation of Europe: The Balkans." In *The earliest occupation of Europe; proceedings of the European Science Foundation Workshop at Tautavel (France) 1993*, ed. Roebroeks, W. and T. Kolfschoten, 51-60. Leiden: Leiden University Press.

Davies, J. L. 1972. *Landforms of cold climates*. Cambridge: MIT Press.

Dean J. S., Gumerman G. J., Epstein J. M., Axtell R. L., Swedlund A. C., Parker M. T., and McCarroll S. 2000 "Understanding Anasazi Culture Change Through Agent Based Modeling." In *Dynamics in Human and Primate Societies: Agent Based Modeling of Social and Spatial Processes*, ed. T. Kohler and G. Gumerman. New York/London: Oxford University Press.

de la Torre, I. and R. Mora 2009. "Remarks on the Current Theoretical and Methodological Approaches to the Study of Early Technological Strategies in Eastern Africa." In *Interdisciplinary approaches to the Oldowan*, ed. E. Hovers and D. R. Braun, 15-24. Vertenrate Paleobiology and Pleoanthropology. New York: Springer.

de los Terreros, Y. S. 2000. "Los orígenes del poblamiento Paleolítico en Europa: una visión bioestratégica." *Espacio, tiempo y forma. Serie I, Prehistoria y arqueología* (13): 33-60.

de Lumley, Henry. 2006. "Il y a 400 000 ans: la domestication du feu, un formidable moteur d'hominisation. " *Comptes Rendus Palevol* 5:149–154.

de Lumley, Henry. 2007. “Les cultures acheuléennes du Midi méditerranéen de la France. Leur place dans les cultures à biface de l’Europe.” In *Colloque international: Les Cultures à bifaces du Pléistocène inférieur et moyen dans le monde. Emergence du sens de l’harmonie*, ed. Henry de Lumley, 75-80. Tautavel.

de Lumley Henry, Médéa Nioradzé, Deborah Barsky, Dominique Cauche, Vincenzo Celiberti, Giorgie Nioradzé, Olivier Notter, David Zvania, David Lordkipanidze. 2005. “Les industries lithiques préoldowayennes du début du Pléistocene inférieur du site de Dmanissi en Géorgie.” *l’Anthropologie* 109: 1-182.

D’Errico, Francisco, Paola Villa. 1997. “Holes and grooves: the contribution of microscopy and taphonomy to the problem of art origins.” *Journal of Human Evolution* 33 (1) (July): 1-31. doi:10.1006/jhev.1997.0141.

Dennell, Robin. 2003. “Dispersal and colonisation, long and short chronologies: how continuous is the Early Pleistocene record for hominids outside East Africa?” *Journal of Human Evolution* 45 (6) (December): 421-440. doi:10.1016/j.jhevol.2003.09.006.

Dennell, Robin W. 2004. “Hominid Dispersals and Asian Biogeography during the Lower and Early Middle Pleistocene, c. 2.0-0.5 Mya.” *Asian Perspectives* 43 (2): 205-226.

Dennell, Robin W., and Wil Roebroeks. 2005. “An Asian perspective on early human dispersal from Africa.” *Nature* 438 (7071): 1099-1104.

Derevianko, A. P. 2009. *The earliest human migrations in Eurasia in the Early Paleolithic*. Novosibirsk.

Derricourt, Robin. 2006. “Getting ‘Out of Africa’: Sea Crossings, Land Crossings and Culture in the Hominin Migrations.” *Journal of World Prehistory* 19 (2) (July 7): 119-132. doi:10.1007/s10963-006-9002-z.

Dmitriyeva, T. N. 1980. “Early Man in the Soviet Union.” *Current Anthropology* 21 (6): 828-830.

Dobosi, Viola T. 2003. “Changing environment – unchanged culture at Vértesszőllős, Hungary.” In *Lower Palaeolithic Small Tools in Europe and the Levant* ed. J.M. Burdukiewicz and A. Ronen. 101-111. BAR International Series 1115. Oxford: Archaeopress.

Dodonov, A. E., Zhou, L. P., Markova, A. K., Tchepalyga, A. L., Trubikhin, V. M., Aleksandrovski, A. L., Simakova, A. N. 2006. “Middle-Upper Pleistocene bio-climatic and magnetic records of the northern Black Sea coastal area.” *Quaternary International* 149 (1): 44-54.

Doronichev, Vladimir, Liubov Golovanova. 2010. “Beyond the Acheulean: A view on the Lower Paleolithic occupation of Western Eurasia.” *Quaternary International* 223-224 (September 1): 327-344. doi:10.1016/j.quaint.2009.12.003.

Doronichev, Vladimir, Liubov Golovanova. 2003. “Bifacial Tools in the Lower and Middle Palaeolithic of the Caucasus and their Context.” In *Multiple Approaches to the Study of Bifacial Technologies,* ed. Marie Sorresi and Harrold L. Dibble. 77-108. Philadelphia: University of Pennsylvania.

Doronichev, Vladimir B. 2000. “Lower Paleolithic Occupation of the Northern Caucasus.” In *Early humans at the gates of Europe. Proceedings of the first international symposium, Dmanisi, Tbilisi (Georgia, September 1998)*, ed. Ofer Bar-Yosef, Marcel Otte and David Lordkipanidze, 67-77. ERAUL 92. Liège: Université de Liège.

Eissmann, Lothar. 2002. “Quaternary geology of eastern Germany (Saxony, Saxon – Anhalt , South Brandenburg, Thuringia), type area of the Elsterian and Saalian Stages in Europe.” *Quaternary Science Reviews* 21: 1275-1346.

Epstein, Joshua M. 2007. “Agent-Based Computational Models and Generative Social Science.” In *Generative Social Science: Studies in Agent-Based Computational Modeling*, ed. Joshua M. Epstein, 1-43. Princeton: Princeton University Press.

Epstein, Joshua M. 2008. "Why Model?" *Journal of Artificial Societies and Social Simulation* 11 (4).

Falguères, C. 2003. "ESR dating and the human evolution: contribution to the chronology of the earliest humans in Europe." *Quaternary Science Review* 22: 1345–1351.

Fernandez, Philippe, Evelyne Crégut-Bonnoure. 2007. "Les Caprinae (Rupicaprini, Ovibovini, Ovini et Caprini) de la séquence pléistocène de Kozarnika (Bulgarie du Nord): morphométrie, biochronologie et implications phylogéniques." *Revue de Paléobiologie* 26 (2): 425-503.

Ferring, Reid, Oriol Oms, Jordi Agustí, Francesco Berna, Medea Nioradze, Teona Shelia, Martha Tappen, Abesalom Vekua, David Zhvania, David Lordkipanidze. 2011. "Earliest human occupations at Dmanisi (Georgian Caucasus) dated to 1.85–1.78 Ma." *Proceedings of the National Academy of Sciences* 108 (26): 10432-10436. doi:10.1073/pnas.1106638108/-/DCSupplemental.www.pnas.org/cgi/doi/10.1073/pnas.1106638108.

Field, Julie S., Michael D. Petraglia, and Marta Mirazón Lahr. 2007. "The southern dispersal hypothesis and the South Asian archaeological record: Examination of dispersal routes through GIS analysis." *Journal of Anthropological Archaeology* 26 (1) (March): 88-108. doi:10.1016/j.jaa.2006.06.001.

Foley, Robert. 1987. "Hominid species and stone-tool assemblages: how are they related?" *Antiquity* 61: 380–392.

Foltyn, Eugeniusz. 2001. "Drugi sezon badań ratowniczych na stanowisku C w Rozumicach, województwo opolskie." *Badania archeologiczne na Górnym Śląsku i ziemiach pogranicznych w 1998 roku* I: 13-20.

Foltyn, Eugeniusz, Edelgarda M. Foltyn, Leonard Jochemczyk, Jerzy Nawrocki, Małgorzata Nita, Jan Maciej Waga, Antoni Wójcik. 2010. "The oldest human traces north of the Carpathians (Kończyce Wielkie 4, Poland)." *Journal of Archaeological Science* 37 (8) (August): 1886-1897. doi:10.1016/j.jas.2010.02.014.

Foltyn, Eugeniusz, Janusz K. Kozłowski, Jan Maciej Waga. 2010. "Geochronology and Environment of the Pre-Eemian Middle Palaeolithic in Southern Poland." *Studia Archeologiczne XLI. Acta Universitatis Wratislaviensis* 3207: 1-25.

Frayer, D. W. 2005. "Some parting words for Jan Jelínek." *Journal of Human Evolution* 49: 270-278. doi:10.1016/j.jhevol.2005.04.007.

French, Hugh M. 2007. *The periglacial environment*. Chichester: John Wiley & Sons.

Fridrich, Jan, Ivana Sýkorová. 2003. "A new Lower Palaeolithic site with a small toolset at Račiněves (Central Bohemia)." In *Lower Palaeolithic Small Tools in Europe and the Levant* ed. J. M. Burdukiewicz and A. Ronen. 93-100. BAR International Series 1115. Oxford: Archaeopress.

Fiedler, Lutz. 1995. "Quelques artefacts de Mauer, site de la mandibule d'*Homo erectus heidelbergensis*." *l'Anthropologie* 99 (1): 115-119.

Gabunia, L, A. Vekua, D. Lordkipanidze. 2000. "The environmental contexts of early human occupation of Georgia (Transcaucasia)." *Journal of Human Evolution* 38 (6) (June): 785-802. doi:10.1006/jhev.1999.0383.

Gabunia, Léo, Susan C. Anton, David Lordkipanidze, Abesalom Vekua, Antje Justus, Carl C. Swisher III. 2001. "Dmanisi and Dispersal." *Evolutionary Anthropology* 10 (5): 158-170.

Gamble, Clive. 1999. *The Palaeolithic Societies of Europe*. Cambridge: Cambridge University Press.

Gatsov, Ivan. 2001. "Between isolation and integration: some remarks about Bulgarian archaeology 1944-1989." In *Quo vadis archaeologia? Whither European archaeology in the 21st century?*, ed. Zbigniew Kobyliński. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Science.

Gaudzinski, Sabine. 1998. “Kärlich-Seeufer. Untersuchungen zu einer altpaläolithischen Fundstelle im Neuwieder Becken (Rheinland-Pfalz).“ *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* 43 (1): 3-240.

Gaudzinski, Sabine, Felix Bittmann, Wolfgang Boenigk, Manfred Frechen, Thijs van Kofschoten. 1996. “Palaeoecology and Archaeology of the Kärlich-Seeufer Opan-Air Site (Middle Pleistocene) in the Central Rhineland, Germany.” *Quaternary Research* 46: 319-334.

Gheorghiu, Dragoş, Christian F. Schuster. 2002. “The Avatars of a Paradigm: a Short History of Romanian Archaeology.” In *Archäologien Europas: Geschichte, Methoden und Theorien,* ed. Peter F. Biehl, Alexander Gramsch, Arkadiusz Marciniak, 290-302. Münster/New York/München/Berlin: Waxmann.

Gibbard, Philip, Kim M. Cohen. 2008. “Global chronostratigraphical correlation table for the last 2 .7 million years.” *Episodes* 31 (2): 243-247.

Ginter, Bolesław, Janusz Krzysztof Kozłowski. 1969. *Techniki obróbki i typologii wyrobów kamiennych paleolitu, mezolitu i neolitu.* Warszawa: Państwowe wydawnictwo naukowe.

Glaesslein, Iris. 2009. “Modes de sélection et contraintes en Europe Centrale prénéanderthalienne.” *L’Anthropologie* 113 (January): 198-210. doi:10.1016/j.anthro.2009.01.005.

Golomshtok, Eugene. 1933. “Anthropological Activities in Soviet Russia.” *American Anthropologist* 35 (2) (April): 301-327. doi:10.1525/aa.1933.35.2.02a00050.

Grace, R. 1996. “Use-Wear Analysis: The State Of The Art.” Archaeometry 38 (2):209-229.

Graham, Shawn. 2006. “Networks, Agent-Based Models and the Antonine Itineraries: Implications for Roman Archaeology.” *Journal of Mediterranean Archaeology* 19 (1) (June): 45-64. doi:10.1558/jmea.2006.19.1.45.

Graham, Shawn, and James Steiner. 2008. Travellersim: Growing Settlement Structures and Territories with Agent-Based Modelling. In *CAA 2006. Computer Applications and Quantitative Methods in Archaeology. Proceedings of the 34th Conference, Fargo, United States, April 2006*, ed. Jeffrey T. Clark and Emily M. Hagemeister. Budapest: Archaeolingua.

Griffin, Arthur F, and Charles Stanish. 2007. “An Agent-based Model of Prehistoric Settlement Patterns and Political Consolidation in the Lake Titicaca Basin of Peru and Bolivia.” *Structure and Dynamics* 2 (2): 1-46.

Gringmuth-Dallmer, E. 1993. “Archaeology in the former German Democratic Republic since 1989.” *Antiquity* 67: 135-142.

Guadelli, J.L., Sirakov, N., Ivanova, S.T., Sirakova, S.V., Anastassova, E., Courtaud, P., Dimitrova, I., Djabarska, N., Fernández, P., Ferrier, C., Fontugne, M., Gambier, D., Guadelli, A., Iordanova, D., Iordanova, N., Kovatcheva, M., Krumov, I., Leblanc, J.C., Mallye, J.B., Marinska, M., Myiteva, V., Popov, V.V., Spassov, R., Taneva, S., Tosterat-Laborde, N., Tsanova, T. 2005. “Une sequence du Paléo- lithique Inférieur au Paléolithique Récent dans les Balkans: La grotte Kozarnika à Orechets (nord-ouest de la Bulgarie). ” In *Les Premiers Peuplements en Europe*, ed. Molines, N., Moncel, M.H., Monnier, J.L. 87-103. British Archaeological Reports International Series 1364. Oxford: ArchaeoPress.

Guérin, Claude. 2007. “Biozonation continentale du Plio-Pléistocène d’Europe et d’Asie occidentale par les mammifères : état de la question et incidence sur les limites Tertiaire/Quaternaire et Plio/Pléistocène.” *Quaternaire* 18 (1) (March 1): 23-33. doi:10.4000/quaternaire.950.

Gurba, J. 2005. “Straty osobowe archaeologii polskiej w czasie II wojny światowej (Próba uzupełnień).” *Annales Universitatis Mariae Curie-Skłodowska Lublin – Polonia Sectio* F LX: 257-264.

Haase, D., J. Fink, Haase, G.,Ruske, R., Pecsi, M., Richter, H., Altermann, M., Jäger, K. D. 2007. “Loess in Europe – its spatial distribution based on a European Loess Map, scale 1: 2,500,000.”

Quaternary Science Reviews 26 (9-10): 1301-1312.

Haesaerts, P., Borziak, I., Chirica, V., Damblon, F., Koulakovska, L., Van der Plicht, J. 2003. "The east Carpathian loess record: a reference for the middle and late pleniglacial stratigraphy in central Europe." *Quaternaire* 14(3): 163-188.

Haidle, Miriam Noël, Alfred F. Pawlik. 2010. "The earliest settlement of Germany: Is there anything out there?" *Quaternary International* 223-224 (September 1): 143-153. doi:10.1016/j.quaint.2010.02.009.

Harzing, A. W. 2007. "Publish or Perish." Available from http://www.harzing.com/pop.htm

Händel, M., Simon, U., Einwögerer, T., Neugebauer-Maresch, C. 2009. "Loess deposits and the conservation of the archaeological record - The Krems-Wachtberg example." *Quaternary International* 198 (1-2): 46-50.

Heather, P. 2010. *Empires and barbarians: the fall of Rome and the birth of Europe*. Oxford: Oxford University Press.

Hijma, Marc P., Kim M. Cohen, Wil Roebroeks, Wim E. Westerhoff, and Freek S. Busschers. 2012. "Pleistocene Rhine-Thames landscapes: geological background for hominin occupation of the southern North Sea region." *Journal of Quaternary Science* 27 (1) (January 21): 17-39. doi:10.1002/jqs.1549.

Hirsch, J. E. 2005. "An index to quantify an individual's scientific research output." *Proceedings of the National Academy of Sciences of the United States of America* 102 (46) (November 15): 16569-16572. doi:10.1073/pnas.0507655102.

Hodder, Ian. 1991. "Archaeological Theory in Contemporary European Societies: the Emergence of Competing Traditions." In *Archaeological Theory in Europe: the Last Three Decades,* ed. Ian Hodder, 1-24. New York: Routledge.

Hoffecker, John F., I. E. Kuz'mina, E. V. Syromyatnikova, M. V. Anikovich, A. A. Sinitsyn, V. V. Popov, V. T. Holliday. 2010. "Evidence for kill-butchery events of early Upper Paleolithic age at Kostenki, Russia." *Journal of Archaeological Science* 37 (5) (May): 1073-1089. doi:10.1016/j.jas.2009.12.008.

Hoffecker, John F, G.F. Baryshnikov, and V.B. Doronichev. 2003. "Large mammal taphonomy of the Middle Pleistocene hominid occupation at Treugol'naya Cave (Northern Caucasus)." *Quaternary Science Reviews* 22 (5-7) (March): 595-607. doi:10.1016/S0277-3791(02)00031-8.

Holmes, Kathryn. 2007. *GIS Simulation of the Earliest Hominid Colonisation of Eurasia*. BAR International series. Oxford: Archaeopress. doi:10.4207/PA.2010.REV84.

Hopkinson, T. 2007. "The transition from the Lower to the Middle Palaeolithic in Europe and the incorporation of difference." *Antiquity* 81: 294-307.

Howell, Clark. 1966. "Observations on the Earlier Phases of the European Lower Paleolithic." *American Anthropologist* 68 (2): 88-201.

Hughes, John K, Alan Haywood, Steven J Mithen, Bruce W Sellwood, and Paul J Valdes. 2007. "Investigating early hominin dispersal patterns: developing a framework for climate data integration." *Journal of Human Evolution* 53: 465-474. doi:10.1016/j.jhevol.2006.12.011.

Isaac, G., Isaac L., Curtis, G. H. 1974. "Age of early Acheulean industries from the Peninj Group, Tanzania". *Nature* 249: 624–627.

Janik, Liliana. 2012. "The social context of Palaeolithic Figural Art: Performativity, Materialisationa and Fragmentation." In *Unravelling the Palaeolithic* ed. Karen Ruebens, Iza Romanowska and Rachel Bynoe, 131-140. BAR University of Southampton Series in Archaeology no. 8. Oxford: ArchaeoPress.

Janssen, Marco A. 2009. "Understanding Artificial Anasazi." *Journal of Artificial Societies and Social Simulation* 12 (4).

Jary, Z. 2009. "Periglacial markers within the Late Pleistocene loess-palaeosol sequences in Poland and Western Ukraine." *Quaternary International* 198 (1-2): 124-135.

Johnson, Mathew. 2010. *Archaeological theory: an introduction*. Chichester: John Wiley and Sons.

Jöris, Olaf. 2006. "Bifacially Backed Knifes (Keilmesser) in the Central European Middle Palaeolithic." In *Axe Age – Acheulian Toolmaking from Quarry to Discard. Approaches to Anthropological Archaeology*, ed. N. Goren-Inbar and G. Sharon. 287-310. London: Equinox.

Kahlke, Ralf-Dietrich, Nuria García, Dimitris S. Kostopoulos, Frédéric Lacombat, Adrian M. Lister, Paul P. A. Mazza, Nikolai Spassov, Vadim V. Titov. 2011. "Western Palaearctic palaeoenvironmental conditions during the Early and early Middle Pleistocene inferred from large mammal communities, and implications for hominin dispersal in Europe." *Quaternary Science Reviews* 30 (11-12) (June): 1368-1395. doi:10.1016/j.quascirev.2010.07.020.

King, Geoffrey, Geoff Bailey. 2006. "Tectonics and human evolution." *Antiquity* 80: 265-286.

Klíma, B. 1956. "Statistická methoda - pomůcka při hodnocení paleolithických kamenných industrií." *Památky archeologické* XLVII: 193-210.

Kobyliński, Zbigniew. 2006. "The birth of the Polish Academic Archaeology." In *Die Anfänge der ur- und frühgeschichtlichen Archäologie als akademisches Fach (1890-1930) im europäischen Vergleich*, 209-219. Rahden/Westf: Berliner Archäologische Forschungen 3.

Kohler, Timothy A. 2012. "Complex Systems and Archaeology." In *Archaeological Theory Today*, ed. Ian Hodder, 93-123. Cambridge: Polity Press.

Kohler, T. A., Gumerman, G. J. 2000. *Dynamics in Human and Primate Societies: Agent-based models of social and spatial processes*. New York: Oxford University Press.

Kolen Jan. 1999. "Hominids without homes: on the nature of Middle Palaeolithic settlement in Europe." In *The Middle Palaeolithic Occupation of Europe*, ed. W. Roebroeks, C. Gamble. Leiden: Leiden University Press.

Kolfschoten Thijs van, Eleine Turner. 1996. "Early Middle Pleistocene mammalian faunas from Kärlich and Miesenheim I and their biostratigraphical position." In *The Early Middle Pleistocene in Europe*, ed. E. Turner, 227-253. Rotterdam.

Konopka, M. 1983. "Carte des sites archéologiques en Pologne: Méthodes et organisation." *Archaeologia Polona* XXI-XXII: 187-216.

Koryakova, Ludmila. 2001. "Teaching archaeology in higher education – a glance from Russia." In *Quo vadis archaeologia? Whither European archaeology in the 21st century?*, ed. Zbigniew Kobyliński. Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Science.

Koulakovska, L., V. Usik, P. Haesaerts. 2009. "Early Paleolithic of Korolevo site (Transcarpathia, Ukraine)." *Quaternary International* 223-224 (September 1): 116-130. doi:10.1016/j.quaint.2009.09.031.

Kowarik, Kerstin, Hans Reschreiter, Gabriel Wurzer, Ralf Totschnig, Andreas Rausch. 2008. "Mining with Agents Agent-based Modeling for the Bronze Age Salt Mine of Hallstatt (Upper Austria)." In *13th International Congress „Cultural Heritage and New Technologies" Vienna, 2008*, 1-19. Vienna.

Kowarik, Kerstin, Reschreiter, Hans, Wurzer, Gabriel. 2010. "Modeling a mine. Agent based Modeling, System dynamics and Experimental Archaeology applied to the Bronze Age Salt mines of Hallstatt." In*: Mining in European History and its Impact on Environment and Human Societies. Proceedings for the 1st Mining in European History-Conference of the SFB-HIMAT*. 199-208. Innsbruck: Innsbruck University Press.

Kousha, K., M. Thelwall. 2007. "Sources of Google Scholar citations outside the Science Citation

Index: A comparison between four science disciplines." *Scientometrics* 74 (2): 273-294. doi:10.1007/s11192-008-0217-x.

Kozłowski, Stefan Karol. 2007. "Imperium atakuje (referat wygłoszony na sesji z okazji 50-lecia IHKM PAN)." In *Contributions to the Central European Stone Age. Papers dedicated to the late Professor Zbigniew Bagniewski,* ed. M. Masojć, T. Płonka, B. Ginter, and S.K. Kozłowski. 273-276. Wrocław: Instytut Archeologii Universytetu Wrocławskiego.

Kretzoi, Miklós. 1990. "Vertebrate fauna of the archaeological site." In *Vértesszölös. Site, man and culture*, ed. Kretzoi Miklós, Dobosi Viola T. Budapest: Akadémiai Kiadó.

Kretzoi, Miklós, Viola Dobosi. 1990. *Vértesszölös. Site, man and culture*. Budapest: Akadémiai Kiadó.

Kretzoi, Miklós, Vértes, Laszlo. 1965. "Upper Biharian Occupation (Intermindel) Site in Western Hungary." *Current Anthropology* 6 (1): 74-87.

Krupic, E. 2008. "Archeologia Polska w latach 1957-1975 w świetle analizy piśmiennictwa cytowanego w artykułach publikowanych na łamach «Archaeologii Polski»." *Archeologia Polski* 53: 169-200.

Lake, Mark. 2001. "The use of pedestrian modelling in archaeology, with an example from the study of cultural learning." *Environment and Planning B: Planning and Design* 28 (3): 385-403. doi:10.1068/b2726.

Laszlovsky, J., C.S. Siklodi. 1991. "Archaeological theory in Hungary since 1960: theories without theoretical archaeology." In *Archaeological Theory in Europe: the Last Three Decades,* ed. Ian Hodder, 272-298. New York: Routledge.

Lech, Jacek. 1998. "Between captivity and freedom: Polish archaeology in the 20th century." *Archaeologia Polona* 35-36: 25-222.

Lengyel, György, Péter Szolyák, Martina Pacher. 2009. "Szeleta Cave Earliest Occupation Reconsidered." *Praehistoria* 9-10: 9-20.

Leroy, S.G., K. Arpe, U. Mikolajewicz. 2011. "Vegetation context and climatic limits of the Early Pleistocene hominin dispersal in Europe." *Quaternary Science Reviews* 30 (11-12) (June): 1448-1463. doi:10.1016/j.quascirev.2010.01.017.

Lewin, Roger. 2000. *Complexity: Life at the Edge of Chaos*. Chicago: University of Chicago Press.

Lioubine, V. P. 2000. "Acheulean of the Caucasus (aspects of chronology, paleoecology and adaptation)." In *Early humans at the gates of Europe. Proceedings of the first international symposium, Dmanisi, Tbilisi (Georgia, September 1998)*, ed. Ofer Bar-Yosef, Marcel Otte, and David Lordkipanidze, 147. ERAUL 92. Liège: Université de Liège.

Lordkipanidze, David, Ofer Bar-Yosef, Marcel Otte. 2000. *Early Humans at the Gates of Europe*. Liège: ERAUL. 92. Liège: Université de Liège.

Lozny, Ludomir. 2011. "Polish Archaeology in Retrospective." In *Comparative Archaeologies*, ed. L. R. Lozny. 195-220. New York: Springer. doi:10.1007/978-1-4419-8225-4.

Ławecka, Dorota. 2000. *Wstęp do archeologii*. Warszawa: Instytut Archeologii Uniwersytetu Warszawskiego.

Macal, C. M., M. J. North. 2010. "Tutorial on agent-based modelling and simulation." *Journal of Simulation* 4 (3): 151-162.

Maday, B. C. 1968. "The Problem of Communication." *Current Anthropology* 9 (2): 180-184.

Mai, D.H., Mania, D., Nötzold, T., Toepfer, V., Vlček, E., Heinrich, W. D. 1983. *Bilzingsleben II. Homo erectus - seine Kultur und seine Umwelt. Veröffentlichungen des Landesamts für Archäologie*

Sachsen-Anhalt. Berlin: VEB Deutscher Verlag der Wissenschaften.

Mania, Dietrich. 2004. "Der Urmensch von Bilzingsleben. Seine Kultur und Umwelt." In *Paläolithikum und Mesolithikum,* ed. Harald Meller, 69-101. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt.

Mania, Dietrich. 1990. *Auf den Spuren des Urmenschen. Die Funde von Bilzingsleben*. Berlin: Theiss Verlad der Wissenschaften GmbH.

Mania, Dietrich, Mania Ursula. 2005. "The natural and socio-cultural environment of *Homo erectus* at Bilzingsleben, Germany." In *The Hominid Individual in Context. Archaeological investigations of Lower and Middle Palaeolithic landscapes, locales and artefacts*, ed. Clive Gamble and Martin Potts, 98-114. London/New York: Routlege.

Mania Dietrich, Ursula Mania, Emanuel Vlček. 1999. "The Bilzingsleben Site – *Homo erectus*, his Culture and his Ecosphere." In *Hominid Evolution. Lifestyles and Survival Strategies*, ed. H. Ullrich, 293-309. Edition Archaea.

Mania Dietrich, Emanuel Vlček. 1987. "Homo erectus from Bilzingsleben (GDR) – his culture and his environment." *Antropologie (Brno)* XXV/1: 1-45.

Manzi, Giorgio, Donatella Magri, Salvatore Milli, Maria Rita Palombo, Vasiliki Margari, Vincenzo Celiberti, Mario Barbieri. 2010. "The new chronology of the Ceprano calvarium (Italy)." *Journal of Human Evolution* 59 (5) (November): 580-585. doi:10.1016/j.jhevol.2010.06.010.

Marciniak, A. 2006. "Central European Archaeology at the Crossroads." In *A future for archaeology: the past in the present*, ed. P. J. Ucko and S. Shennan, 156-171. London: Routledge Cavendish.

Marciniak, A., Rączkowski, W. 1991. "The Development of Archaeological Theory in Poland under Conditions of Isolation." *World Archaeological Bulletin* 5.

Marshack, Alexander. 1988. *"An Ice Age Ancestor?" National Geographic* 174 (4): 478-481.

Marshack, Alexander. 1982. "Non-utilitarian fragment of bone from the Middle Palaeolithic layer." In *Excavation in the Bacho Kiro Cave (Bulgaria): Final report*, ed. J. K. Kozłowski, 117. Warszawa: Państwowe Wydawnictwo Naukowe.

Martos, Antonio Juan. 1994. "Algunas cuestiones de interés sobre el poblamiento del continente europeo durante el Pleistoceno Medio." *Espacio, tiempo y forma. Serie I, Prehistoria y arqueología* (7): 13-42.

McNabb, John. 2012. *Dissent with Modification. Human Origins, Palaeolithic Archaeology, and Evolutionary Anthropology in Britain 1859-1901*. Oxford: ArchaeoPress.

Merton, Robert K. 1968. "The Matthew Effect in Science." *Advancement of Science* 159 (3810): 56-63.

Merton, Robert K. 1988. "The Matthew Effect in Science II. Cumulative Advantage and the Symbolism of Intellectual Property." *Sociology. The Journal of the British Sociological Association* 159: 606-623.

Mesoudi, Alex, Michael J. O'Brien. 2008. "The Cultural Transmission of Great Basin Projectile-Point Technology II : An Agent-Based Computer Simulation." *American Antiquity* 73 (4): 627-644.

Mgeladze, Ana, David Lordkipanidze, Marie-Hélène Moncel, Jackie Despriee, Rusudan Chagelishvili, Medea Nioradze, Giorgi Nioradze. 2010. "First human settlement of the Caucasus: Technical behavior and raw material acquisition at Dmanisi, Georgia (1.77Ma)." *Quaternary International* 223-224 (September): 422-425. doi:10.1016/j.quaint.2009.07.015.

Milisauskas, Sarunas. 1986. "Selective Survey of Archaeological Research in Eastern Europe." *American Archaeology* 51 (4): 779-798.

Milisauskas, Sarunas. 1990. “People’s revolutions of 1989 and archaeology in Eastern Europe.” *Oxford Journal of Archaeology* 64: 283-285.

Milisauskas, Sarunas. 1998. “Observations on Polish archaeology 1945-1995.” *Archaeologia Polona* 35-36: 223-236.

Miller, P. N. 2007. *Momigliano and antiquarianism: foundations of the modern cultural sciences*. Toronto: University of Toronto Press.

Miraj, Lida, Moikom Zeqo. 1993. “Conceptual changes in Albanian archaeology.” *Antiquity* 67: 123-125.

Mitchell, Melanie. 2009. *Complexity: a guided tour*. New York: Oxford University Press.

Mithen, Steven, Melissa Reed. 2002. “Stepping out: a computer simulation of hominid dispersal from Africa.” *Journal of Human Evolution* 43 (4) (October): 433-462. doi:10.1006/jhev.2002.0584.

Molodkov, Anatoly. 2001. “ESR dating evidence for early man at a Lower Palaeolithic cave-site in the Northern Caucasus as derived from terrestrial mollusc shells.” *Quaternary Science Reviews* 20 (5-9) (December): 1051-1055. doi:10.1016/S0277-3791(00)00044-5.

Moncel, Marie-Hélène. 1998-9. “Répartition du matériel lithique dans le niveau 1 du site Pléistocène moyen d’Orgnac 3 (Ardèche) – fouilles J. Combier 1959-1972.” *Préhistoire Anthropologie Méditerranéennes* 7-8: 63-74.

Moncel, Marie-Hélène. 2010. “Oldest human expansions in Eurasia: Favouring and limiting factors.” *Quaternary International* 223-224 (September): 1-9. doi:10.1016/j.quaint.2010.02.016.

Monnier, Gilliane F. 2006. “The Lower/Middle Paleolithic Periodization in Western Europe. An Evaluation.” *Current Anthropology* 47 (5): 709-744.

Montet-White, Ante. 1996. *Le Paléolithique en Ancienne Yougoslavie*. Grenoble: Jérôme Millon.

Mosquera, M., A. Ollé, and X. P. Rodríguez. 2012. “From Atapuerca to Europe: Tracing the earliest peopling of Europe.” *Quaternary International* (January): in press. doi:10.1016/j.quaint.2012.01.031.

Muhs, D. R. 2007. “Loess Deposits, Origins and Properties.” In *Encyclopedia of Quaternary Science*, ed. A. E. Scott, 1405-1418. Oxford: Elsevier.

Musil, Rudolph, Karel Valoch. 1968. “Stranska Skala: Its Meaning for Pleistocene Studies.” *Current Anthropology* 9 (5): 534-539.

Nerudova, Zdenka. 2008. “Sidelni strategie v oblasti Krumlovskeho lesa ve starsi dobe kamenne.” *Pamatky archeologicke* XCIX: 5-34.

Neustupný, Evžen. 1991. “Recent Theoretical Achievements in Prehistoric Archaeology in Czechoslovakia.” In *Archaeological Theory in Europe: the Last Three Decades,* ed. Ian Hodder, 248-271. New York: Routledge.

Neustupný, Evžen. 1993. “Czechoslovakia: the last three years.” *Antiquity* 67: 129-134.

Nguyen, N, Patrick Taillandier, Alexis Drogoul, Pierre Auger. 2012. “Inferring Equation-Based Models from Agent-Based Models: A Case Study in Competition Dynamics.” In *Principles and Practice of Multi-Agent Systems 13th International Conference, PRIMA 2010 Kolkata, India, November 12-15, 2010 Revised Selected Papers*, ed. Nirmit Desai, Alan Liu, and Michael Winikoff, 413-427. Kolkata: Springer. doi:10.1007/978-3-642-25920-3_30.

Nikitas, P., and E. Nikita. 2005. “A study of hominin dispersal out of Africa using computer simulations.” *Journal of Human Evolution* 49 (5) (November): 602-17. doi:10.1016/j.jhevol.2005.07.001.

Noonan, James P, Graham Coop, Sridhar Kudaravalli, Doug Smith, Johannes Krause, Joe Alessi, Feng Chen. 2006. "Sequencing and analysis of Neanderthal genomic DNA." *Science* 314 (5802) (November 17): 1113-1118. doi:10.1126/science.1131412.

Oliva, Martin. 2005. *Palaeoithic and Meslithic Moravia*. Brno: Moravské zemské muzeum.

Oms, O., J. M. Pares, B. Martinez-Navarro, J. Agusti, I. Toro, G. Martinez-Fernandez, A. Turq. 2000. "Early human occupation of Western Europe: Paleomagnetic dates for two Paleolithic sites in Spain." *Proceedings of the National Academy of Sciences of the United States of America* 97 (19): 10666-10670.

Otte, Marcel. 2010. "Before Levallois." *Quaternary International* 223-224 (September): 273-280. doi:10.1016/j.quaint.2009.11.033.

Otte, Marcel. 2012. "The management of space during the Paleolithic." *Quaternary International* 247 (January): 212-229. doi:10.1016/j.quaint.2010.11.031.

Panera Gallego, Joaquín. 1996. "Contextualizaci*ón del complejo inferior de Ambrona en el Achelense de la Península Ib*érica." *Complutum* 7: 17-36.

Pares, Josep M., Alfredo Perez-Gonzalez, Antonio Rosas, A. Benito, J.M. Bermúdez de Castro, Eudald Carbonell, R. Huguet. 2006. "Matuyama-age lithic tools from the Sima del Elefante site, Atapuerca (northern Spain)." *Journal of Human Evolution* 50: 163-169. doi:10.1016/j.jhevol.2005.08.011.

Parfitt, Simon, Nick M. Ashton, Simon G. Lewis, Richard L. Abel, G. Russell Coope, Mike H. Field, Rowena Gale, Peter G. Hoare, Nigel R. Larkin, Mark D. Lewis, Vassil Karloukovski, Barbara A. Maher, Sylvia M. Peglar, Richard C. Preece, John E. Whittaker, Chris B. Stringer. 2010. "Early Pleistocene human occupation at the edge of the boreal zone in northwest Europe." *Nature* 466 (7303) (July 8): 229-33. doi:10.1038/nature09117.

Parfitt, Simon A., René W. Barendregt, Marzia Breda, Ian Candy, Matthew J. Collins, G. Russell Coope, Paul Durbidge, Mike H. Field, Jonathan R. Lee, Adrian M. Lister, Robert Mutch, Kirsty E.H. Penkman, Richard C. Preece, James Rose, Christopher B. Stringer, Robert Symmons, John E. Whittaker, John J. Wymer, Anthony J. Stuart. 2005. "The earliest record of human activity in Northern Europe: artefacts from the Cromer Forest-bed Formation at Pakefield, Suffolk, UK." *Nature* 438: 1008-1012.

Parunak, H. Van Dyke, Robert Savit, Rick L. Riolo. 1998. "Agent-Based Modeling vs . Equation-Based Modeling: A Case Study and Users' Guide." In *Proceedings of Workshop on Modeling Agent Based Systems (MABS98), Paris, 1998*, 1-16. Paris.

Pécsi Márton. 1990. "Geomorphological position and absolute age of the Vértesszölös Lower Palaeolothic site." In *Vértesszölös. Site, man and culture,* ed. Kretzoi Miklós, Dobosi Viola T. Budapest: Akadémiai Kiadó.

Pennington, R. 2001. "Hunter-gatherer demography." In *Hunter-gatherers: an interdisciplinary perspective*, ed. C. Panter-Brick, 170-204. Cambridge: Cambridge University Press.

Peris, Josep Fernández, Pere, Guillem Calatayud, Rafael, Martínez Valle. 1997. *Cova del Bolomor. Los Primeros Habitantes de las Tierras Valencianas*. Valencia: Diputació de Valencia.

Peretto, Carlo, Filomena Ornella Amore, Alberto Antionazzi, Aldo Antionazzi, Jean-Jacques Bahain, Laura Cattani, Elena Cavallini, Paola Esposito, Christophe Falguères, Jean Gagnepain, Ian Hedley, Michel Laurent, Vincent Lebreton, Laura Longo, Sarah Milliken, Paola Monegatti, Andreu Ollé, Nevio Pugliese, Josette Renault-Miskovsky, Massimo Sozzi, Sergio Ungaro, Sergio Vannuci, Joseph Maria Vergè*s,* Jean-Jacques Wagner, Yuji Yokoyama. 1998. "L'industrie lithique de Cà Belvedere di Monte Poggiolo: stratigraphie, mati*ère première, typologie, remontages et traces d'utilisation*." *l'Anthropologie* 4: 343-465.

Piperno, Marcello. 1999. "L'industria litica del livello Alfa." In: *Notarchirico. Un sito del Pleistocene medio iniziale nel bacino di Venosa*, ed. Marcello Piperno, 271-274. Venosa: Edizioni Osanna.

Praslov, Nikolai D. 1995. “The earliest occupation of the Russian Plain: a short note.” In *The earliest occupation of Europe; proceedings of the European Science Foundation Workshop at Tautavel (France) 1993*, ed. Roebroeks, W. and T. Kolfschoten, 61-66. Leiden: Leiden University Press.

Premo, Luke S. 2006. “Agent-based models as behavioral laboratories for evolutionary anthropological research.” *Arizona Anthropologist* 17: 91-113.

Querol, M. Angeles, Manuel, Santonja. 1983. *El yacimiento de cantos trabajados de el Aculadro (Puerto de Santa María, Cádiz).* Madrid: Excavaciones arqueologicas en España.

Railsback, S. F., V. Grimm. 2011. *Agent-Based and Individual-Based Modeling: A Practical Introduction*. Princeton: Princeton University Press.

Rekovets, L., A. Chepalyga, V. Povodyrenko. 2007. “Geology and mammalian fauna of the Middle Pleistocene site, Medzhybozh, Ukraine.” *Quaternary International* 160 (1) (January): 70-80. doi:10.1016/j.quaint.2006.09.014.

Richter, Jürgen. 2011. “Neanderthal Lifeways, Subsistence and Technology.” In *Neanderthal Lifeways, Subsistence and Technology: One Hundred Fifty Years of Neanderthal Study*, ed. Nicholas J. Conard and Jürgen Richter, 19:7-14. Dordrecht: Springer Netherlands. doi:10.1007/978-94-007-0415-2.

Rightmire, Phillip G. 2001. “Patterns of hominid evolution and dispersal in the Middle Pleistocene.” *Quaternary International* 75: 77-84.

Rightmire, Phillip G. 1998. “Human Evolution in the Middle Pleistocene: The Role of *Homo heidelbergensis*.” *Evolutionary Anthropology* 6 (6): 218-227.

Rightmire, Phillip G. 1990. *The Evolution of Homo erectus. Comparative anatomical studies of an extinct human species*. Cambridge: Cambridge University Press.

Rightmire G. Philip, David Lordkipanidze, Abesalom Vekua. 2006. “Anatomical descriptions, comparative studies and evolutionary significance of the hominin skulls from Dmanisi, Republic of Georgia.” *Journal of Human Evolution* 50, 115-141.

Rodríguez, Jesús, Jesús Angel Martín-González, Idoia Goikoetxea, Guillermo Rodríguez-Gómez, Ana Mateos. 2011. “Mammalian paleobiogeography and the distribution of Homo in early Pleistocene Europe.” *Quaternary International* in press (September): 1-11. doi:10.1016/j.quaint.2011.09.023.

Roe, Derek. 1981. *The Lower and Middle Palaeolithic Periods in Britain*. London/Boston/Henley: Routledge and Kegan Paul.

Roebroeks, Wil. 1994. “Updating the Earliest Occupation of Europe.” *Current Anthropology* 35 (3): 301-305.

Roebroeks, Wil. 2001. “Hominid behaviour and the earliest occupation of Europe: an exploration.” *Journal of Human Evolution* 41(5): 437-461.

Roebroeks, Wil, and Thijs van Kolfschoten. 1994. “The Earliset Occupation of Europe: a short chronology.” *Antiquity* 68 (February): 489-503. doi:10.1086/204707.

Roebroeks, Wil, and Thijs van Kolfschoten. 1995. *The earliest occupation of Europe. Proceed- ings of the European Science Foundation workshop at Tautavel (France), 1993.* Leiden: Leiden University Press.

Roebroeks, Wil, Paola Villa. 2011. “On the earliest evidence for habitual use of fire in Europe.” *Proceedings of the National Academy of Sciences of the United States of America* 108 (13) (March 29): 5209-14. doi:10.1073/pnas.1018116108.

Roebroeks, Wil, Nicholas J. Conard, Thijs van Kolfschoten. 1992. “Dense Forests, Cold Steppes, and the Palaeolithic Settlement of Northern Europe.” *Current Anthropology* 33 (5): 551-586.

Rolland, Nicolas. 1995. “Biogéographie et préhistoire: le cas du peuplement paléolithique inférieur de l’Europe.” In *Nature et Culture, actes du colloque international de Liège (13-17 décembre 1993), ed.* Marcel Otte, 11-61. ERAUL. 68. Liège: Université de Liège.

Rolland, Nicolas. 1998. “The Lower Palaeolithic settlement of Eurasia, with special reference to Europe.” In *Early human behaviour in global context: the rise and diversity of the Lower Paleolithic Period*, ed. Michael D. Petraglia and Ravi Korisettar, 187-220. London: Routledge.

Rosas, A., R. Huguet, E. Carbonell, J. M. Bermúdez de Castro, J. Vallverdú, J. van der Made, E. Allué. 2006. “The ‘Sima del Elefante’ cave site at Atapuerca (Spain) Context and Background of the Sima.” *Estudios Geológicos* 62 (1): 327-347.

Rousseau, D. D., Derbyshire, E., Antoine, P., Hatte, C. 2007. “Loess Records. Europe.” In *Encyclopedia of Quaternary Science*, ed. A. E. Scott, 1440-1456. Oxford: Elsevier.

Runnels, Curtis, 1995. “Review of Aegean Prehistory IV: The Stone Age of Greece from the Palaeolithic to the Advent of the Neolithic.” *American Journal of Archaeology*, 99(4): 699-728.

Рыжов, С.Н., Ж.Н. Матвиишина, А.С. Пудовкина, П.а. Левчук. 2009. “стРатиГРаФиЧЕскиЕ и ПЛаниГРаФиЧЕскиЕ иссЛЕдОВаниЯ ПаЛЕОЛитиЧЕскОЙ стОЯнки маЛЫЙ РакОВЕц iV на ЗакаРПатьЕ.” *Vita antiqua* 7-8: 60-71.

Sablin, M.V., E.Yu. Girya. 2010. “The Earliest Evidence of Human Occupation in South eastern Europe: a Processed Camel Bone Fragment from the Lower Don.” *Archaeology, Ethnology and Anthropology of Eurasia* 38 (2) (June): 7-13. doi:10.1016/j.aeae.2010.08.003.

Sachse-Kozłowska, E., S. K. Kozłowski. 2004. “Piekary I. Aperçu historique des recherches.” In *Piekary près de Cracovie (Pologne). Complexe des sites paléolithiques,* ed. E. Sachse-Kozłowska and S. K. Kozłowski, 20-22. Rozprawy Wydziału Historyczno-Filozoficznego, tom 104. Kraków: L’Académie Polonaise des sciences et des letres.

Santonja, Gomez Manuel. 1995. “The Lower Palaeolithic in the northern Submeseta and in the environs of Atapuerca. State of knowledge in 1992.” In *Actas evolución humana en Europa y los yacimientos de la Sierra de Atapuerca*, ed. Jose María Bermúdez de Castro, 421-444. Valladolid: Junta de Castilla y León, Consejería de Cultura y Turismo.

Santonja, Gomez Manuel, Paola Villa. 2006. “The Acheulian of Western Europe.” In *Axe Age: Acheulian Toolmakingfrom Quarry to Discard*, ed. N Goren-Inbar and G Sharon, 429–478. London: Equinox Publishing.

Santonja Gomez Manuel, Paola Villa. 1990. “The Lower Palaeolithic of Spain and Portugal.” *Journal of World Prehistory* 4 (1): 45-94.

Schild, Romuald. 1998. “Stefan Krukowski (1890-1982): a reclusive eccentric within the archaeological establishment.” *Archaeologia Polona* 35-36: 343-356.

Schild, Romuald. (eds.) 2005. *The killing fields of Zwoleń: a Middle Palaeolithic Kill-butchery-site in Central Poland.* Warszawa: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Schild, Romuald, Fred Wendorf. 2002. “Forty years of the Combined Prehistoric Expedition.” *Archaeologia Polona* 40: 5-22.

Schmitt, Daniel, Steven E. Churchill, William L. Hylander. 2003. “Experimental Evidence Concerning Spear Use in Neandertals and Early Modern Humans.” *Journal of Archaeological Science* 30 (1) (January): 103-114. doi:10.1006/jasc.2001.0814.

Schreve, D. C. Keen, D. H. Limondin-Lozouet, N. Auguste, P. Santisteban, J. I. Ubilla, M. Matoshko, A. Bridgland, D. R. Westaway, R. 2007. “Progress in faunal correlation of Late Cenozoic fluvial sequences 2000-4: the report of the IGCP 449 biostratigraphy subgroup.” *Quaternary Science Reivews* 26: 2970-2995.

Schwarcz, H. P., R. Grün, A. G. Latham, D. Mania, K. Brunnacker. 1988. "The Bilzingsleben Archaeological Site: New Dating Evidence." *Archaeometry* 30 (1): 5-17.

Scott, Gary R, Luis, Gibert. 2009. "The oldest hand-axes in Europe." *Nature* 461 (7260) (September 3): 82-85. doi:10.1038/nature08214.

Semenov, S. A. 1964. *Prehistoric Technology. An experimental study of the oldest tools and artefacts from traces of manufacture and wear*. Bath: Adams & Dart.

Shchelinsky, V. E., A. E. Dodonov, V. S. Baigusheva, S. A. Kulakov, A. N. Simakova, A. S. Tesakov, V. V. Titov. 2010. "Early Palaeolithic sites on the Taman Peninsula (Southern Azov Sea region, Russia): Bogatyri/Sinyaya Balka and Rodniki." *Quaternary International* 223-224 (September 1): 28-35. doi:10.1016/j.quaint.2009.08.017.

Sklenář, Karel. 1983. *Archaeology in Central Europe: the first 500 years*. Leicester: Leicester University Press; New York: St. Martin's Press.

Simán, K. 2003. "The Evolution and Culture of Modern Man." In *Hungarian Archaeology at the Turn of the Millenium*, ed. Z. Visy, M. Nagy and Z. B. Kiss, 81-85. Budapest: Ministry of National Cultural Heritage.

Simone, Suzanne, P. Baissas, L. Barral, J. L. Bischoff, H. Bocherens, M.-F. Bonifay, J.-F. Bussiere J. Chaline, F. Courant, Ch. Falgueres, G. J. Hennig, F. Lecolle, M.-P. Ledru, M.-A.de Lumley, P. Simon, D. Zany. 2002. "Assessment of the researches about the Middle Pleistocene of Aldene Cave." *Bulletin du Musée D'Anthropologie Préhistorique de Monaco* 42: 15-21.

Sinitsyn, Andey A. 2007. "Variabilité du Gravettien de Kostienki (Bassin moyen du Don) et des territoires associés." *Paleo* 19: 181-202.

Sinnhuber, Karl A. 1954. "Central Europe - Mitteleuropa - Europe Centrale. An Analysis of a Geographical Term." *Transactions and Papers (Institute of British Geographers)* 20: 15-39.

Sirakov, N., J.-L. Guadelli, S. Ivanova, S. Sirakova, M. Boudadi-Maligne, I. Dimitrova, Ph. Fernandez. 2010. "An ancient continuous human presence in the Balkans and the beginnings of human settlement in western Eurasia: A Lower Pleistocene example of the Lower Palaeolithic levels in Kozarnika cave (North-western Bulgaria)." *Quaternary International* 223-224 (September): 94-106. doi:10.1016/j.quaint.2010.02.023.

Skoflek, István. 1990. "Plant remains from the Vértesszölös travertine." In *Vértesszölös. Site, man and culture,* ed. Kretzoi Miklós, and Viola T Dobosi. Budapest: Akadémiai Kiadó.

Smalley, I., O'Hara-Dhand, K., Wint, J., Machalett, B., Jary, Z., Jefferson, I. 2009. "Rivers and loess: The significance of long river transportation in the complex event-sequence approach to loess deposit formation." *Quaternary International* 198 (1-2): 7-18.

Smith, Fred H. 1982. "Upper Pleistocene Hominid Evolution in South-Central Europe : A Review of the Evidence and Analysis of Trends." *Current Anthropology* 23 (6): 667-703.

Soffer, Olga. 1985. *The Upper Palaeolithic of the Central Russian Plain*. San Diego: Academic Press.

Soffer, O., J. M. Adovasio, D. C. Hyland. 2000. "The 'Venus' Figurines: Textiles, Basketry, Gender, and Status in the Upper Paleolithic." *Current Anthropology* 41 (4) (November 18): 511-537. doi:10.1016/j.ijcard.2005.11.063.

Steele, James. 2009. "Human Dispersals: Mathematical Models and the Archaeological Record." *Human Biology* 81 (2-3): 121-140.

Stepanchuk, Vadim, Sergei Ryzhov, Leonid Rekovets, Zhanna Matviishina. 2010. "The Lower Palaeolithic of Ukraine: Current evidence." *Quaternary International* 223-224: 131-142. doi:10.1016/j.quaint.2009.12.006.

Street, Martin, Thomas Terberger, Jörg Orschiedt. 2006. "A critical review of the German Paleolithic hominin record." *Journal of Human Evolution* 51 (6) (December): 551-79. doi:10.1016/j.jhevol.2006.04.014.

Stremme, Helmut E. 1989. "Thermoluminescence dating of the pedostratigraphy of the quaternary period in NW Germany." *Geoderma* 45 (November): 185-195. doi:10.1016/0016-7061(89)90050-5.

Stringer, Chris. 2012. "The status of Homo heidelbergensis (Schoetensack 1908)." *Evolutionary anthropology* 21 (3) (May): 101-7. doi:10.1002/evan.21311.

Stringer Chris, Jean-Jacques Hublin. 1999. "New age estimates for the Swanscombe hominid, and their significance for human evolution." *Journal of Human Evolution* 37: 873-877.

Suhr, Grietje. 2005. "Eine Chance für Neue Paradigmen? Theoretische Ansätze in der Archäologie Polens, der Tschechischen Republik und Ungarns." Unpublished PhD dissertation, Universität Viadrina.

Svoboda, Jiří. 1987. "Lithic Industries of the Arago, Vertesszollos, and Bilzingsleben Hominids: Comparison and Evolutionary Interpretation." *Current Anthropology* 28 (2): 219-227.

Svoboda, Jiří. 2003. "Continuities, Discontinuities, and Interactions in Early Upper Paleolithic Technologies. A view from the Middle Danube." In *The Early Upper Palaeolithic Beyond Western Europe,* ed. P. J. Brantingham, S. L. Kuhn and K. W. Kerry, 30-49. Berkeley/Los Angeles/London: University of California Press.

Svoboda, Jiří. 2005. "Předmostí. Kontext paleoantropologických nálezů." *Přehled výzkumů* 46: 63-93.

Svoboda, Jiří, Vojen Ložek, Emanuel Vlček. 1996. *Hunters between East and West: the Paleolithic of Moravia*. New York: Springer.

Svoboda, Jiří, Ofer Bar-Yosef (eds). 2003. *Stránská Skála. Origins of the Upper Palaeolithic in the Brno Basin, Moravia, Czech Republic*. Cambridge: Peabody Museum of Archaeology and Ethnology, Harvard University.

Svoboda, Jiří, Karel Valoch. 2003. "History and Strategy of Research at Stránská Skála." In *Stránská Skála. Origins of the Upper Palaeolithic in the Brno Basin, Moravia, Czech Republic*, ed. J. A. Svoboda and O. Bar-Yosef, 1-14. Cambridge: Peabody Museum of Archaeology and Ethnology, Harvard University.

Swisher, C. C. III., Curtis, G. H., Jacob, T., Getty, A. G., Suprijo, A. Widiasmoro. 1994. "Age of the earliest known hominids in Java, Indonesia." *Science* 263: 1118–1121.

Sýkorová, Ivana. 2003. "Kladno-Krocehlavy – sidliste staropaleolitickeho cloveka." *Pamatky Archeologicke* XCIV: 5-48.

Tabaczyński, Stanisław. 2007. "Polish archaeology in my lifetime." *Antiquity* 81: 1074–1082.

Tattersall, Ian. 2007. "Neanderthals, *Homo sapiens*, and the question of species in paleoanthropology." *Journal of Anthropological Science* 85: 139-146.

Thieme, Hartmut. 1997. "Lower Paleolithic hunting spears from Germany." *Nature* 385: 807-810.

Thieme, Hartmut. 2003. "The Lower Palaeolithic Sites at Schöningen, Lower Saxony, Germany." In *Lower Palaeolithic Small Tools in Europe and the Levant,* ed. J.M. Burdukiewicz and A. Ronen, 9-28. BAR International Series 1115. Oxford: Archaeopress.

Thieme, Hartmut. 2005. "The Lower Palaeolithic art of hunting. The case of Schöningen I3 II-4, Lower Saxony, Germany." In *The Hominid Individual in Context. Archaeological investigations of Lower and Middle Palaeolithic landscapes, locales and artefacts*, ed. Clive Gamble and Martin Potts, 115-132. London/New York: Routledge.

Tourloukis, V. 2010. *The early and middle Pleistocene archaeological record of Greece: current status and future prospects*. Leiden: Leiden University Press.

Trauth, Martin H., Maslin, Mark A., Deino, Alan, Strecker, Manfred R. 2005. Late cenozoic moisture history of East Africa. *Science* 309 (5743): 2051-2053.

Turner, Elaine. 1998. "Quaternary Deposits and Palaeolithic Excavations in the Karl Schneider Gravel Pit." *Jahrbuch des Römisch-Germanischen Zentralmuseums Mainz* 44: 5-192.

Ullrich, H. 1992. "Human evolutionary research in Eastern Germany." *Human Evolution* 7 (3): 31-39.

Valde-Nowak, Paweł, Adam Nadachowski, Teresa Madeyska. 2003. *Obłazowa Cave. Human activity, stratigraphy and palaeoenvironment*. Krakow: Institute of Archaeology and Ethnology, Polish Academy of Sciences.

Valde-Nowak Paweł, Nadachowski Adam, Wolsan Mieczysław. 1987. "Upper Palaeolithic boomerang made of a mammoth tusk in South Poland." *Nature* 329: 436-438.

Valoch, Karel. 1968. "Evolution of the Palaeolithic in Central and Eastern Europe." *Current Anthropology* 9 (5): 351-390.

Valoch, Karel. 1970. "Early Middle Palaeolithic (Stratum 14) in the Kůlna Cave near Sloup in the Moravian (Czechoslovakia)." *World Archaeology* 2 (1): 28-38.

Valoch, Karel. 1972. "Rapports entre le Paleolithique moyen et la Paleolithique supérieur en Europe centrale.» In *The origin of Homo sapiens*, ed. F. Bordes, 28-38. Paris: UNESCO.

Valoch, Karel. 1986. "La Variabilité du Paléolithique inférieur et moyen en Europe Centrale." In *Chronostratigraphie et facies culturels du Paléolithique Inférieur et moyen dans l'Europe du nord-ouest*, ed. A. Tuffreau, and J. Sommé, 61-73. Paris.

Valoch, Karel. 1995. "The earliest occupation of Europe: Easter Central and Southeastern Europe." *The earliest occupation of Europe; proceedings of the European Science Foundation Workshop at Tautavel (France) 1993*, ed. Roebroeks, W. and T. Kolfschoten, 67-84. Leiden: Leiden University Press.

Valoch, Karel. 1996. *Le Paléolithique en Tchéquie et en Slovaquie*. Grenoble: Jérôme Millon.

Valoch, Karel. 1999. "Stránská Skála, Un Site Cromériene Près De Brno (Moravie, République Tchèque)." In *Los Homínidos Y Su Entorno En El Pleistoceno Inferior Y Medio De Eurasie. Actas Del Congreso Interacional de Paleontologia Humana, Orce 1995,* ed. J. Gibert, F. Sánchez, L. Gibert and F. Ribot, 451-458. Orce: Museo de Prehistoria y Paleotologia "J. Giber".

Valoch, Karel. 2004. "Pleistocenni sedimenty a paleoliticke artefakty z cihelny v Modricich u Brna." *Archeologicke rozhledy* LVI: 619-626.

Vandenberghe, J., H. Renssen, K. van Huissteden, G. Nugteren, M. Konert, H. Lu, A. Dodonov, J. P. Buylaert. 2006. "Penetration of Atlantic westerly winds into Central and East Asia." *Quaternary Science Reviews* 25 (17-18): 2380-2389.

van der Made, Jan. 2011. "Biogeography and climatic change as a context to human dispersal out of Africa and within Eurasia." *Quaternary Science Reviews* 30 (11-12) (June): 1353-1367. doi:10.1016/j.quascirev.2010.02.028.

van der Made, J., A. Mateos. 2010. "Longstanding biogeographic patterns and the dispersal of early Homo out of Africa and into Europe." *Quaternary International* 223-224 (September 1): 195-200. doi:10.1016/j.quaint.2009.11.015.

Vasil'ev, Sergey A. 2002. "Palaeolithic studies in Russia: Retrospect and Prospects." In *Archäologien*

Europas: Geschichte, Methoden und Theorien, ed. Peter F. Biehl, Alexander Gramsch and Arkadiusz Marciniak, 255-270. Münster/New York/München/Berlin: Waxmann.

Vékony, G. 2003. “The History of Archaeological Fieldwork in Hungary.” In *Hungarian Archaeology at the Turn of the Millenium*, ed. Z. Visy, M. Nagy and Z. B. Kiss, 81-85. Budapest: Ministry of National Cultural Heritage.

Velkov, V. 1993. “Archaeology in Bulgaria.” *Antiquity* 67 (254): 125-129.

Vértes, Laszlo. 1961. “An Experiment in Exhibition: ‘The Palaeolithic Age’ in the Hungarian National Museum.” *Current Anthropology* 2 (3): 247-254.

Vértes, Laszlo. 1965. “Typology of the Buda-Industry, a pebble-tool industry from the Hungarian Lower Palaeolithic.” *Quaternaria* 7: 185-195.

Vértes, Laszlo. 1990. “Settlement and Technology: the Evaluation of the Site and its Connections; Compiled on the basis of L. Vértes published articles and unpublished manuscripts by Viola T. Dobosi.” In *Vértesszölös. Site, man and culture,* ed. Kretzoi Miklós, Viola T. Dobosi. Budapest: Akadémiai Kiadó.

Villa, Paola. 1983. *Terra Amata and the Middle Pleistocene Archaeological Record of Southern France*. Berkeley: University of California Press.

Villa, Paola. 2001. “Early Italy and the Colonization of Western Europe.” *Quaternary International* 75: 113-130.

Vlček, E., D. Mania, U. Mania. 2000. “A new find of a Middle Pleistocene mandible from Bilzingsleben, Germany.” *Die Naturwissenschaften* 87 (6) (June): 264-5.

Voormolen, Boudewijn. 2008. *Ancient hunters, modern butchers. Schöningen 13II – 4, a kill – butchery site dating from the northwest European Lower Palaeolithic*. Unpublished PhD Thesis, Leiden University.

Wagner, Günther A, Matthias Krbetschek, Detlev Degering, Jean-jacques Bahain, Qingfeng Shao. 2010. “Radiometric dating of the type-site *for Homo heidelbergensis* at Mauer, Germany.” *Proceedings of the National Academy of Sciences* 107 (46): 19726-19730. doi:10.1073/pnas.1012722107/-/DCSupplemental.www.pnas.org/cgi/doi/10.1073/pnas.1012722107.

Wagner, Günther A., Lutz Christian Maul, Manfred Löscher, H. Dieter Schreiber. 2011. “Mauer – the type site of *Homo heidelbergensis*: palaeoenvironment and age.” *Quaternary Science Reviews* 30 (11-12) (June): 1464-1473. doi:10.1016/j.quascirev.2010.01.013.

Weber, Thomas. 2004. “Die ältesten Spuren des Menschen in Sachsen-Anhalt.” In *Paläolithikum und Mesolithikum,* ed. Harald Meller, 61-67. Halle (Saale): Landesamt für Denkmalpflege und Archäologie Sachsen-Anhalt.

Wendorf, Fred, Romuald Schild. 1980. *Prehistory of the Eastern Sahara*. New York: Academic Press.

White, Mark J. 2000. “The Clactonian Question: On the Interpretation of Core-and-Flake Assemblages in the British Lower Paleolithic.” *Journal of World Prehistory* 14 (1): 1-63.

White, Mark J., Nicholas Ashton. 2003. “Lower Palaeolithic Core Technology and the Origins of Levallois Method in North-Western Europe.” *Current Anthropology* 44 (4): 598-609.

Wilensky, U. 1999. “NetLogo.” Accessed: 20.05.2010. http://ccl.northwestern.edu/netlogo/ Center for Connected Learning and Computer-Based Modeling, Northwestern University. Evanston, IL

Wojtal, Piotr, Krzysztof Sobczyk. 2005. “Man and woolly mammoth at the Kraków Spadzista Street (B) – taphonomy of the site.” *Journal of Archaeological Science* 32 (2): 193-206. doi:10.1016/j.jas.2004.08.005.

Yokoyama Yuji, Roland Bibron, Christophe Falguères. 1988. "Datation absolue des planchers stalagmitiques de la Grotte de Vallonnet á Roquebrune-Cap-Martin (Alpes-Maritimes) France, par la résonance de spin électronique (ESR). " *l'Anthropologie* 92 (2): 429-436.

Zeuner, Friedrich E. 1935. "The Pleistocene Chronology of Central Europe." *Geological Magazine* 72 (08) (May 1): 350-376. doi:10.1017/S0016756800094413.