Central German Lower and Middle Palaeolithic assemblages. An overview of technocomplexes supported by flake analysis

Mitteldeutsche Inventare des Alt- und Mittelpaläolithikums. Ein Überblick über die Technokomplexe auf der Grundlage einer Analyse der Abschläge

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Abstract - In Central Germany, Palaeolithic assemblages occur with and without bifacial tools – handaxes, backed bifacial knives (Keilmesser), leaf points (Blattspitzen) – over a time span of more than 300 ka (i.e. between more than 400 ka and less than 50 ka ago). There are biface-rich, biface-poor and biface-free assemblages in different technocomplexes from the Middle Pleistocene Lower (clactonoid) Palaeolithic through the (Early) Saalian Middle (acheuloid) Palaeolithic up to the Upper Pleistocene – Interglacial (Eemian) and Early Weichselian (glacial) Middle Palaeolithic. In this paper, I would like to address these assemblages and present them in a new light.
The aim of this paper is twofold: first of all, I would like to provide an overview of selected Central German Lower and Middle Palaeolithic assemblages illustrating all technocomplexes. On top of that I have added information on some interesting recent single finds in order to outline the extension of the Pleistocene oecumene.
Secondly, I have statistically investigated samples of flint debitage from each of these assemblages. The analysis reveals that the flakes provide evidence for a gradual development from the older to the younger technocomplexes, which is virtually independent of the presence or absence of bifacially worked tools. The tool (and even biface) frequencies play a limited role in assigning an assemblage to a specific technocomplex. Consequently, the traditional method of using index fossils as indicators for technocomplexes should at least be supplemented by results from flake analysis.

***Zusammenfassung** - In Mitteldeutschland kommen älterpaläolithische Inventare mit und ohne bifazielle Werkzeuge – Faustkeile, Keilmesser, Blattspitzen – über einen Zeitraum von mehr als 300 ka (d. h. zwischen mehr als 400 ka und weniger als 50 ka) vor. Es gibt Biface-reiche, Biface-arme und Biface-freie Inventare in verschiedenen Technokomplexen vom mittelpleistozänen (clactonoiden) Altpaläolithikum über das (früh-)saalezeitliche (acheuloide) Mittelpaläolithikum bis hin zum jungpleistozänen interglazialen (eemzeitlichen) und glazialen (frühweichselzeitlichen) Mittelpaläolithikum. In diesem Beitrag möchte ich diese Inventare in einem neuen Licht präsentieren.*
Das Ziel dieser Arbeit ist zweierlei: Zunächst möchte ich einen Überblick über ausgewählte mitteldeutsche alt- und mittelpaläolithische Inventare geben, die alle Technokomplexe illustrieren. Darüber hinaus habe ich Informationen zu einigen interessanten neueren Einzelfunden hinzugefügt, um die Ausdehnung der pleistozänen Ökumene zu skizzieren.
Zweitens habe ich Stichproben von Feuersteinabschlägen aus jedem dieser Inventare statistisch untersucht. Die Analyse zeigt, dass die Abschläge eine allmähliche Entwicklung von den älteren zu den jüngeren Technokomplexen belegen, die sich praktisch unabhängig vom Vorhandensein oder Fehlen von bifaziell bearbeiteten Werkzeugen vollzog. Die Werkzeughäufigkeiten (und sogar die Biface-Häufigkeiten) spielen eine begrenzte Rolle bei der Zuordnung eines Inventars zu einem bestimmten Technokomplex. Folglich sollte die traditionelle Methode der Verwendung von Leitformen als Indikatoren für Technokomplexe zumindest durch Ergebnisse der Abschlaganalyse ergänzt werden.

Keywords - Stone artefact technology, attribute analysis, Central Germany
Steinartefakttechnologie, Merkmalaufnahme, Mitteldeutschland

Introduction

The region between the southern border of the Weichselian glaciation and the northern foothills of the Central German highlands of the Harz, Thuringian forest, and Erzgebirge (Ore mountains) is characterized by multiple alternations of continent-wide ice shields and human settlements. Although it is still unclear if there were worked stone artefacts before the Elsterian glaciation, we are sure that the post-Elsterian sediments

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like river gravels of the older Middle Pleistocene terrace (Ruske 1973) contain human traces: flint artefacts including cores, flakes, and differently retouched implements, tools. And even Middle Pleistocene limnic layers like the travertine complex found in Bilzingsleben with a large amount of plant remains, fauna (sometimes with human cut marks), and human skull fragments include flint and non-flint (quartzite, crystalline, limestone) pieces – some of which have been worked by early humans.

In Central Germany, artefact assemblages with bifaces occur during a time span between perhaps more than 400 ka and less than 50 ka ago (Tab. 1; cf. Lauer & Weiss 2018). We may distinguish four identifiable technocomplexes in the region between the southernmost margins of the Weichselian and the Elsterian glaciations:

(i) The clactonoid (after Clacton-on-Sea in the UK) early post-Elsterian Lower Palaeolithic dated in the Holsteinian interglacial and in the lower part of the Saalian glacial complex sensu lato. It may be classified in Marine Isotope Stage (MIS) 11 more or less immediately after MIS 12 (= Elsterian glaciation)
(ii) The acheuloid (after St. Acheul in northern France) Middle Palaeolithic from the early Saalian sensu stricto (Drenthe). It belongs in MIS 10 or 9 to 7.
(iii) The Middle Palaeolithic from the last (Eemian) interglacial – traditionally classified as Tayacian, Taubachian or Weimarer Kultur. It belongs in MIS 5e (or in the case of Ehringsdorf MIS 7).
(iv) The Middle Palaeolithic from the early last glacial (Weichselian) – Mousterian, Micoquian, and the Middle Palaeolithic leaf point industries. These sites belong in the MIS 5d to 3.

A fifth group outside this classification scheme is an artificial one: assemblages which cannot be classified clearly as they may be dated in the penultimate or in the last glaciation – Saalian or Weichselian. They mostly come up during gravel digging in quarry ponds with poorly dated sediments often below the ground water levels. However, the finds from these assemblages make up a substantial number of all finds from the Palaeolithic (including the Lower and the Middle Palaeolithic periods) so they should not be neglected when this period is investigated.

We have found a large number of sites with and without bifaces from all these industries. Even for the younger periods (Weichselian Middle Palaeolithic) extremely diverse tool spectra with and without bifacial tools have been discovered. Some of these bifacial tools have traditionally been regarded as index fossils thus

Site	Find type	Number of flakes[1]	Find conditions	Relative dating	Absolute dating (ka/BP)	Reference
Barleben-Adamsee	assemblage	109	"underwater collection"	Saalian or Weichselian	-	-
Bilzingsleben	assemblage	173	excavation, 4-mm-sieving	Middle Pleistocene	>350	Mallick 2000
Clacton-on-Sea	assemblage	134	gravel collection	Middle Pleistocene	<450	Ashton et al. 1994
Delitzsch-Südwest	assemblage	104	gravel collection	Saalian	227 ± 15	Krbetschek et al. 2008
Ermlitz-Rübsen	single find	-	surface collection	Saalian or Weichselian	-	-
Eythra	assemblage	300	gravel collection	Saalian	280 ± 45	Krbetschek et al. 2008
Großhelmsdorf	single find	-	surface collection	Weichselian	-	-
Hundisburg	assemblage	71	gravel collection	Saalian	-	-
Königsaue A/B	assemblage	269/504	excavation, sieving	Weichselian	49-45.64 calBP (1-s; OxA-7124) 45.57-44.85 calBP (1-s; MAMS-24487)	Weiss et al. 2017
Lichtenberg	assemblage	139	excavation, sieving	Weichselian	57 ± 6	Veil et al. 1994
Magdeburg-Rothensee	assemblage	107	"underwater collection"	Saalian or Weichselian	-	-
Markkleeberg	assemblage	3	gravel collection	Saalian	236 + 23	Lauer & Weiss 2018
Potsdam-Nedlitz	single find	-	excavation	Weichselian	-	-
Taubach	assemblage	223	excavations and collections	Eemian	114	Mallick 2007
Wallendorf	assemblage	730	gravel collection	Middle Pleistocene	447 ± 52; 406 ± 44	Lauer & Weiss 2018
Weimar-Ehringsdorf	assemblage	760	excavations and collections	Eemian (or Pre-Eemian)	-	cf. Schäfer 2007
Westeregeln	assemblage	338	excavation, 4-mm-sieving	Weichselian	50.31 + 1.58/-1.32	Weber 1996a

Tab. 1. Find circumstances of the assemblages cited in the text. [1] This column contains the number of flakes analysed in the present study, which is not identical to the total number of finds from the site.

Tab. 1. *Fundumstände der im Text zitierten Inventare. [1]Diese Spalte enthält die Anzahl der in der vorliegenden Studie analysierten Abschläge, die nicht mit der Gesamtzahl der Funde aus der jeweiligen Fundstelle identisch ist.*

playing an important role in the classification of the assemblages into technocomplexes. In this paper, I will argue that it is not only tool composition that should be taken into account in elucidating the relationship between the assemblages. Instead, the remains of all stages of the tool production process (blanks, cores, and flakes) need to be looked at in order to fully understand the technological development by which these assemblages may be related. A statistical analysis of the morphological features that these remains display may tell us more than the traditional index fossils.

In order to provide such an analysis, I have conducted a study investigating a sample of 6,966 complete flint flakes from selected Central German Lower and Middle Palaeolithic assemblages. All technocomplexes are represented in the study. I have exclusively focused here on the most numerous group of artefacts, namely flakes. I have analysed measurable and observable flake features such as form quotients, flaking angles, and platform and dorsal face conditions.

Study area

In this section, the material of the study will be presented on the basis of Central German Lower and Middle Palaeolithic assemblages, from which samples were taken. Apart from that, I address some interesting recent single finds (bifaces), which may illustrate that Palaeolithic biface-containing assemblages were more widespread than today's picture of excavated assemblages with bifacial tools suggests. These single finds, however, have not been included in my statistical analysis.

In addition to the Central German assemblages I supplemented my study with a further sample from Clacton-on-Sea for reasons of comparison. The artefacts from this assemblage were made of a comparable raw material (cretaceous flint). The Central European flint raw material, Baltic moraine flint, was brought to the region by the Pleistocene glaciers of the Elsterian and the Saalian glaciations, later also by the Upper Pleistocene Weichselian glaciers during the Upper Palaeolithic (Fig. 1).

There are different raw material qualities and size distributions in the study area (Weber 1997b: 436-437, Figs. 2-3): The best (larger and more homogeneous) raw pieces were found rather north-eastwards, less good pieces in the southwestern area near the extreme borders of the earlier Elsterian and Saalian glaciations. Perhaps there are differences in the accessibility during the different phases – in the interglacials the larger flint pieces were probably more difficult to reach for the inhabitants than during the colder periods with sparser vegetation cover. The geological contexts in which the artefacts are found – especially fluvial and lacustrine sediments – were deposited under different climatic conditions from thermal through the onset up to glacial maximum circumstances.

Additionally, the possibility of (multiple) rearrangements of the finds – up to recent finding situations should be taken into account. I. Romanowska

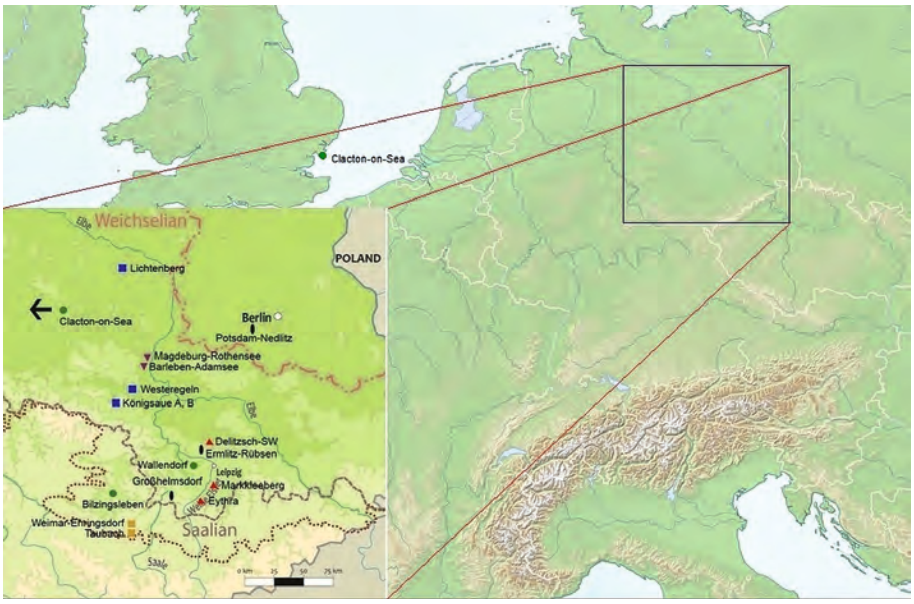

Fig. 1. Map of the study area. Green circles: Middle Pleistocene post-Elsterian clactonoid assemblages, red upright triangles: Early Saalian sensu lato acheuloid assemblages, yellow squares: Interglacial resp. Eemian assemblages, blue squares: Early Weichselian assemblages, purple inverted triangles: Early Saalian or Early Weichselian assemblages and black lancets: Single finds (Redrawn with permission of the author M. Weiss after Lauer et al. 2020, Fig. 1).

Abb. 1. *Karte des Studiengebietes. Grüne Kreise: mittelpleistozäne nachelsterzeitliche clactonoide Inventare, rote aufrechte Dreiecke: frühsaalezeitliche (sensu lato) acheuloide Inventare, gelbe Quadrate: interglaziale bzw. eemzeitliche Inventare, blaue Quadrate: frühweichselzeitliche Inventare, violette umgekehrte Dreiecke: frühsaale- oder frühweichselzeitliche Inventare und schwarze Lanzetten: Einzelfunde (Mit freundlicher Genehmigung des Autors M. Weiss nach Lauer et al. 2020, Abb. 1).*

(2012) has argued that the Central and East European archaeological record for the Lower Palaeolithic is influenced – biased – by the distribution of loess sediments even in these parts of our continent as the loess may cover the finds from older surfaces. In the case of Central Germany, we have a remarkable loess coverage and, clearly, we have not found Palaeolithic artefacts on the – mostly Upper Weichselian – loess surfaces.

Middle Pleistocene post-Elsterian clactonoid assemblages (Wallendorf, Bilzingsleben and Clacton-on-Sea)

Even the oldest clactonoid (sensu Collins 1968) or Lower Palaeolithic assemblages (sensu Lauer & Weiss 2018) contain roughly elaborated bifacial tools. This is true for Wallendorf and Bilzingsleben as well as for Clacton-on-Sea (cf. Wymer 1985), which is, of course, not situated in Central Germany but in eastern England. The sample from Clacton-on-Sea included in the present study was analysed by me several years ago (cf. Weber 2007) and has been reassessed for the present context. It contains 134 flakes.

The Wallendorf (Saalekreis, Saxony-Anhalt) gravel pit in the post-Elsterian older Middle Pleistocene terrace (Ruske 1973) shows up to 12 metres of sands and gravels, which were accumulated on the ground of a river during a period in which the climate was getting colder: beginning with a temperate wood phase up to arctic permafrost conditions. This climatic development is reflected by an increase of the percentage of limestone (Muschelkalk) pebbles in the sediments, by the presence of different molluscs in several fine-grained sediment lenses, and by remains of ice wedge pseudomorphs (cryoturbated structures) as permafrost indicators in the upper layers (Weber & Thum 1991). The artefacts were found mostly in the lower parts of the profile. It is possible that the cultural remains belong to the transition from a warmer period immediately after the Elsterian (Holsteinian) to the first cooler event in the Saalian sensu lato (Fuhne). In calendar years, this may have been between 350,000 and 400,000 years ago. From the viewpoint of traditional tool typology, the Wallendorf artefacts have been attributed to the Clactonian technocomplex with simple cores, thick flakes, tools with rough retouch and at least a few bifacial worked tools (Fig. 2; cf. Rudolph et al. 2012). The sample used for the present study contains 730 flakes.

The travertine complex Steinrinne near Bilzingsleben (Kindelbrück parish, Sömmerda district, Thuringia) excavated by Dietrich Mania between 1969 and 2003 has yielded several human remains ascribed to *Homo erectus* or *Homo heidelbergensis* together with a large number of ecofacts (like plant remains and fauna) and cultural remains including several small and rough bifacial facial flint points. The artefacts are disputed as the archaeological evidence is a matter of controversial discussion (Beck et al. 2007). C. Pasda (2012: 39) wrote: "Different natural agencies, like glacial and fluvioglacial action, rock fall, fluvial disturbance, frost action, sediment load and trampling can result in artefact-like features such as bulbs, radial lines, butts, ventral and dorsal faces".

Pasda is certainly justified in drawing our attention to the fact that the geological situation – more or less autochthonous settlement features versus results of a mass flow combined with fluvial inundation – may have affected the interpretation of certain pieces as artefacts or geofacts. However, I do not agree with him when it comes to the extent to which he claims this to have happened in the case of this site.

R. Rocca (2016: 215), on the other hand, has emphasized that Central and Eastern European Lower Palaeolithic assemblages (like Bilzingsleben) "are characterized by a great variability of small tools on different types of blanks" – in her opinion predominantly no flakes but natural blanks. I agree with her but I see this tendency manifested more clearly in sites where the tools were made from "bad" (i.e. small-sized and/or non-flint) raw material (cf. Weber 1983: 497).

For Bilzingsleben, the excavator Dietrich Mania has described a large number of worked flint pieces, with bifacial retouched implements among them. The non-flint (quartzite, travertine, crystalline etc.) pieces also seemed to show traces of bifacial working (Fig. 2: 2-3). However, for these coarse-grained raw materials, distinguishing geofacts from artefacts is much more difficult than in the case of the cryptocrystalline flints (Bock et al. 2017). In order to be able to objectively distinguish naturally modified pieces from artificially modified ones, it would be extremely useful to draw on the study elaborated by Dies (1975: 153). He writes: "On the wave nature of the energy input at the blow, some peculiarities can also be observed during the breaking process: since the waves are reflected at interfaces, are diffracted at obstacles and flaws, they can interfere with the primary wave, so that especially with quartzite flakes arise on the fracture surface, which in their accumulation are characteristic of impact stress." (translation Th. Weber) Furthermore, the wavy appearance of the surface, the so-called Wallner lines and lancet-shaped fractures can be attributed to this. "Here an attempt was undertaken to distinguish between pressed (natural) surfaces and flaked (artificial) surfaces on the micro Scanning Electron Microscope (SEM) level. We would like to replicate that study based on a clear artefact with a relatively fresh surface like the handaxe from Potsdam-Nedlitz (see below, Fig. 4: 1) which may be compared with other – rather doubtful – pieces made of coarser raw materials. The results of this comparison might shed more light on the differences between artefacts and geofacts.

In spite of all these caveats, I have decided to include specific finds from Bilzingsleben in my statistical analysis of flake features. I use a sample of flint flakes analysed by myself in the early 1980s (Weber 1986). In order to ensure flake status, I have confined myself to solely

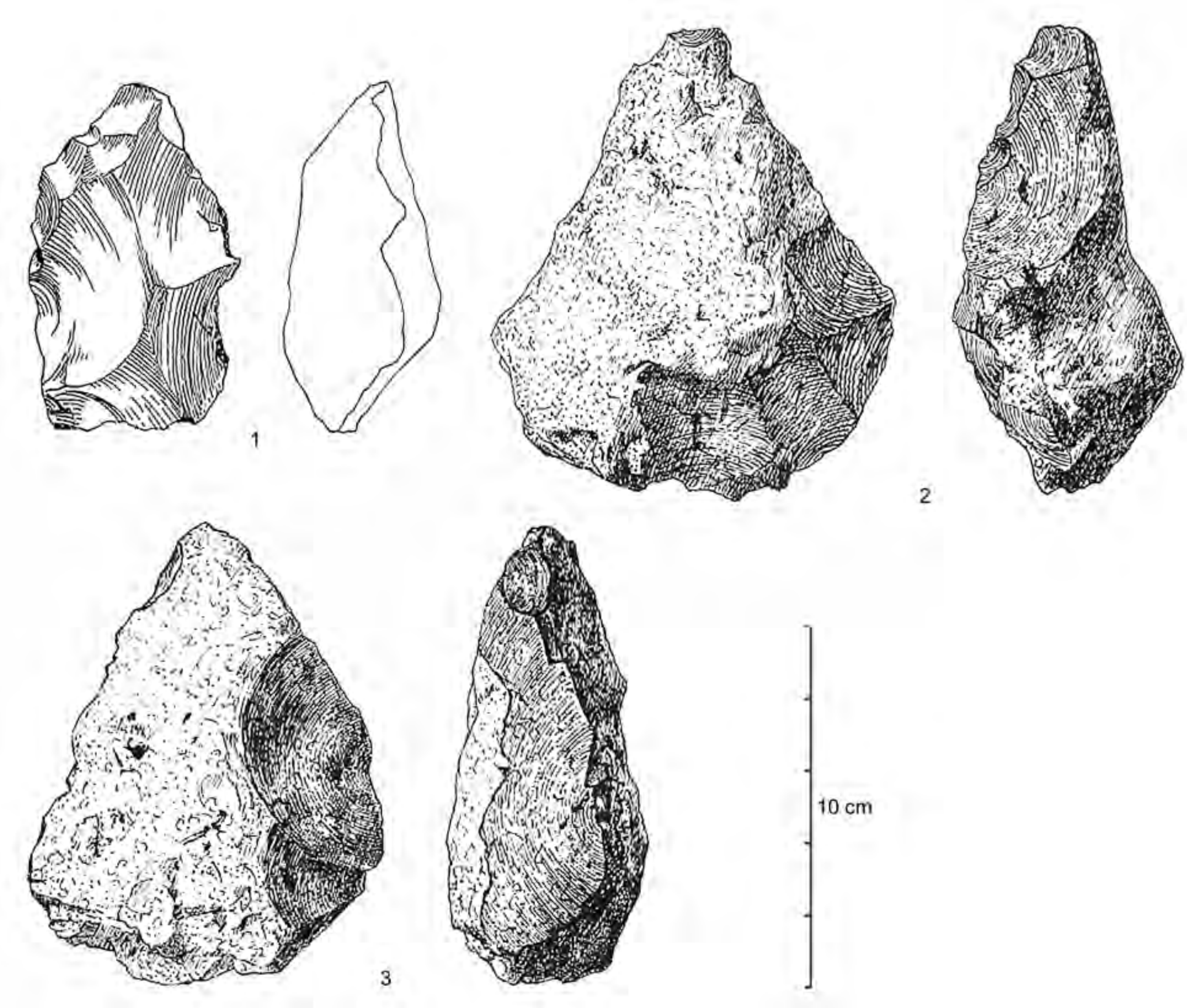

Fig. 2. 1: Wallendorf, Saalekreis. Flint handaxe trimmed with a few face retouch negatives (Drawing: Jochen Thum. Cf. Weber 2004, Abb. 12.2), 2: Bilzingsleben, Ldkr. Sömmerda. Pointed oval handaxe, Granite, Bi 159:9 (Drawing: Manfred Rohrbeck), 3: Bilzingsleben. Ldkr. Sömmerda. Pointed oval handaxe (?). Travertine, Bi 162:22 (Drawing: Manfred Rohrbeck).
Abb. 2. *1: Wallendorf, Saalekreis. Faustkeil aus Flint, bearbeitet mit einigen Flächenretusche-Negativen (Zeichnung: Jochen Thum. Vgl. Weber 2004, Abb. 12.2), 2: Bilzingsleben, Ldkr. Sömmerda. Spitzer ovaler Faustkeil, Granit, Bi 159:9 (Zeichnung: Manfred Rohrbeck), 3: Bilzingsleben. Ldkr. Sömmerda. Spitzovaler Faustkeil (?). Travertin, Bi 162:22 (Zeichnung: Manfred Rohrbeck).*

including pieces with length and flake width (breadth) values ≥ 20 mm and measurable platforms (width and depth ≥ 1 mm) with at least one dorsal negative. In this way I rely on a minimum of two impacts in treating something as a flake. This cutoff resulted in a total of 173 flakes for my analysis.

Early Saalian sensu lato acheuloid assemblages (Markkleeberg main terrace, Delitzsch- Südwest, Eythra and Hundisburg)

Later, during a long phase of the Early Saalian sensu stricto there are bifacial-poor such as Markkleeberg (near Leipzig; cf. Baumann & Mania 1983: Abb. 161-166) and rather bifacial-rich assemblages such as, e. g., Eythra, which – unfortunately – has not been fully well-dated yet. For the most part, it has been assigned to the Saalian sensu lato (cf. Rudolph et al. 1995: Abb. 6; Lauer & Weiss 2018). In Markkleeberg, gravels of a river silt immediately above the Tertiary (Oligocene) sea sands are covered by kryogenic sediments. As in the Early Saalian the ice sheet extended up to South of Leipzig for the last time, this Early Saalian (Zeitz phase ice margin) may give us a terminus ante quem for these gravels of the so-called main terrace (Hauptterrasse).

The 3,000 Markkleeberg artefacts I have used for the present study (from Baumann's and Mania's excavations in the 1970s and 1980s; cf. Weber 2020) were found in the main terrace's layers more or less immediately above the gravel basis. Perhaps there was a comparable process of sediment accumulation as the one observed in Wallendorf. The absolute dating of the Markkleeberg assemblage depends on the Saalian chronology. Lauer and Weiss (2018: 4 & Fig. 2) show different find layers from the main terrace with 236 ±23 and 217 ±23 ka up to the Markkleeberg cryoturbation with values near 150 or 160 ka. As the southernmost Saalian extension to Zeitz with the later ice margins near the Petersberg (Halle) and the Fläming was a more or less integral climatic event, the terminus ante quem for this archaeological material can be given with not more than perhaps 160,000 years ago. But even for this case it is possible that the development of the main terrace has taken a long time of perhaps several 10,000s of years (cf. Lauer & Weiss 2018). The pieces of my sample from the excavations in the gravel basis undertaken by Baumann and Mania (1983) may belong to an earlier stage of the main terrace of c. 250 ka ago. Typologically spoken, these Markkleeberg finds form a part of the Acheulian with relatively rare but characteristic handaxes and a special flaking preparation technology (Levallois, cf. Wisniewski 2014).

In the former (devastated) village Eythra (Zwenkau open cast, Leipzig district, Saxony), the volunteer archaeologists Wolfgang Bernhardt, Adrian Pustlauck, Armin and Peter Rudolph have collected a large number of flint artefacts mostly from the main terrace gravels exposed in the lignite pit (Rudolph et al. 1995). New data from a Max Planck Institute dating project show that the basal part of these main terrace gravels containing the artefacts can be dated back to 280 ± 45 ka ago (Lauer & Weiss 2018: 4 & Fig. 2). For the present study I have used a sample of 300 flakes. In the former lignite open cast Delitzsch-Südwest north of Leipzig (North Saxony district, Saxony, Bernhardt & Rudolph 1996) terrace gravels from the period between the Elsterian and Early Saalian (Drenthe) glaciations have been found. Here, among the total of 104 artefacts, several pieces in Levallois technology have been discovered, however, with neither larger pieces nor bifaces. Not far from there, in the same open cast in the former subdistrict Zwochau, C. Pasda has excavated several artefact concentrations in rather fine-grained sediments of a gravel-silt-peat-complex from a tributary of the upper main terrace, which is dated more reliably as in the Early Saalian sensu lato (Pasda 1996; Weber 1996b; Wansa & Wimmer 1996). For my analysis, I have addressed all recovered pieces (i.e. flakes).

From the typological point of view all the pieces from the Leipzig region are comparable with the newly excavated Hundisburg Acheulian material also dated to the Early Saalian (Ertmer 2011). The older pieces from this gravel pit have included at least two handaxes (cf. Toepfer 1961: Abb. 1-3 & 6). For the present study, I have investigated 71 flakes from these older finds.

Eemian respectively Interglacial assemblages (Weimar-Ehringsdorf and Taubach)

From the last (Eemian) interglacial in Central Germany we have not found bifacial worked tools except for the well-known Ehringsdorf hand points and Fäustel (small handaxes) (cf. Behm-Blancke 1959/60: Abb. 59: 3, 60 & 61; Toepfer 1970: 362 & Abb. 95: 5). M. Kot (2017: 77) argues that the "Ehringsdorf tools were abandoned while being extremely exhausted" as a result of consecutive – and also bifacial – rejuvenations. Therefore Ehringsdorf (and the other Ilm valley assemblages) are characterized by a large number of stone artefacts made of other raw materials than flint. If the Ehringsdorf pieces belong to this interglacial is – even from the viewpoint of the absolute datings – still an open question. From the viewpoint of the radiometric data (Mallick 2000: 102 & Abb. 7: 45; Mallick & Frank 2002) and following palaeontological considerations (Schäfer 2007: 182) there are arguments that the Ehringsdorf site (at least the Lower Travertine layer) should be placed in the MIS 7 and thus in an earlier interglacial than the Eemian (= MIS 5e). If we follow these arguments, then these Lower Travertine pieces from Ehringsdorf may be dated earlier than the artefacts from MIS 6 (= Late Saalian) assemblages (like from the Markkleeberg cryoturbated horizon – cf. Wisniewski 2014: 369 & Fig. 2). For the present study, I have analysed 760 flint flakes from the lower Travertine layer of Ehringsdorf using the data taken by D. Schäfer (1993; 2007).

Taubach, the eponymous site for the so-called Taubachian, is also situated in the Ilm valley near Weimar and is characterized by the most blade-like flakes in the Eemian Middle Palaeolithic (Schäfer 1993). For the present analysis, I have drawn upon a sample of 223 flakes. Just like the majority of all these interglacial sites, the Taubach assemblage does not contain any bifacial worked pieces.

Other assemblages from the same period such as the *Elephas antiquus* killing sites Gröbern and Lehringen with their small specialized tool kits and Rabutz with a limited number of flakes have not lent themselves for the present analysis.

Early Weichselian assemblages (Königsaue A, Königsaue B, Lichtenberg and Westeregeln)

The upper layers of the lignite mine Königsaue (Salzlandkreis, Saxony-Anhalt) originated in the former Aschersleben lake emerged by salt elutriation (halokinesis) and drained in the 18th century. The coal mining in the mid-20th century opened up a large sequence of lake sediments probably from the last (Eemian) interglacial over the Weichselian Glacial up to the geological present – Holocene (Mania & Toepfer 1973). In the deposits of an early Weichselian interstadial (Königsaue Ib) three archaeological horizons have been monitored. Two of these horizons – Königsaue A and Königsaue C (the lowest and the uppermost, cf. Mania & Toepfer 1973: Taf. 26-27) – are typologically characterized by the presence of bifacial knives (Keilmesser) as Central European Micoquian whereas the third (middle) horizon, Königsaue B, contains a Mousterian without bifacial working (Mania & Toepfer 1973: Taf. 38-60). For the present study, I have analysed 269 flakes from Königsaue A and 504 from Konigsaue B (using data from Schäfer 1993).

J. K. Kozlowski (2014: 357), however, argues for the "Micoquian as more than just a type of Mousterian". Königsaue B is different from Königsaue A in certain respects: the Königsaue B flake production has often included pieces for further modification into retouched implements (as has been the case in Wallendorf and Markkleeberg), whereas Königsaue A and C show a remarkable number of Keilmesser resharpening waste. A. Picin (2016) has interpreted these differences as a result of different activities during different kinds of Neanderthal visits in Königsaue: "…difference in the toolkit composition supports the hypothesis of logistical mobility during the Keilmesser occupations and residential mobility during the Levallois-Mousterian settlement." (Picin 2016: 7).

J. A. Frick (2020) has summed up the research history of the European Micoquian and has shown that the different Keilmesser groups with and without leaf points should be dated in the Early or Early Middle Weichselian – unfortunately with some uncertainties between MIS 5c and MIS 3. The Königsaue interstadial shows indications of a temperate cool climate. Following the excavator's stratigraphical view of a complete sequence (Vollgliederung) of the Weichselian represented in Königsaue (Mania 1973: 7), this interstadial may be parallelized with the later part of the first warmer Early Weichselian interstadial (Brörup – MIS 5c), in calendar years between more than 74,000 and less than 115,000 years ago (cf. Deutsche Stratigraphische Kommission 2016). But from the viewpoint of radiocarbon data, two resin pieces from the find horizons A and B (Grünberg et al. 1999; Hedges et al. 1998) as well as a reindeer bone fragment from horizon B have yielded datings of near or less 50 ka (Picin 2016: 11). It cannot be excluded that the Königsaue interstadial was simultaneous with MIS 3 and thus with a later stage of the Weichselian (Weiss et al. 2018). Picin is correct in saying that "a further extensive dating program is mandatory" (Picin 2016: 11). A collaborative, multidisciplinary dating project based on palynology, malacology, petrography, and absolute dating (OSL) of the sediments, etc. is currently planned and hopefully carried out soon by researchers from several German institutes.

In Lichtenberg (Lüchow-Dannenberg district, Lower Saxony) in the 1980s a Micoquian open air site was discovered by K. Breest and S. Veil in an Early Weichselian valley in stratified sands with cryoturbatic transformation (Veil et al. 1994; Weiss 2019; Weiss 2020). Among the approximately 150 artefacts from Lichtenberg, there are 20 bifacial worked knives, additionally flakes (mostly from tool resharpening), no cores (Breest & Veil 1989: 5 & cf. Abb. 5). For the present study, I have used the data from 139 unretouched flakes (measured by D. Schäfer).

The Weichselian assemblages from Westeregeln near Staßfurt (Salzlandkreis, Saxony-Anhalt) have come from two different geological situations – from an ice wedge in the Buntsandstein clay pit (Weber 2015) and from karst fissures in the Zechstein gypsum quarry. Both assemblages contained bifaces (two from a Moustérien de tradition acheuléenne (MTA) in the clay pit – Fig. 3: 2 & 3) and a backed knife in the karst sediment. Another micoquoid handaxe (Fig. 3: 1) found under rather unclear conditions some 60 years ago may have come from the same (karstic) context. For my analysis, I have used 338 artefacts from the karst fissures (excavation 2008-2009).

Early Saalian or Early Weichselian assemblages (Magdeburg-Rothensee and Barleben- Adamsee)

Some assemblages of the Middle Elbe dredged Palaeolithic were uncovered below the recent water level of the flooded gravel pits. Therefore, they were not detectable in their stratigraphic context. Some of them may be assigned to the Saalian Middle Palaeolithic for reasons of flake attribute analysis (Weber 1997a) but other assemblages from the same region to the Early Weichselian. Of course, the gravels from different glaciations can also be mixed in a plane landscape. We may expect that in this large river valley the relation between early glacial sedimentation and late glacial denudation changed during the different glaciations. Therefore, we cannot exactly date the single artefacts (like handaxes) found in the different outcrops (like gravel pits) but we can specify chronological trends for the majority of the pieces found under more or less the same conditions. It is impossible to assign most of these pieces exactly to the second – Saalian – or to the fourth – Early Weichselian – technocomplex. In Magdeburg-Rothensee (Landeshauptstadt Magdeburg, Saxony-Anhalt), several handaxes have been found (Kiehl & Weber 1991). In my analysis, I have included a sample of 107 flint flakes from there. In Barleben-Adamsee (Landkreis Börde, Saxony-Anhalt), amateur-archaeologist Uwe Beye discovered – among several handaxes – the fragment of a leaf point or a leaf-formed knife probably from the latest Middle Palaeolithic (Beye & Weber 2012: Abb. 1). From Barleben-Adamsee, I have analysed 114 flakes.

Collecting techniques

The absolute measurement values for the artefacts from the assemblages included in this study show large differences in flake size (length) reflecting raw material size but also the specific excavation or collection conditions. Naturally, the use of sieves for the investigation of fine-grained layers enables us to recover smaller artefacts whereas collections in coarse-grained sediments complicate the discovery of these smaller pieces. Fluvial (and marine) layers where the finds have simply been collected (Wallendorf, Clacton-on-Sea, Markkleeberg, Delitzsch-Südwest, Eythra, Hundisburg – only the older finds, Magdeburg-Rothensee, Barleben-Adamsee) show large size values – with the largest size medians for collections gained by a sieving process after underwater extraction (Magdeburg-Rothensee and Barleben). In such cases, the sieve width is 32 mm and therefore shorter flakes are quite rare. In Clacton-on-Sea, only larger pieces (mostly >50 mm in length) have been collected by S. H. Warren in coarse gravels near Lion's Point. They are now in the collection of the British Museum (Weber 2007: 148). The lacustrine sediments examined with more or less careful excavation techniques or collecting activities (Bilzingsleben, Ehringsdorf,

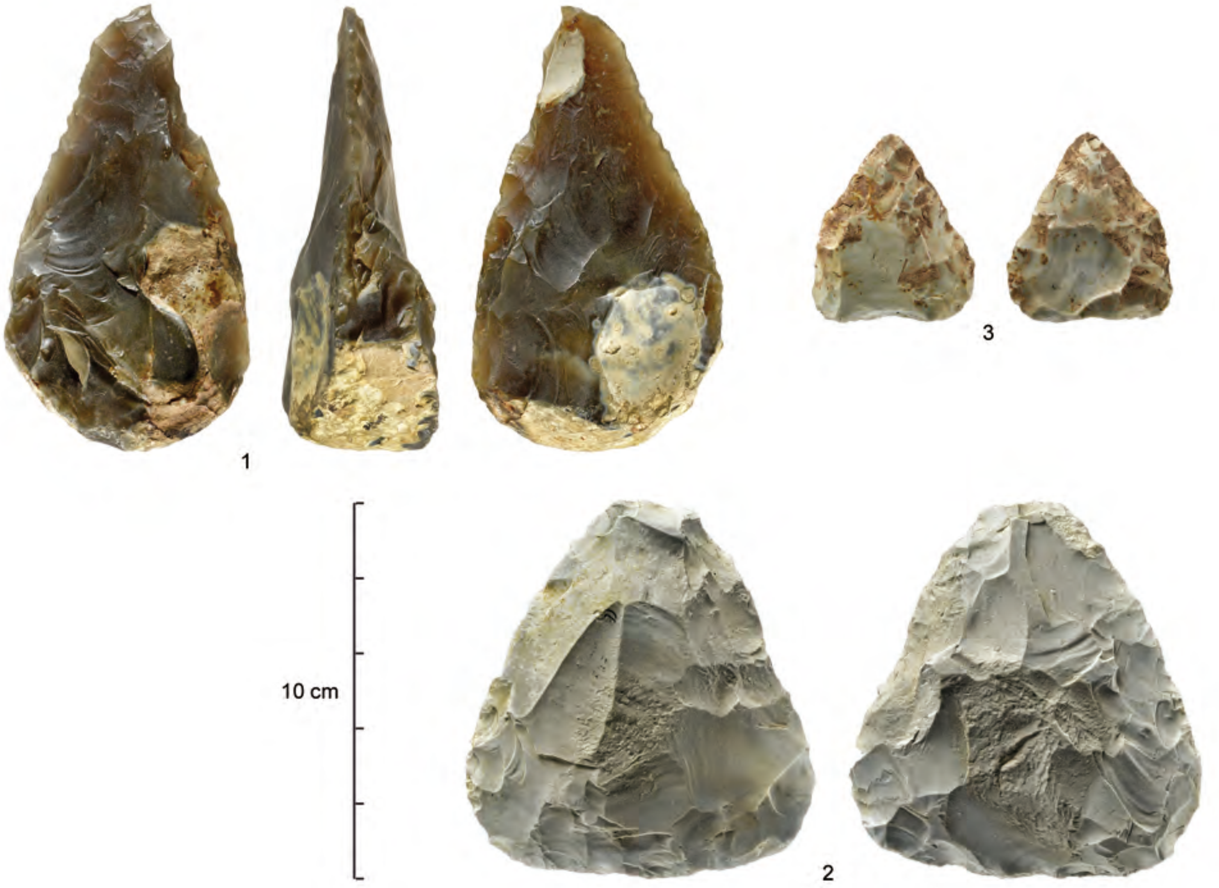

Fig. 3. 1: Westeregeln. Salzlandkreis. Micoquian handaxe from one of the karstic doline infills in the Berling ´sche gypsum quarry found by Mrs. G. Breithaupt in the 1950s (pers. comm. Breithaupt; LDA no. 12701:1, Photo LDA Sachsen-Anhalt, Andrea Hörentrup), 2: Westeregeln. Salzlandkreis. Moustérien de tradition acheuléenne (MTA) handaxe of non-patinated, non-transparent grey flint from an ice wedge found in 2001 in the small Buntsandstein clay pit near the Alte Ziegelei by Andreas Geisler (LDA no. 2001:1547, Photo LDA Sachsen-Anhalt, Juraj Lipták), 3: Westeregeln. Salzlandkreis. Small Moustérien de tradition acheuléenne (MTA) handaxe of patinated flint from the Buntsandstein clay pit found by K. Wächter (LDA no. 2002:6301a, Photo LDA Sachsen-Anhalt, Juraj Lipták).

Abb. 3. *1: Westeregeln. Salzlandkreis. Micoquien-Faustkeil aus einer Karst-Doline-Aufschüttung im Berling ´schen Gipssteinbruch, gefunden von Frau G. Breithaupt in den 1950er Jahren (pers. Mitteilung Breithaupt; LDA Nr. 12701:1, Foto LDA Sachsen-Anhalt, Andrea Hörentrup), 2: Westeregeln. Salzlandkreis. Moustérien de tradition acheuléenne (MTA) Faustkeil aus nicht patiniertem, undurchsichtigem grauem Feuerstein aus einem 2001 in der kleinen Buntsandstein-Tongrube bei der Alten Ziegelei von Andreas Geisler entdeckten Eiskeil (LDA-Nr. 2001:1547, Foto LDA Sachsen-Anhalt, Juraj Lipták), 3: Westeregeln. Salzlandkreis. Kleiner Moustérien de tradition acheuléenne (MTA) Faustkeil aus patiniertem Feuerstein aus der Buntsandstein-Tongrube, gefunden von K. Wächter (LDA Nr. 2002:6301a, Foto LDA Sachsen-Anhalt, Juraj Lipták).*

Taubach, Königsaue A and B, Lichtenberg, Westeregeln) have also yielded smaller pieces (Fig. 6). But the length values for the smallest artefacts do not differ so much for the macrolithic (gravel) and the microlithic (limnic) assemblages. The lower limit is usually between 10 and 20 mm.

New single finds

In addition, just during the last few years, some bifacial tools were detected in un-expected geological contexts – from the surface of the northern Thuringian basin covered with Pleistocene coarse debris layers through the Last Glacial Maximum Saxonian loess landscape up to the North German Weichselian moraine's area. The dispersal area of bifacial tools and therefore the Lower and Middle Palaeolithic settlement zone in Central Germany has been significantly enlarged by these new discoveries. However, these single pieces are only fragmentary traces of human presence during the Palaeolithic and should not be over-interpreted as definite indications for certain phases of human settlement history.

In 2014, volunteer archaeologist Thomas Großer discovered a spectacular handaxe on the field surface near Großhelmsdorf (Heideland parish, Saale-Holzland-Kreis, Thuringia) in the northeastern Thuringian basin. The piece, made of tertiary quartzite, is 162 mm long (it was probably a little bit longer as the tip is old-broken) and – with its elongated tip – seems to belong to a Weichselian micoquoid technocomplex. Not far from its exact find position, a flint piece, a backed bifacial knife, perhaps from a similar cultural context, has been recovered (Fig. 4: 2). It is, of course, quite difficult to date these pieces: in each of these cases the embedding sediments can only give indications for a terminus ante quem and we have to take into account different processes of re- deposition. Obviously, there is a high degree of probability that the youngest possible layers

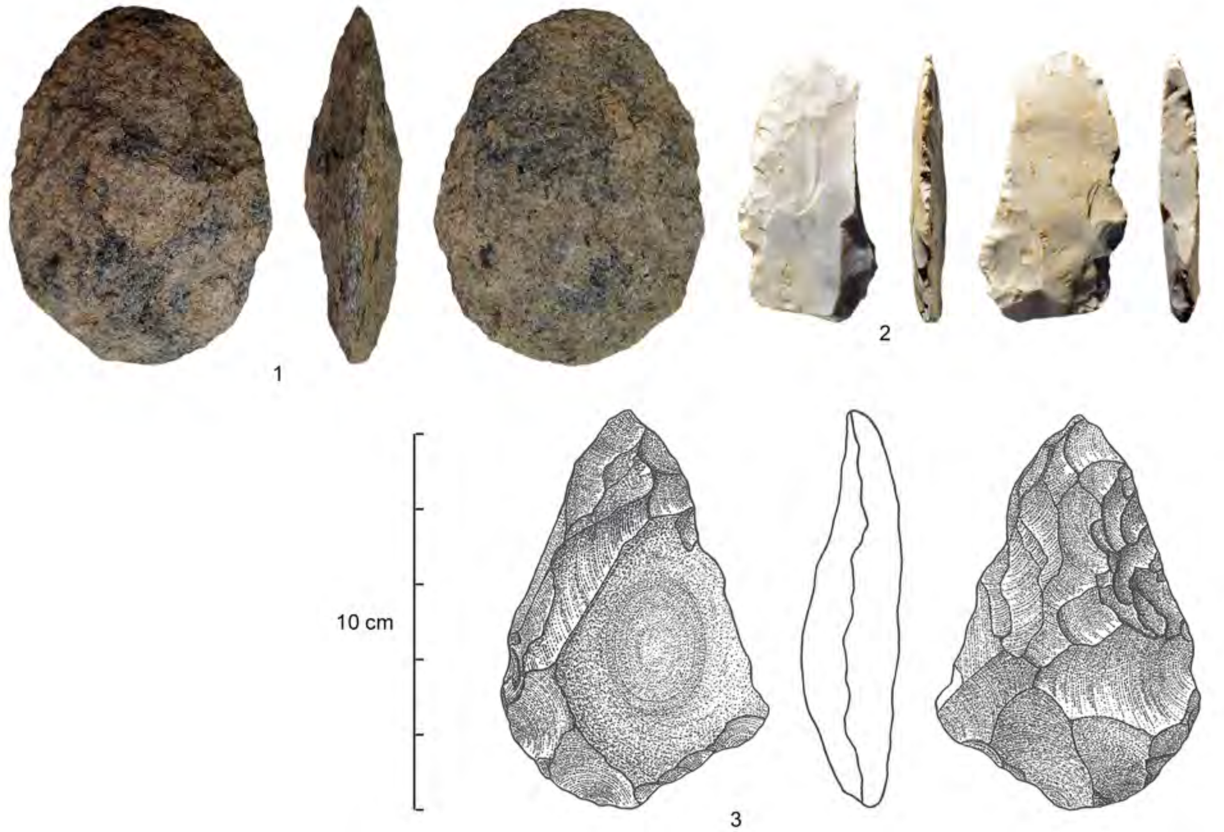

Fig. 4. 1: Potsdam-Nedlitz. Amygdaloid handaxe. Granite (Photo Jonas Beran), 2: Großhelmsdorf, Saale-Holzland-Kreis. Backed bifacial knife (Keilmesser). White patinated flint (Photo Thomas Weber), 3: Ermlitz-Rübsen. Saalekreis. Pointed handaxe. Quartzite (Drawing Wolfgang Bernhardt).
Abb. 4. *1: Potsdam-Nedlitz. Mandelförmiger Faustkeil. Granit (Foto Jonas Beran), 2: Großhelmsdorf, Saale-Holzland- Kreis. Bifazial retuschiertes Messer mit Rücken (Keilmesser). Weiß patinierter Feuerstein (Foto Thomas Weber), 3: Ermlitz-Rübsen. Saalekreis. Spitzer Faustkeil. Quarzit (Zeichnung Wolfgang Bernhardt).*

were exposed on the surface and we may expect that even relatively late – Early Weichselian – handaxes or bifaces survived in this manner. It is difficult to judge if these single finds only reflect prehistoric populations crossing the region or rather the conspicuousness of such elaborated pieces (against the insignificance of cores and flakes) for the recent collectors, who do not recover the accompanying industry.

In 1999, amateur archaeologist Wolfgang Bernhardt found a handaxe made of fine-grained quartzite on the northern border of the Elster-Luppe valley near Ermlitz-Rübsen (Schkopau parish, Saalekreis, Saxony-Anhalt), which was characterized by an extensive face retouch (Fig. 4: 3). The production process seems to have triggered a frost-break and – perhaps as a result of the position near the surface – wind polish can be observed. The piece has probably been relocated from earlier sediments in the loess layer, which probably should be dated in the Upper Weichselian.

Jonas Beran excavated several granite, quartzite and flint pieces with probable facial retouch, one of them a clear amygdaloid handaxe (Fig. 4: 1; Beran & Kurzhals 2015) in Potsdam-Nedlitz (Landeshauptstadt Potsdam, Brandenburg) in the region of the Late Weichselian moraine zone, in the area of a Middle Neolithic Funnel Beaker culture settlement. From a geological viewpoint, it seems to be clear that these pieces have also been found in a secondary position as these Weichselian moraines covered this landscape several millennia after the end of the Middle Palaeolithic.

Methods

Flint waste analyses

If we want to be able to trace the technological development of the tool production process over time, it is not enough to examine bifaces or other finished tools. All debris from the production process has to be investigated. That includes a look at how the material was selected and removed (cf. Schäfer & Weber 1988; Weber 2017), how the blanks were produced, how the tool was finished and how it was used. Any assumptions on the last of these points, however, strongly depend on surface preservation and require the presence of use wear traces on the artefacts, which are extremely rare. This aspect is not suitable for statistical investigation. Other characteristics of the artefacts – on the other hand – lend themselves very well to statistical analyses. With their help, we are able to identify technological groups of assemblages – technocomplexes – without

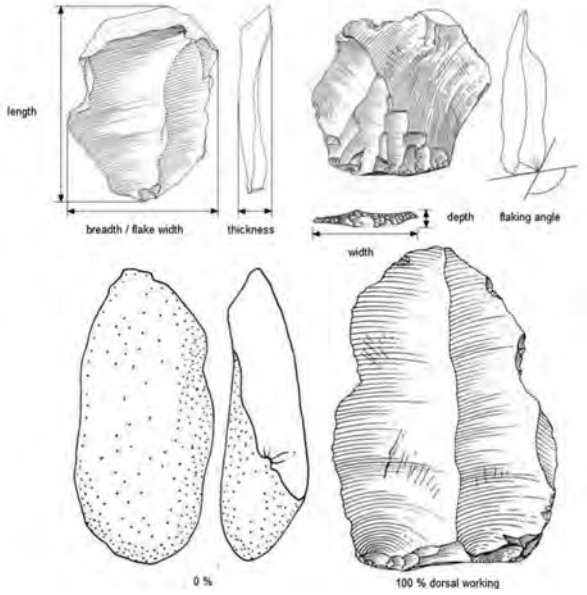

Fig. 5. Flake features included in this study: size measurements and form quotients of the piece and of the striking platform (above), and the percentage of the dorsal worked portion (below).
Abb. 5. *In diese Studie einbezogene Abschlagmerkmale: Abmessungen und Formquotienten des Stückes und des Schlagflächenrestes (oben) und der Antel der Dorsalflächenbearbeitung (unten).*

depending too much on the presence or absence of elaborated retouched tools. These index fossils rather reflect the immediate purposes of special activities at different sites than the place of the assemblage in the course of the technical development (cf. Weber 1986).

As flakes are usually the most numerous artefact category in an assemblage, they are particularly suitable for statistical comparisons. In the present analyses, I have exclusively concentrated on complete pieces leaving the incomplete (i.e. broken) ones aside since they would not allow us to detect all of the features in full. Admittedly, this results in a bias against finer (i.e. flatter and longish) flakes especially from coarse-grained sediments with post-depositional movements as these are particularly susceptible to breaking. For the study of blade – Upper Palaeolithic – industries, such a bias would surely be

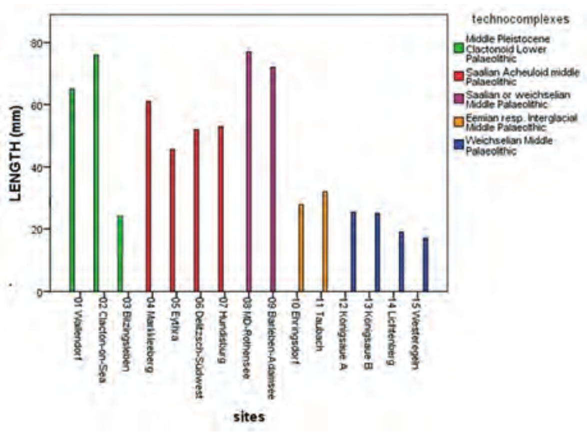

Fig. 6. Range for the length values of not retouched flint flakes.
Abb. 6. *Spannweiten für die Längenwerte von nicht retuschierten Feuersteinabschlägen.*

substantial. Here, however, it may be neglected.

For my analyses, it has, of course, been necessary to collect large amounts of data in the first place. In the 1970s, I started gathering quantitative as well as qualitative data on thousands of artefacts (predominantly, in fact, flakes) from different periods of the Lower and Middle Palaeolithic (Weber 1986: 71-80). It became gradually apparent that some of the specified attributes were more telling than others in discriminating different technocomplexes (cf. Weber 2006). It is the form quotients of the piece, the conditions of platform remnants, the interior flaking angle, and the percentage of worked dorsal surface, which show clear developments over time. This enables us to separate the geologically fixed technocomplexes – more or less independently from the extraction method or the sampling technique.

For the present analysis, I have therefore investigated these exact features for the total amount of 6,648 complete flint flakes taken from the 15 Lower and Middle Palaeolithic assemblages.

Form quotients

As the absolute size of a flake is naturally determined by raw material size, which may vary greatly. Absolute measurements are of a limited use when it comes to identifying similarities between assemblages from the same technocomplexes or investigating technological trends (Fig. 5). Form quotients are independent of absolute sizes and provide a more reliable basis for comparison here. However, some of the results of the present analysis are more easily interpreted with a knowledge of the average flake sizes of the respective assemblages. The arithmetic mean of flake length is provided for each of the investigated assemblages in figure 6.

(i) Length Breadth/Width Index (LBI) – the quotient of length and width (breadth) measured in the flaking direction (l/b) – as a measurement for the elongation of a flake. In my earlier publications I have used the term breadth for the measurement of the piece (in contrast to the term width, which I have used for the dimension of the remnant of the flaking platform). The higher the LBI values are, the more bladelike a piece is.

(ii) Relative Thickness Index (RTI) – the quotient of thickness and the arithmetic mean for length and width (breadth) (200t/[l+b]) – as a flatness measurement.

(iii) Width Depth Index (WDI) – the quotient of width and depth of the striking platform (w/d) showing the narrowness of the platform part separated by the production of the given flake.

Unfortunately, the data collected here are not directly comparable to those gathered for other studies such as, e.g., the interesting study by Lin et al. (2015). Their measurement techniques differ from the ones that have been used by me and several colleagues in collecting data from the assemblages discussed in this paper. Lin et al. measure the length of flakes: "from the point of percussion to the most distal end of the flake and width [...] is measured at the midpoint of, and perpendicular to, the length axis" (2015: 91), whereas oriented in flaking direction, which results in different figures.

Conditions of platforms remnants

The conditions of the striking platforms have been qualitatively analysed for all the flakes from the selected assemblages. I have distinguished (Fig. 5)

(i) unclear ambiguous plane platforms, meaning flat surfaces, for which we cannot decide if they are primary or covered with one – flat – negative (e. g. in the case of patinated pieces),
(ii) primary platforms (without negatives, with cortex or pebble surface),
(iii) pieces with platforms which are covered with (one or more) negative(s) which are not parts of a faceting,
(iv) faceted platforms with negatives from the dorsal face attached immediately before production of the given flake,
(v) pointed and destroyed platform remnants for which a reconstruction of the initial platform condition on the core is not possible.

Interior flaking angle

The interior flaking angle measured with a goniometer between the platform on the impact point and the basal part of the ventral face (cf. Weber 1986: 76 & Abb. 3) is a characteristic for the percussion technique (Fig. 5). The general trend that may be observed is: the harder the strike, the larger the angles tend to be. A self-experimental flake series produced with flint and sandstone hammers has shown that direct percussion with a hard hammerstone (flint) generally produces angle values higher than the ones resulting from direct strikes with a sandstone hammer (Thum & Weber 1987; Thum & Weber 1991). Indirect percussion with the help of a stone, bone, or hardwood chisel or a pressing technique tend to produce still lower angle values. Although it is not possible to state exact values for each flaking technique, the differences in mean and deviation values can be detected. J. Thum investigated only the influence of harder and softer hammerstones on the flaking angles. He worked alternately with hard (flint) and soft stones (sandstone). The technique he used was self-optimizing. Other flake features were not studied.

Percentage of worked dorsal surface

The percentage of worked dorsal surface (covered by flake scars/negatives) from the previous core reduction process has been estimated for each flake in 10 % steps (Fig. 5). Apart from that, Lin et al. (2015: 94) have also distinguished between cortical (nodule) and other "old non-cortical surfaces that are unrelated to anthropogenic activities" when it comes to untreated surfaces – a distinction which we, unfortunately, have not made. The intention was not to reconstruct human mobility by means of comparison between observed and expected cortex values but only to compare the general exploitation of the flint raw material from site to site measured by the – mean – ratio of worked dorsal surface. Even in the case of high relative frequencies for pieces with exactly 100 % dorsal worked surface these mean values tend to be high (cf. Weiss et al. 2017: 81).

Results

The length-width (breadth) ratio (LBI) values do not show a clear trend during the Palaeolithic technocomplexes from the Middle Pleistocene up to the Weichselian (Fig. 7). In my opinion, this cannot be explained only by the shape and size of the material, since different sites are characterized by the same raw materials (cf. Weber 1997b). Only the upper values for the inter-quartile ranges from Hundisburg and Taubach reach some higher values (near 1.5). This indicates the existence of several blades with LBI values of 2.0 and beyond and with more or less parallel lateral edges. A clear trend to bladeness – like later in the Upper Palaeolithic – cannot yet be shown.

The relative thickness indices (RTI) of the flakes, however, reveal a clear development from the Middle Pleistocene clactonoid Lower Palaeolithic through the acheuloid Middle to the Upper Pleistocene Eemian and Early Weichselian Middle Palaeolithic. Figure 8 shows decreasing values from medians near and over 30 (Clactonian) through approximately 25 (Acheulean) up to values near and below 20 (Early Weichselian Middle Palaeolithic). In simple terms: the flakes clearly become flatter over time. It seems to function more or less independently of the appearance of the biface technique - in the course of the Old to Middle Palaeolithic this trend is expressed in both assemblages rich and poor in hand axes.

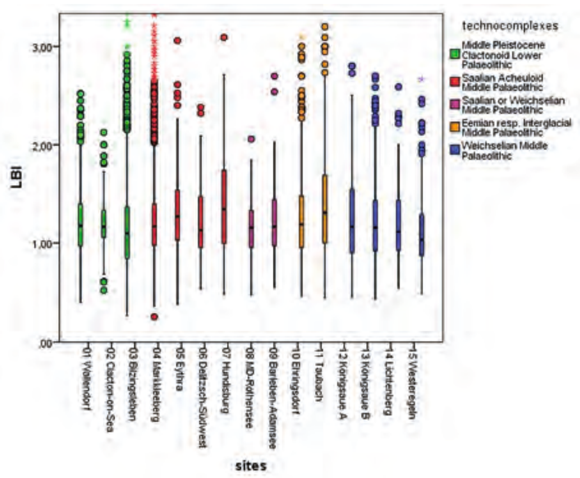

Fig. 7. Median values (horizontal lines), quartiles (boxes), value distributions except outliers (vertical lines), outliers (circles) and extreme values (asterisks) for the LBI (length breadth/width index) values of not retouched flint flakes.
Abb. 7. *Medianwerte (horizontale Linien), Quartile (Boxen), Wertverteilungen ohne Ausreißer (vertikale Linien), Ausreißer (Kreise) und Extremwerte (Sternchen) für die LBI-(Längen-Breiten-Index)Werte von nicht retuschierten Feuersteinabschlägen.*

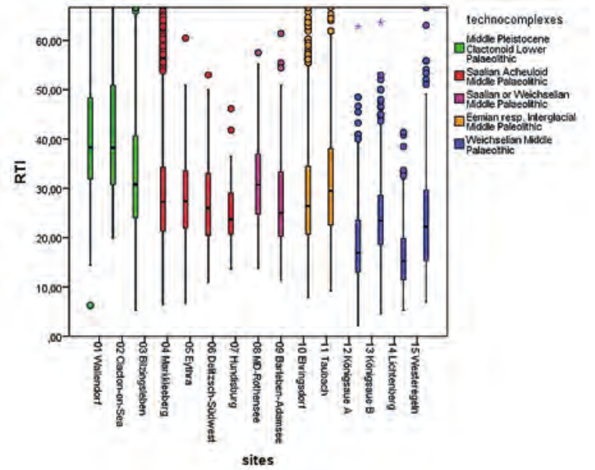

Fig. 8. Median values, quartiles, value distributions except outliers, outliers and extreme values for the RTI (relative thickness index) values of not retouched flint flakes.

Abb. 8. *Medianwerte (horizontale Linien), Quartile (Boxen), Wertverteilungen ohne Ausreißer (vertikale Linien), Ausreißer (Kreise) und Extremwerte (Sternchen) für die RDI (relativer Dickenindex-)Werte von nicht retuschierten Feuersteinabschlägen.*

The histograms for the RTI distributions were regrouped in the five clusters for the chronologically placed assemblages – Clactonian, Acheulian, unclear (Saalian or Weichselian) Middle Palaeolithic, Interglacial (mostly Eemian) Middle Palaeolithic, and Early Weichselian Middle Palaeolithic. For the first of these diagrams, it is worth pointing out that the curves for Wallendorf and for Clacton-on-Sea show only minor differences for their modal values (Fig. 9: a) – which is also true for their values of absolute length measurements (Fig. 6).

The Bilzingsleben flakes (from much smaller raw material) exhibit a modal value of about 25 – like the Acheulean flakes from Markkleeberg and Eythra while Delitzsch and Hundisburg likewise display modal values between 20 and 25 (Fig. 9: b). Curves with more than one peak may be explained by the relatively small number of flakes included in the analysis (i.e. ca. 100 pieces for Delitzsch-Südwest, Hundisburg, Magdeburg-Rothensee, and Barleben-Adamsee; cf. Fig. 6).

The RTI value curves of the unclear assemblages from Magdeburg-Rothensee and Barleben-Adamsee resemble each other – with similarities to the Acheulean assemblages, too. Interestingly, Magdeburg- Rothensee displays somewhat higher RTI values than Barleben (Fig. 9: c).

The curves for Ehringsdorf and Taubach are nearly congruent despite the distinct typological and possibly chronological classifications for both find complexes (Fig. 10: a).

The generally most leftist curves with the lowest RTI values are found for the Weichselian assemblages Königsaue A, Lichtenberg and Westeregeln (Fig. 10: b) with a high degree of similarity for Königsaue A and Lichtenberg with their large amounts of flakes produced in resharpening the numerous bifacial knives, whereas in Königsaue B the clumsier flakes from Levallois or discoid core degradation predominate (Weiss et al. 2017: 86).

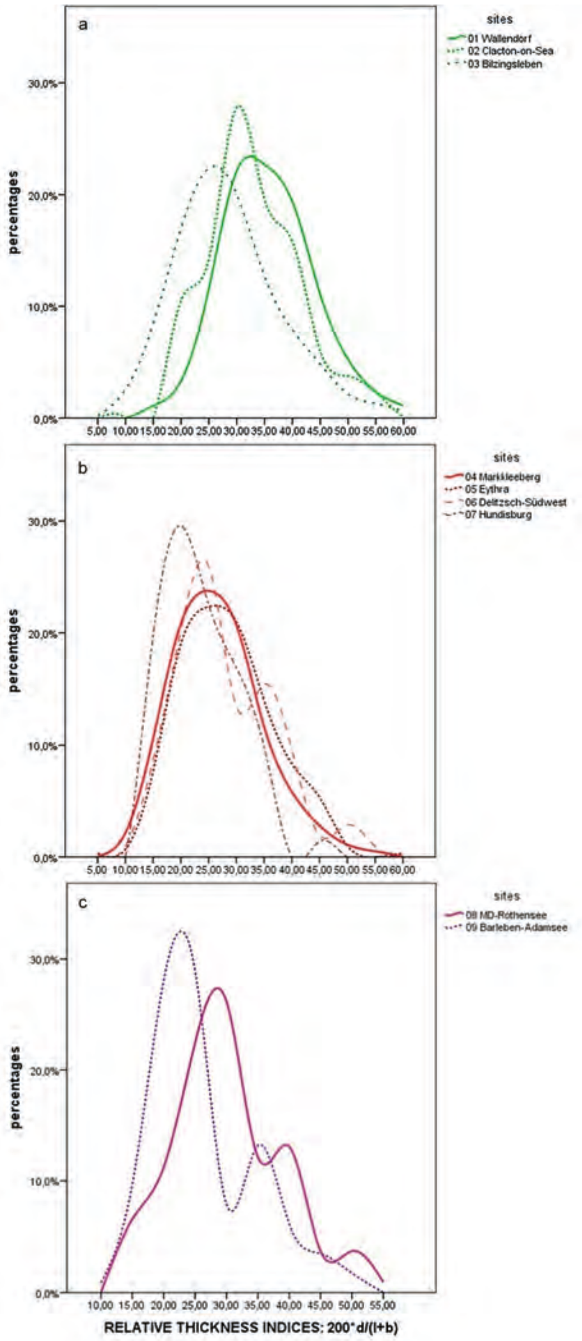

Fig. 9. RTI (relative thickness index) values of not retouched flint flakes: histograms for the RTI distributions of the clactonoid (a), acheuloid (b), and unclear (c) flint flake assemblages.

Abb. 9. *RDI-Werte (relativer Dickenindex) von nicht retuschierten Feuersteinabschlägen: Histogramme für die RDI- Verteilungen der clactonoiden (a), acheuloiden (b) und unklaren (c) Feuersteinabschlaginventare.*

The relative frequencies of the individual values for the different platform conditions (Fig. 11) exhibit large differences between the technocomplexes. In the Lower Palaeolithic assemblages (except Clacton-on-Sea) primary surfaces (i.e. without any platform preparation) predominate. The flakes from the acheuloid and the unclear Saalian or Weichselian assemblages overwhelmingly have negative- covered platforms (frequently with one negative or flake-scar only).

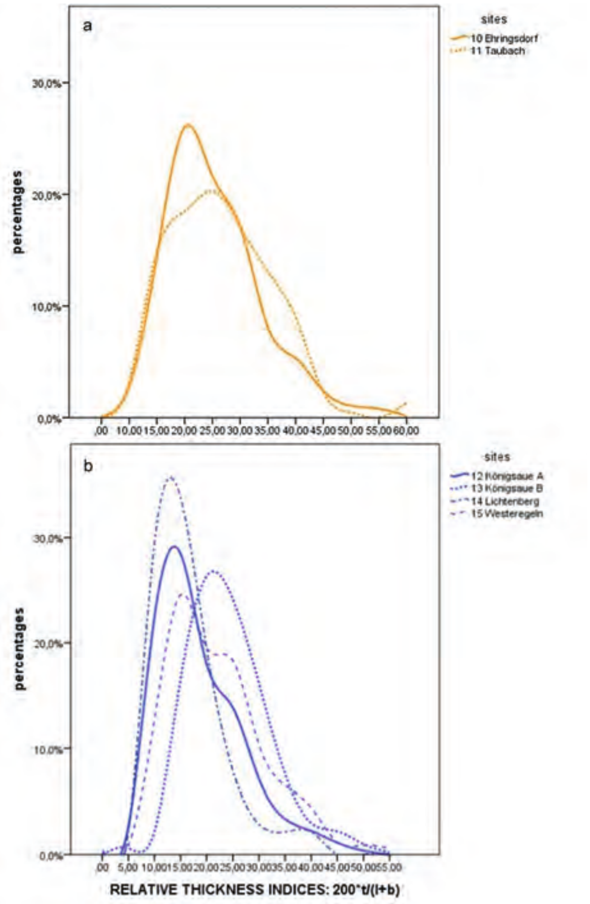

Fig. 10. RTI (relative thickness index) values of not retouched flint flakes: histograms for the RTI distributions of the Interglacial/Eemian (a), and Early Weichselian (b) flint flake assemblages.
Abb. 10. *RDI-Werte (relativer Dickenindex) von nicht retuschierten Feuersteinabschlägen: Histogramme für die RDI- Verteilungen der interglazialen/eemzeitlichen (a) und frühweichselzeitlichen (b) Feuersteinabschlaginventare.*

In the Upper Pleistocene assemblages, we find more facetted platforms in different – often higher – percentages. The growing numbers for pointed (and destroyed) platforms in the younger (Weichselian) assemblages are a result of more flakes from retouched implements being resharpened leaving small unremarkable platform remnants, which is, e.g., the case for Königsaue A – more than for Königsaue B. Lichtenberg may also be interpreted in the same manner as Königsaue A, whereas the punctiform or ridge formed platforms in Westeregeln may be understood as a result of the frequently microlithic flake size.

In measuring the flaking angles, the low artefact length values of some sites (especially Bilzingsleben and Westeregeln) have complicated the use of a goniometer. The number of flakes included in this part of the analysis is generally lower than for the other features (cf. Fig. 12 for the total numbers). The mean flaking angles decrease from the Clactonian with medians of about 130 degrees to about 120 degrees for the Saalian (and Saalian or Weichselian) Middle Palaeolithic assemblages.

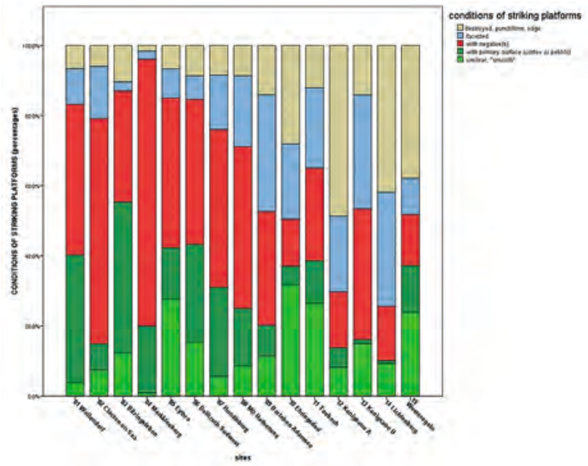

Fig. 11. Relative frequencies of the different conditions of striking platforms in the not retouched flint flake assemblages (N = numbers of observations).
Abb. 11. *Relative Häufigkeiten der unterschiedlichen Schlagflächenrestzustände in den Inventaren nicht retuschierter Feuersteinabschläge (N = Anzahl der Beobachtungen).*

For the Eemian and the definitively Early Weichselian flakes we find angle medians of about 110 and interquartile ranges between 100 and 120 degrees. Interestingly, the two Königsaue assemblages do not differ so much despite their provenance of being either remains of face-trimmed tool production or of core reduction.

Regarding the dorsal values, the mean percentages of worked surface (Fig. 13) generally show a marked increase from the older to the younger pieces. This can be understood as a consequence of the growing percentages of pieces with worked surface only (completely covered in flake-scars). Beginning with mean values between 50 % and over 60 % in the Middle Pleistocene Lower Palaeolithic, the averages grow to

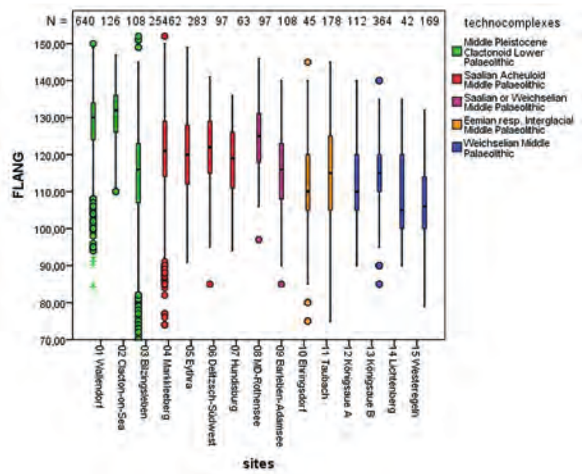

Fig. 12. Median values, quartiles, value distributions except outliers, outliers and extreme values for the (interior) flaking angles of the complete flakes (N = numbers of observations).
Abb. 12. *Medianwerte, Quartile, Wertverteilungen ohne Ausreißer, Ausreißer und Extremwerte für die (inneren) Schlagwinkel der vollständigen Abschläge (N = Anzahl der Beobachtungen).*

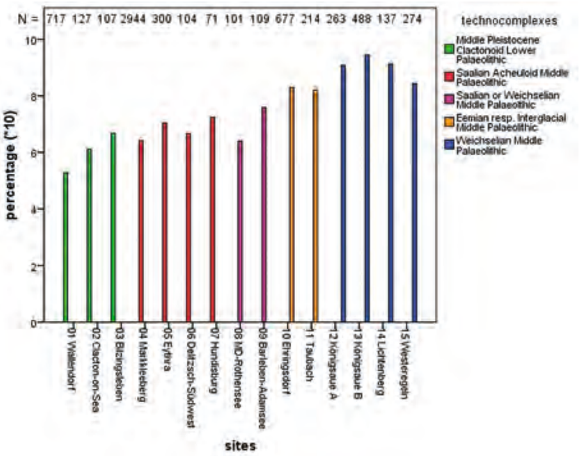

Fig. 13. Arithmetic means of the dorsal worked surface portions in the different assemblages of not retouched flint flakes (N = numbers of observations).
Abb. 13. *Arithmetische Mittel der dorsal bearbeiteten Flächenanteile in den verschiedenen Inventaren von nicht retuschierten Feuerstein-abschlägen (N = Anzahl der Beobachtungen).*

60 % and 70 % in the Saalian acheuloid assemblages – independently of the presence or absence of handaxes. Even the two unclear Saalian or Weichselian assemblages indicate the same setup: an argument for the dating in the penultimate glaciation. The Upper Pleistocene (i.e. Eemian and Weichselian) flakes always show mean values over 80 % (sometimes above 90 %), following an increase of the flakes with 100 % worked dorsal surface. This is still independent of the assumption that in Königsaue A most flakes are probably pieces from tool resharpening, whereas in Königsaue B they are mostly the results of core reduction. It seems to function more or less independently of the appearance of the biface technique - in the course of the Lower to Middle Palaeolithic this trend is expressed in both assemblages rich and poor in hand axes.

Discussion

In the Central German Lower Palaeolithic sites, we find quite rough and irregular flakes, which show a limited use of the given raw material reflected in a low scale of dorsal working – comparable with the sample from Clacton-on-Sea. Macrolithic (Wallendorf) and microlithic flakes (Bilzingsleben) show similar values.

The acheuloid (Saalian or probably Saalian) assemblages reflecting a time span of perhaps 200 ka (between > 300 and 140 ka ago) also show technological similarities independent from the presence or absence of any biface production. The flakes are narrower and flatter than during the antecedent Lower Palaeolithic and the degree of dorsal working has increased. As the Saalian Palaeolithic covers such a long time span it will be interesting to search for signs of a technological development within that period, e. g. in Markkleeberg.

In the last (for Ehringsdorf perhaps penultimate) interglacial finer – sometimes more longish but not necessarily flatter – flakes predominate. With Taubach and Ehringsdorf, we have been looking at two Ilm valley sites from the border of the Elsterian glaciations, which are characterized by an absence of high-quality flint. Therefore, it is difficult to compare the flakes from there to the older ones found in regions with better flint raw material. Furthermore, it is arguably more difficult to find useful, large-sized flint material under temperate conditions than during cooler periods. However, Central Germany's braided river systems should have made glacial sediments containing flint accessible during the interglacials, too. Nevertheless, Ehringsdorf is still characterized by an extreme exploitation of the existing flint material.

The Early Weichselian assemblages may be dated in a time span of 60 ka (between more than 100 and less than 50 ka ago). As the dating is not clear in every case, we cannot definitely distinguish between MIS 5 and MIS 3. With regard to the RTI, we definitely find the finest (i.e. flattest) flakes in the Early Weichselian. Interestingly, two of the four clearly Early Weichselian assemblages (Königsaue A and Lichtenberg) show relatively small percentages of pieces with measurable flaking angles (less than 50 %) perhaps reflecting large amounts of tool resharpening flakes.

The unclear material from Barleben-Adamsee possibly belongs to the Early Weichselian, which has already been hinted at by the presence of a leaf point. Moreover, the RTI values tend to be smaller than in Magdeburg-Rothensee, which also suggests that Barleben- Adamsee is younger. The fact that the RTI values are not as low as for the Early Weichselian assemblages may be understood as resulting from a bias: the flattest pieces have possibly been destroyed in the coarse river gravel sediments because of their fragility.

Conclusion

What my analysis has shown – most importantly – is a gradual development of flaking technology from rather rough and clumsy flakes to flatter, more bladelike ones. The features resulting from flake production provide objective criteria for determining the position of an archaeological assemblage in the global technological development. As a consequence of that, the presence or absence of bifacial implements should not be relied on exclusively when an assemblage is assigned to a technocomplex. It should, at the very least, be supplemented by results from flake analysis.

It is not only since the last glaciation that we find different types of tool compositions (like Mousterian and Micoquien) at sites where the same flaking technology was employed, which may be interpreted as a result of different functional purposes addressed at the different sites. Even the Central European Saalian Acheulian and Levalloisian assemblages can be interpreted in this way as they display different tool (and even biface) contents in combination with flake assemblages whose features exhibit similar values. Only for the Lower Palaeolithic, we have not detected such differences yet – perhaps as a result of the current state of research.

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Inhalt - *Contents*