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*Medieval cup nested weights from czech and moravian sites. Gruna, Hradisko (left); Písek, u Šarlatského rybníka (front); Vícov, Městisko (bottom right); Boskovice, castle (top right). Cf. the article by J. Doležel in this volume. Photo by P. Smékal.*


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# A Re-interpretation of Early Upper Palaeolithic Assemblages from Stránská Skála: The Differences in Lithic Economy between the Aurignacian and the Bohunician Assemblages

## Přehodnocení časně mladopaleolitických souborů ze Stránské skály: Ekonomické rozdíly mezi stránskoskalským aurignacienem a bohunicienem

Ladislav Nejman

***Abstract***

*The Middle-Upper Palaeolithic transition is one of the most significant periods in European prehistory and the site of Stránská Skála in Moravia is one of the most important Early Upper Palaeolithic sites in Europe. A materialist approach is used to analyse the Aurignacian and Bohunician assemblages from Stránská Skála. Although the chronostratigraphic separation and the technological differences between the Aurignacian and Bohunician industries at Stránská Skála have been well documented, the new results and interpretations of lithic patterns suggest that at Stránská Skála there are very few differences between the lithic economies of the Bohunician and the Aurignacian.*

***Keywords***

*Middle-Upper Palaeolithic transition, anatomically modern humans, Moravia, lithics.*

## 1. Introduction

The Middle-Upper Palaeolithic transition, which took place approximately 45,000–35,000 years BP (before present), is one of the most significant events in European prehistory. A large amount of archaeological evidence from sites located in various parts of Europe points to two major parallel events during the Middle-Upper Palaeolithic transition: the first arrival of anatomically modern humans (AMH) and a proliferation of new and distinct stone artefact assemblages. Although there is no doubt among archaeologists that these events took place, interpretations of the archaeological evidence vary.

The proponents of the so-called 'Human Revolution' model postulate that a dramatic alteration in human behaviour took place during the European Middle-Upper Palaeolithic transition (*e.g.* Bar-Yosef 1998, 2002; Binford 1989; Klein 2000; Mellars, Stringer 1989; Noble, Davidson 1991; Tattersall 1995). The changes in human behaviour often quoted include systematic production of prismatic blades; higher degree of standardisation and morphological variability in the Upper Palaeolithic than in the Middle Palaeolithic; relatively rapid shifts in core reduction strategies; exploitation of bone and antler; systematic use of grinding and pounding tools; production of beads, pendants, human and animal figurines and other symbolic objects; long-distance exchange networks in lithics, raw materials and marine shells; and the invention of improved hunting tools (*e.g.* Bar-Yosef 2002). These behavioural changes are often interpreted as an indication of rapid technological changes, emergence of self-awareness and group identity, increased social diversification, formation of long-distance alliances and the ability to symbolically record information (Bar-Yosef 2002).

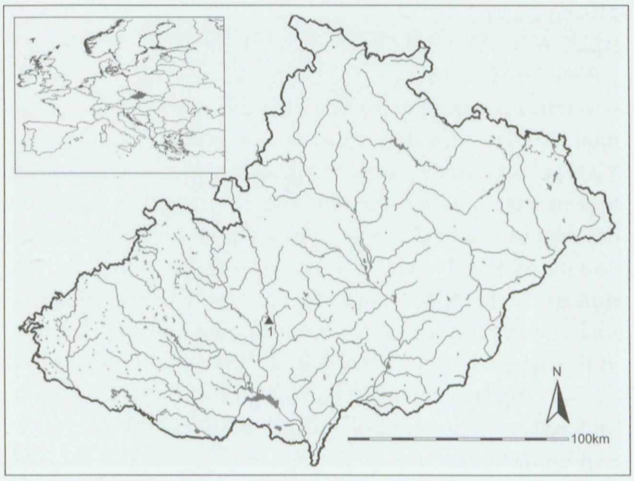


Fig. 1: Map of Moravia. 1: Brno Stránská skála, studied site. *Obr. 1: Mapa Moravy. 1: Brno Stránská skála, pojednávaná lokalita*

Others argue that the European Middle-Upper Palaeolithic transition was a more complex phenomenon, with a mosaic pattern of different changes in different areas and different degrees of change (*e.g.* Straus 1995, 2005, Teyssandier 2008). A recent seminal review of this question claims that the 'revolutionary' nature of the European Upper Palaeolithic is most probably due to a discontinuity in the archaeological record rather than a rapid cultural, cognitive, and/or biological transformation (McBrearty, Brooks 2000).

Different lines of skeletal and archaeological evidence presented by these authors suggest a gradual transformation of both the human anatomy and human behaviour from an archaic to a more modern pattern over a period of more than 200,000 years, and taking place in Africa

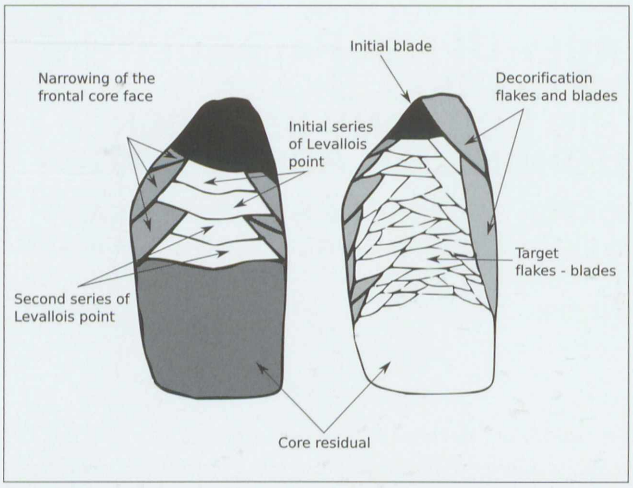


Fig. 2: A schematic illustration of the reduction trajectory for the Bohunician industry (left) and the Aurignacian blade industry (right) (from Škrdla 1999). *Obr. 2: Schématický diagram znázorňující redukční postup bohunické industrie (vlevo) a aurignacké čepelové industrie (vpravo) (podle Škrdla 1999)*

(McBrearty, Brooks 2000). Henshilwood and Marean (2003) have argued that modern human behaviour cannot be defined by the simple presence or absence of traits on a Eurocentrically derived list of traits, such as the one proposed by proponents of the 'Human Revolution' model.

Henshilwood and Marean (2003) convincingly argue that many of the traits can be explained by other processes like climatic variation and resource and labour intensification, which has nothing to do with behavioural modernity. Furthermore, virtually all of them involve the presence or absence of material remains that are subject to taphonomic vagaries of time-sensitive differential preservation. They conclude that the key criterion for modern human behaviour is the use of **symbolism** to organize behaviour, so it is the archaeological signature of such behaviour which unambiguously indicates modern human behaviour.

One of the most important issues which is still subject to debate is the period of coexistence of AMH and Neanderthals, and the degree of cultural mixing (acculturation). Some authors maintain that this period of overlap was rather extended and lasted for several thousand years (*e.g.* Churchill, Smith 2000) and led to 'acculturation', explaining the common elements of Early Upper Palaeolithic (EUP) industries and the Middle Palaeolithic and Upper Palaeolithic industries. The acculturation hypothesis was used to explain the origin of some of the Central European transitional industries even much earlier (*e.g.* Allsworth-Jones 1986; Kozlowski 1982; Oliva 1991a). Even later, Svoboda (2005) considers this hypothesis likely. Others argue against the acculturation model, maintaining that all transitional industries were manufactured by the Neanderthals before the arrival of modern humans (*e.g.* Zilhão, d'Errico 1999; Zilhão 2006). Conard and Bolus (2003) argue that the apparent coexistence of Neanderthals and modern humans (they call it the 'Coexistence Effect') is exaggerated by the extreme variations in the production, transport and deposition of $^{14}C$. They argue that this problem is especially acute in the period around 40,000 calendar years ago around the time of the Laschamp magnetic excursion, and also several thousand years later, around the time of the Mono Lake excursion. Adams and Ringer (2004) argue that in central Europe, the period of coexistence of Neanderthals and modern humans was more restricted than previously thought, and in the northern Carpathian Basin, there is a 5,000 to 10,000 year gap between the disappearance of Neanderthals and appearance of modern humans.

Although progress has been made, intensive research in the last twenty years has failed to answer some of the most important questions concerning the M/UP transition. The most important questions relate to the aspects of hominid behaviour which resulted in the changes in material culture and the ecological context in which this happened. The preserved aspects of material culture from the M/UP transition include the distinctly different lithic assemblages (compared to the 'monotony' of the preceding Middle Palaeolithic assemblages) (cf. Kuhn 1995) which proliferated during the EUP period, the marked increase in the exploitation of bone and antler as raw materials, and the manufacture of art objects and paintings. It is known which aspects of material culture changed but there is uncertainty about how and by what processes the changes in behaviour took place. There is also a fierce debate about the nature and length of the period of coexistence between AMH and Neanderthals.

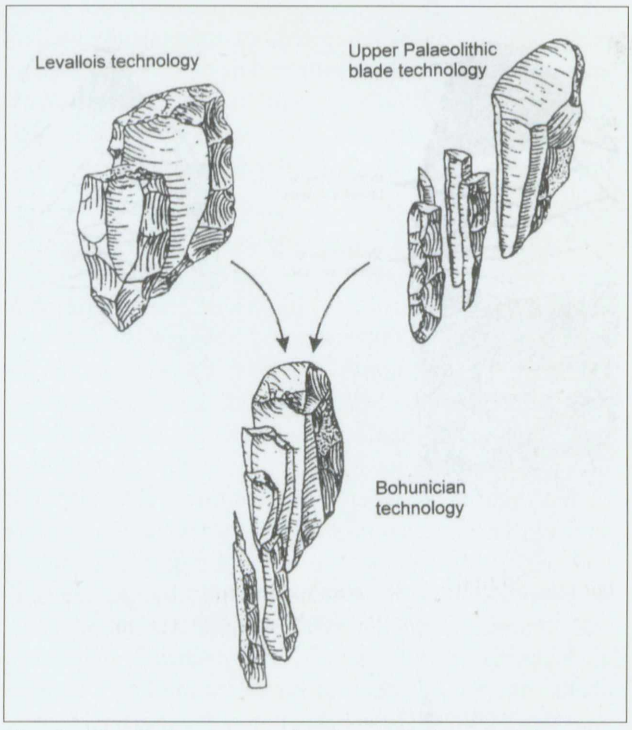


Fig. 3: The Bohunician reduction technique and its relationship to Levallois and blade technology (from Škrdla 1999). *Obr. 3: Znázornění bohunické redukční metody a její spojitosti s levalloiskou a čepelovou technologií (podle Škrdla 1999)*

Tab. 1: The Temporal Differences Between Retouched Flakes (unbroken flakes only) at Stránská Skála. Note: p values in bold – correlation is significant at the 0.05 level (2-tailed). *Tab. 1: Časové rozdíly mezi retušovanými (kompletními) úštěpy ze Stránské skály.*

| Attribute | Industry | Mean | Std. Dev. | t | df | p | N |
|---|---|---|---|---|---|---|---|
| Weight | Aurignacian | 8.62 | 10.01 | -1.785 | 282.0 | .075 | 157 |
| | Bohunician | 10.92 | 12.28 | | | | 147 |
| Length | Aurignacian | 34.30 | 11.06 | -2.119 | 273.2 | **.035** | 157 |
| | Bohunician | 37.44 | 14.44 | | | | 147 |
| Weight | Aurignacian | 21.26 | 7.67 | -2.892 | 302.0 | **.004** | 157 |
| | Bohunician | 24.17 | 9.83 | | | | 147 |
| Thickness | Aurignacian | 7.62 | 3.29 | 0.507 | 302.0 | .612 | 157 |
| | Bohunician | 7.43 | 3.51 | | | | 147 |
| Elongation Index | Aurignacian | 1.79 | 0.75 | 0.930 | 255.0 | .357 | 142 |
| | Bohunician | 1.70 | 0.80 | | | | 115 |
| MGIUR | Aurignacian | 0.56 | 0.18 | 0.390 | 191.0 | .697 | 105 |
| | Bohunician | 0.54 | 0.20 | | | | 88 |
| % of length retouched | Aurignacian | 0.33 | 0.23 | 1.109 | 191.2 | .309 | 105 |
| | Bohunician | 0.30 | 0.18 | | | | 90 |

Due to geographical limitations, *H. sapiens* is most likely to have arrived in Europe from the east (from Africa via the Levant) and then spread to the rest of Europe in a westerly direction. Human groups would necessarily have to have spread along this trajectory because the only way from Africa to Europe on dry land was via the Levant. This hypothesis has been given a significant boost by Gilbert Tostevin's research where he demonstrated using quantitative data that antecedents for the eastern and central European Upper Palaeolithic existed in the Levant several thousand years before they appeared in the former regions (Tostevin 2000a, b, 2003b). The idea of a Near Eastern origin for the Moravian Aurignacian industries was suggested much earlier by Svoboda and Simán (1989).

## 2. The Role of Moravia

The archaeological record of central Europe, and Moravia in particular, is crucial to the questions pertaining to the Middle-Upper Palaeolithic transition. There are several reasons why this region specifically, should be considered as a crucial staging point for debates about the Middle-Upper Palaeolithic transition. Firstly, this region is not only rich in hominid and lithic assemblages from the Middle-Upper Palaeolithic period, but the archaeological record also shows important differences to the EUP record in other parts of Europe. Additionally, if the Middle-Upper Palaeolithic transition had a southeast to northwest geographic progression as has been postulated (*cf.* Tostevin 2000b), Moravia is situated in the centre of this pathway.

Secondly, there is a number of sites in Moravia which have large excavated assemblages from stratified contexts from the period between 30-50 kya (thousand years ago) and new stratified sites have been discovered recently and are in the process of being excavated. In addition, several hundred surface sites which have been attributed to this period are documented in Moravia, which indicates relatively dense and/or long-term occupation of this region by EUP hominids. There is, theoretically, a great potential for more stratified sites to be found in this region.

Thirdly, the Late Middle Palaeolithic, EUP and Upper Palaeolithic archaeological record in Moravia is not only rich but unique. Some of the stone artefact assemblages are associated with hominid skeletal remains (*e.g.* Neanderthal remains in Kůlna, layer 7a), and large skeletal *H. sapiens* assemblages from the EUP period (which are not associated with significant lithic assemblages, *e.g.* Mladeč), have been excavated. Since the Vogelherd human skeletons have been redated to the Neolithic (Conard *et al.* 2004), the Mladeč remains are the only hominid skeletons in Europe purportedly associated with Aurignacian artefacts.

## 3. Surface Sites

Surface scatters of artefacts dominate the archaeological record in many parts of the world. Although they are often dismissed as disturbed and thus of little scientific value, when the research question is concerned with landscape use, surface artefact scatters hold great potential for understanding past landscape use (*e.g.* Fanning and Holdaway 2001). Although chronological change through time cannot be studied using artefacts found on the surface, there is a potential to investigate change across space (Holdaway *et al.* 1998).

Chronological information is typically not available for surface sites because they are not in stratigraphic contexts, however many attempts have been made to guess their age based on typological similarities to excavated assemblages of known ages. It is very important to take the surface collections into account and not base models of prehistoric occupation merely on the stratified evidence, since the stratified sites account for less than 5% of the EUP archaeological material in Moravia (Oliva 1991a). There are several hundred known EUP surface

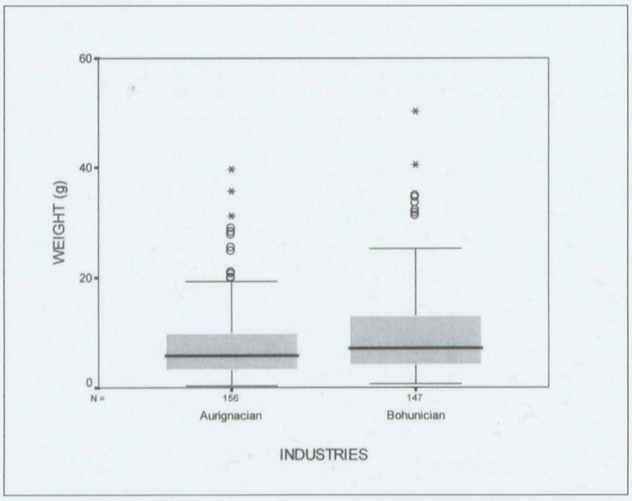


Fig. 4: A boxplot illustrating the difference in weight (g) between the Aurignacian and Bohunician assemblages. Only complete, retouched flakes are included in the samples. *Obr. 4: Krabičkový diagram rozdílu mezi aurignacienem a bohunicienem ve váze (g) kompletních, retušovaných úštěpů ze Stránské skály.*

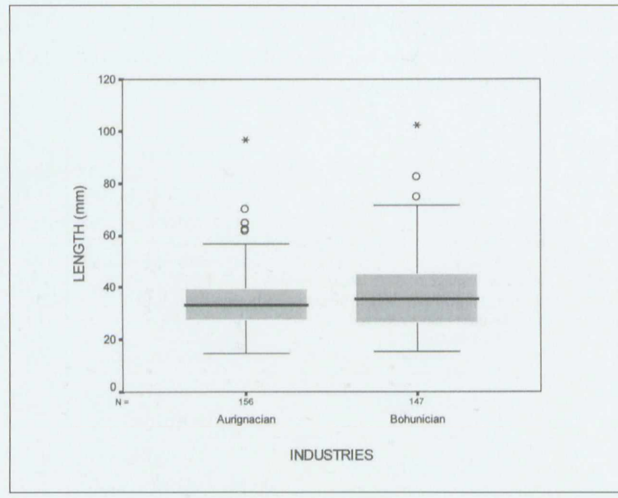


Fig. 5: A boxplot illustrating the difference in flake length (mm) between the Aurignacian and Bohunician assemblages. Only complete, retouched flakes are included in these samples. *Obr. 5: Krabičkový diagram rozdílu mezi aurignacienem a bohunicienem v délce (mm) kompletních, retušovaných úštěpů ze Stránské skály.*

sites in Moravia. Szeletian sites number approximately 100 (Oliva 1991a). The concentration of Aurignacian sites in Moravia is the highest east of France (Oliva 1993). Oliva (1991b) also lists numerous Middle Palaeolithic surface sites.

The large numbers of collected retouched artefacts (often several hundred to several thousand) indicates regional settlement stability and a high degree of sedentism and territoriality (Oliva 1993). The rich sites are often concentrated at strategic locations such as where mountains and lowlands meet and where herd animals movements were restricted by natural obstacles. An example of this is the high concentration of Aurignacian assemblages in the vicinity of Napajedla Gate, the eastern hillsides of the Drahany Plateau, and the Krumlovian Forest area. All of these locations are elevated high above the surrounding plain, with excellent views in several directions.

The large number of Palaeolithic collections collected in Moravia over the past 100 years, by archaeologists and amateurs alike, attest to the great archaeological richness of the region. At the same time, these collections lack organic artefacts and typologically speaking, they are often diverse combinations of Mousterian, Micoquian, Bohunician, Szeletian, and Aurignacian elements. As a result, they further complicate the picture of the EUP occupation in this region (also see Neruda, Nerudová in press; Nerudová in print a, b; Valoch 1977).

## 4. Classification of Lithic Assemblages

A variety of lithic assemblages, which have been classified as chronologically transitional between the Middle Palaeolithic and the Upper Palaeolithic industries, have been found in some parts of Europe. These industries tend to have an eclectic mix of technological and typological elements from both periods, but the nature of this mix is different in each area, and more than one different kind of 'mix' is often present in the same area (*e.g.* Szeletian and Bohunician industries in southern Moravia). Because the fusion of Middle Palaeolithic and Upper Palaeolithic elements is often considered to be distinct to each region where it occurs, several typological groupings have been designated for these 'transitional' assemblages.

Although in this work I use the traditional industry type labels designated by typologists, this is only for their descriptive usefulness, and I do not necessarily subscribe to such classificatory groupings, nor do I believe that they should be reified (*cf.* Tostevin, Škrdla 2006).

The particular Middle Palaeolithic, EUP and Upper Palaeolithic assemblages often temporally overlap, sometimes even in the same geographical region. Some are considered to be more similar to the late Middle Palaeolithic assemblages in the local area (*e.g.* the Szeletian industry is often considered to have 'evolved' from the local Micoquian industry) (*e.g.* Neruda 2000; Valoch 1990a, b), and others are considered to be more similar to the Upper Palaeolithic assemblages in the local area (*e.g.* Bohunician and the local Aurignacian). This has given rise to various theories and speculations about the 'genetic' relationships between them (for a discussion see Svoboda, Simán 1989). Some researchers argue that Aurignacian is not a proxy of the initial dispersion of modern human behaviour as is often assumed, that the evolution towards the Upper Palaeolithic predated the Aurignacian (*e.g.* Teyssandier 2008) and that the Aurignacian has different histories and origins in the different geographical areas where it occurs (Teyssandier 2006).

The classification of the various defined industries is fraught with such difficulties, that some authors rightly point out that the current classifications of assemblages and the whole concept of unified lithic industries is no longer valid (*e.g.* Churchill, Smith 2000; Straus 1995). This is because all of the industries are "highly variable internally, intra- and interregionally, synchronically

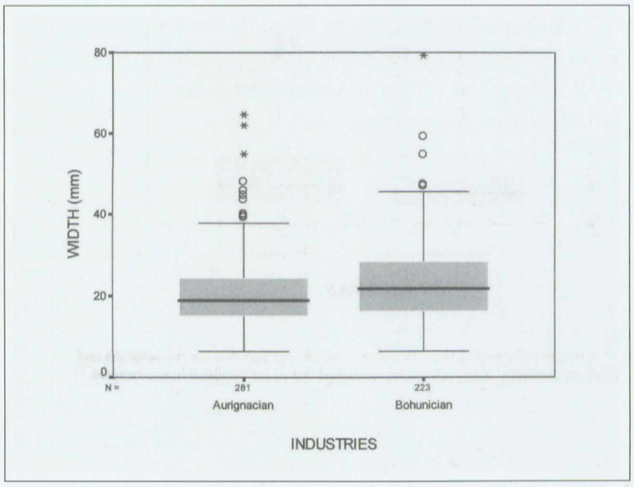


Fig. 6: A boxplot illustrating the differences in flake width (mm) between the Aurignacian and Bohunician assemblages. All retouched flakes are included in the samples. *Obr. 6: Krabičkový diagram rozdílu mezi aurignacienem a bohunicienem v šířce (mm) kompletních, retušovaných úštěpů ze Stránské skály.*

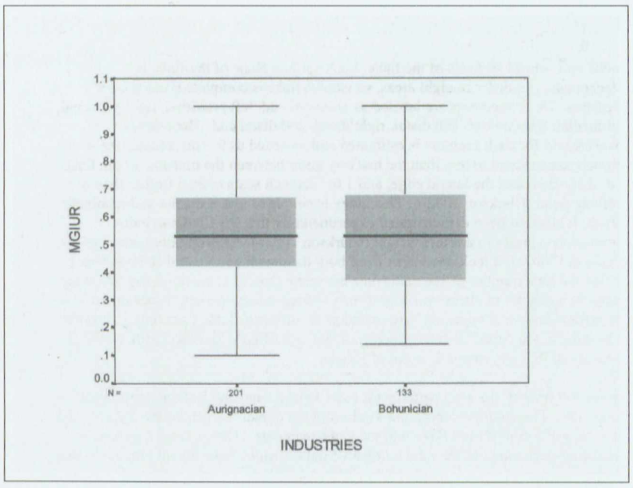


Fig. 7: A boxplot illustrating the differences in MGIUR between the Aurignacian and Bohunician assemblages. All retouched flakes are included in the samples. The medians are almost identical. *Obr. 7: Krabičkový diagram rozdílu mezi aurignacienem a bohunicienem v MGIUR retušovaných úštěpů ze Stránské skály. Střední hodnoty jsou téměř identické.*

and diachronically, among and within individual sites." (Straus 1995:8). One reason for these problems is small sample sizes. For example, in some cases, researchers have argued that a single Chatelperronian point is enough to define an occupational level as Chatelperronian (Carbonell *et al.* 2000). Straus (1995:8) continues: *Much of this variability can be explained in terms of sampling factors, differences in activities or site functions, artifact disposal modes, and differences in raw materials.*

These problems are clearly evident in the Moravian Palaeolithic assemblages and the numerous discussions in the local literature on this topic demonstrate this (*e.g.* Svoboda, Simán 1989). The problem of defining acceptable limits to industrial variability is ubiquitous but is usually ignored (Tostevin 2000a). As this author succinctly points out: "Constraining assemblage variability into industrial types when we specifically want to understand *change* in hominid material culture behavior only serves to distort our view of the transition" (2000a:92).

## 5. Methodological Issues

Typological classifications are traditionally used to describe stone artefact assemblages. The typology proposed by Bordes (1953, 1961) is the most frequently used classification by archaeologists for European Palaeolithic stone artefact assemblages. This is primarily a morphological typology, where the shape of the object and location of retouch determine the type and, to a lesser extent, technological characteristics (i.e. processes of manufacture).

In contrast to the traditional typological schemes, many studies have now demonstrated that morphological variation in many lithic assemblages occurs along a continuum. The reduction continuum models further propose that the continuous variation in morphology reflects different stages in a continuous reduction process (*e.g.* Dibble 1984, 1987, 1995; Hiscock, Attenbrow 2005a, b; Holdaway *et al.* 1996; McPherron 1994, 2000; Rolland, Dibble 1990). A relationship between morphological transformations and extent of reduction has been demonstrated for a number of Palaeolithic assemblages from various parts of the world. For example, Dibble (1984, 1987) demonstrated this in selected Iranian and French Middle Palaeolithic assemblages, Hiscock (1996) demonstrated this on the Dabba industry from Haua Fteah (Libya), Flenniken (1985) and Wheat (1976) demonstrated this on biface assemblages in North America, and Clarkson (2002b, 2005) and Hiscock and Attenbrow (2003) demonstrated this on Australian assemblages.

This model has also been found to be capable of explaining a large part of the morphological variation in notched flakes from French Mousterian assemblages (Hiscock, Clarkson 2007; Holdaway et al. 1996). The reduction model and its ramifications are in direct opposition to the assumption inherent in typological classifications, where variation is implicitly assumed to occur in discrete clusters which are represented by the implement types. In fact, typology reduces the observed variability in artefact assemblages to such an extent that chronological changes are readily apparent (Hiscock, Attenbrow 2005b). Although reduction models are becoming increasingly popular in some parts of the world the majority of archaeologists still adhere to the traditional typologies, primarily for their descriptive usefulness.

A recent study has tested this model using the lithic assemblages from Kůlna (layers 6a & 7a), Stránská Skála, Bohunice, and Vedrovice V. The objective of this exercise was to test if differential reduction can explain some of the morphological variation observed in the assemblages (Nejman, Clarkson 2008). The study looked at the trends in the distribution of retouch, the angle of retouch, and blank shape. These characteristics are central to typological variation and suggest that typological divisions may mask patterns of covariation between morphology and reduction intensity. Overall, the findings

Tab. 2: Clarkson Index Patterns at Aurignacian SS2 (N = 22) and retouch frequency of individual flake segments for SS2. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 2: Charakteristiky Clarksonova Indexu v aurignackém souboru SS2 (N = 22) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS2. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| | **Flake segment** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Retouch Invasiveness Score | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 1 | 4 | 8 | 8 | 6 | 9 | 5 | 4 |
| **1.0** | 0 | 0 | 0 | 1 | 3 | 0 | 0 | 0 |
| **Total** | 1 | 4 | 8 | 9 | 9 | 9 | 5 | 4 |
| ***% Total*** | *5* | *18* | *36* | *41* | *41* | *41* | *23* | *18* |

5

18 18

36 23

41 41

41

of this study support an already well-established body of research (as discussed previously) which proposes that continuous variation in morphology evident on retouched artefacts actually reflects different stages in a continuous reduction process. Morphological variability in both scrapers and notched flakes from the four Moravian sites was found to be related to differential reduction. Thus, the reduction continuum model appears to be a better explanation of variability in Moravian scraper types than the traditional typological explanation, which sees morphological types reflecting mental templates or functional designs. The study also concluded that a common sequence of morphological changes is found for scrapers in many parts of the world despite differences in chronology and the hominin species responsible for those assemblages. The degree of reduction did not explain all of the morphological variability observed in the Moravian Palaeolithic assemblages. Factors not examined in this study, such as functional constraints or culturally transmitted preferences for particular retouching procedures or shapes, may account for some of that variation (Nejman, Clarkson 2008).

Although it has been demonstrated that the reduction models are a powerful explanation for intra-assemblage morphological variability, it should not be assumed that this applies to all lithic assemblages. For example, Kuhn (1992) argues that at Grotta di Sant' Agostino, a Middle Palaeolithic site in Italy, the shapes of blanks have a stronger influence on some retouched artefact forms than reduction. Close (1991) has argued that implements in the Middle Palaeolithic assemblage Bir Tarfawi (Eastern Sahara) are independent types based on design and not simply stages in a reduction sequence. Gordon (1993) has argued that the Mousterian point at Ghar (Israel) is an independent type and not simply an exhausted form of scraper.

A descriptive typology such as Bordes' does address a need, which is useful to both typologists and materialists. A standardized type list allows comparison and integration of many different lithic assemblages from a large geographical area and from a wide temporal spread. However, "the goal of archaeology is not to account for the typologically defined contrasts between assemblages, but to gain insight into the behavior of prehistoric hominids" (Kuhn 1992, 126). A standardized type list is not useful for the kind of research presented in this paper since the goal is to obtain quantitative data which can be used to compare assemblages, with the goal of inferring behaviours of the assemblage manufacturers. Essentialist classifications such as typology tend to emphasize central tendency and downplay variation because central tendency is assumed to represent the essence of the group. This approach is decidedly inappropriate for cultural phenomena, which are in a constant state of change (Clarkson 2004).

Disputing the meaning of types in typological schemes is not a recent phenomenon. The current debates between typologists and proponents of the reduction continuum models are reminiscent of the exchanges between American archaeologists Spaulding and Ford in the 1950s. Spaulding (1953, 1954) argued that types were inherent in prehistoric objects and that their classification follows the distinctions that their prehistoric manufacturers intended. Ford (1954a, b) argued that types were not inherent in artefacts and that they were merely constructs of archaeologists who devised the typology.

In this work, lithic assemblages from one of the most important EUP sites in Europe, Stránská Skála, are analysed. Stránská Skála is a limestone cliff on the eastern edge of the city of Brno (Czech Republic) and contains layers of chert, which was utilized by people from the Early Palaeolithic to the Neolithic. This site is one of the richest and most important EUP sites in Europe. The various Upper Palaeolithic occupations have been systematically investigated since 1982 (Svoboda 1987a) and the excavations continued until 1999 (Svoboda, Ofer-Bar Yosef 2003). The site contains multiple EUP horizons, which have produced assemblages classified as Aurignacian and Bohunician. Several tens of thousands of stone artefacts have been recovered so far.

Tab. 3: Clarkson Index Patterns at Aurignacian SS2a3 (N = 17) and retouch frequency of individual flake segments for SS2a3. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 3: Charakteristiky Clarksonova Indexu v aurignackém souboru SS2a3 (N = 17) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS2a3. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| Retouch Invasiveness Score | **Flake segment** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 0 | 4 | 3 | 6 | 4 | 2 | 4 | 3 |
| **1.0** | 0 | 0 | 1 | 1 | 3 | 3 | 1 | 1 |
| **Total** | 0 | 4 | 4 | 7 | 7 | 5 | 5 | 4 |
| ***% Total*** | *0* | *24* | *24* | *41* | *41* | *29* | *29* | *24* |

0
24 24
24 29
41 29
41

The materialist approach employed for this research is used to analyse the Stránská Skála assemblages. Using the materialist approach to analyse the Stránská Skála assemblages, a potential to discover new information has been demonstrated, which has resulted in new knowledge about the Middle-Upper Palaeolithic transition in this region. The materialist approach offers some advantages over the typological approach because it divides an assemblage into categories based on observable features without referring to ideal forms, the mental predisposition of the maker, or the presumed goals of the artisan. Both inter- and intra-class variation is emphasised by materialist descriptions. Materialist classifications analyse the artefact in terms of the mechanisms by which it was created, rather than the presumed purposes for which it was created (Hiscock 2007). A fundamental advantage of the materialist approach is that the construction history of each artifact is being taken into account, providing clear data about manufacturing processes and creating quantitative images of variability within an assemblage. Furthermore, assertions about the knapper's mental goals are not presumptively incorporated into the description of artefacts (Hiscock 2007).

## 6. The Aurignacian and Bohunician Industries at Stránská Skála

Many of the claims regarding the lithic differences between the Aurignacian and Bohunician industries are directly testable using the data collected for this project. For example, the relative degree of 'bladeyness' can be established, i.e. flake length/width (also called elongation), by comparing the average elongation values of retouched and unretouched flakes between the industries (the Elongation Index as used in this research refers to the mean value of elongation for a given sample of flakes).

Much of the literature to date has reported that important differences exist between the younger Aurignacian assemblages and the older Bohunician assemblages, which justify their division into separate industrial types (*e.g.* Svoboda 1993; Škrdla 2003a, b; Tostevin 2000a, b, 2003a, Tostevin, Škrdla 2006). This is a topical question, and the purported differences between Aurignacian and Bohunician assemblages at Stránská Skála have also been used to argue for two separate models of the origin of these two temporally distinct lithic industries (Tostevin 2000a, b, 2003a). Each of these two industrial types can also be considered as a chronological proxy, because there is a consistent chronostratigraphic distinction between them. The Aurignacian assemblages are always younger than the Bohunician assemblages; the Bohunician assemblages always underlie the Aurignacian assemblages. The available $^{14}$C dates (see *e.g.* Svoboda 2003) also corroborate their chronostratigraphic separation. While the Aurignacian is widely recognised as a pan-European phenomenon, the Bohunician was originally geographically confined to the Brno Basin in southern Moravia (Svoboda 1993). Some authors have recently claimed that the Bohunician is spread over a wider area, being also present at sites in Bohemia, western Ukraine and eastern Slovakia (see Foltyn, Kozlowski 2003).

One of the criteria used to distinguish the Bohunician and the Aurignacian industries is the relative proportion of blades. For example, Svoboda (1987b) has demonstrated that in the Bohunician assemblages the relative proportion of blades is somewhat lower than in the Aurignacian assemblages. Another criterion used to distinguish the two industries is relative frequencies of retouched implements. The Bohunician is said to contain some Middle Palaeolithic types (sidescrapers and points), but Upper Palaeolithic types such as endscrapers on flakes and wide blades and burins are present in greater proportions. Endscrapers always outnumber burins, and some carinated endscrapers (Aurignacian types) can also be found in the Bohunician assemblages. In contrast to the Bohunician, the Aurignacian has more thick and carinated endscrapers, and the ratio of endscrapers to burins can vary between assemblages (Svoboda 1993, Svoboda *et al.* 2002).

The most important criterion for distinguishing the Aurignacian and the Bohunician industries has been the dif-

Tab. 4: Clarkson Index Patterns at Aurignacian SS2a4 (N = 200) and retouch frequency of individual flake segments for SS2a4. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 4: Charakteristiky Clarksonova Indexu v aurignackém souboru SS2a4 (N = 200) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS2a 4. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| | **Flake segment** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Retouch Invasiveness Score | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 16 | 37 | 54 | 42 | 65 | 53 | 60 | 36 |
| **1.0** | 5 | 6 | 5 | 8 | 20 | 16 | 11 | 10 |
| **Total** | 21 | 43 | 59 | 50 | 85 | 69 | 71 | 46 |
| ***% Total*** | *11* | *22* | *30* | *25* | *43* | *35* | *36* | *23* |

11
22 23
30 36
25 35
43

ferences in core reduction techniques (see Fig. 2). The Bohunician reduction strategy (see Fig. 3) involves a combination of Levallois flake and blade flaking (Svoboda, Škrdla 1995; Škrdla 1999, 2000a, b) where the intent of the artisan was to obtain a Levallois flake with a faceted platform. Any blades are by-products (Škrdla 2003a).

This unique reduction technique is specific to the Bohunician assemblages at Stránská Skála. It involves the removal of blades from two opposite platforms resulting in a triangular cross-section from which a series of Levallois points were struck. The resulting wide frontal face of the core was then narrowed by the removal of several blades and so on. Complete refitted sequences are available for the Stránská Skála Bohunician assemblages and they clearly demonstrate the presence of the Bohunician reduction strategy, in which the blade and Levallois flakes are struck from the same core (Škrdla 1999, 2000a, b). Based on conjoins from Bohunician assemblage Stránská Skála III, Neruda and Nerudová (2005) contest this finding by reporting three different reduction techniques present in the Bohunician of Stránská Skála. Two of these techniques ('sub-prismatic' and 'Upper Palaeolithic blade' method) involve the production of blades and the third technique involves Levallois flakes being produced.

Unfortunately, verifying the presence of the Bohunician reduction sequence in Bohunice has not been possible (as yet) because the few refitted sequences are inadequate for comparisons to the Stránská Skála sequences (Škrdla, Tostevin 2005), although Tostevin and Škrdla (2006) do show that core morphologies at discard as well as attribute analysis of the debitage points are more similar to the Stránská Skála Bohunician assemblages than to other assemblages tested.

The Aurignacian reduction technique, on the other hand, is claimed to have been oriented towards blade production, and other flakes are considered to be merely by-products. This industry is typified by precores with frontal crests and prismatic cores (Svoboda 1993), and the 'target artefact' is the blade (Škrdla 2003a). Unfortunately, very few conjoined artefacts are available for the Stránská Skála Aurignacian assemblages to complete this picture, but good examples of this reduction technique are available from refittings of the Vedrovice Ia Aurignacian assemblage (Neruda, Nerudová 2005).

Tostevin (2000b, 2003a) investigates the issue of different core reduction techniques between the Bohunician and Aurignacian industries in a systematic and very detailed analysis of the lithic operational sequences. He divides the lithic operational sequence into five knapping domains (core modification, platform maintenance, direction of core exploitation, dorsal surface convexity system and tool manufacture), each of which he further subdivides into a varying number of behavioural steps. He then performs pair-wise comparisons to determine the degree of difference between the industries for each behavioural step and by adding up the scores for the behavioural steps in each knapping domain. Based on the relatively large differences in the behavioural steps identified within the five knapping domains, Tostevin (2000b) builds an argument for the separation of the Aurignacian and Bohunician industries. As a result of the measured differences between the two artefact production sequences, he determines a relatively significant amount of difference between the two industries. He frames this problem in terms of independent innovation (in situ behavioural change) versus diffusion (spread of behaviours from one region to another as a result of either population movement and/or diffusion of isolated behaviours). Based on the results of his analyses, he argues that the archaeological record points to two separate diffusion events – the Bohunician Behavioural Package between 46,000-42,000 BP and the Aurignacian Behavioural Package between 36,000-32,000 BP. Škrdla (2003c) analysed and compared the refitted sequences between the Levantine site Boker Tachtit (levels 1 and 2), and the Bohunician assemblages at Stránská Skála, concluding that the core reduction techniques between the two sites are

Tab. 5: Clarkson Index Patterns at Aurignacian SS3a3 (N = 43) and retouch frequency of individual flake segments for SS3a3. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 5: Charakteristiky Clarksonova Indexu v aurignackém souboru SS3a3 (N = 43) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS3a3. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| Retouch Invasiveness Score | **Flake segment** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 4 | 5 | 12 | 12 | 10 | 10 | 11 | 3 |
| **1.0** | 0 | 0 | 0 | 2 | 6 | 1 | 1 | 2 |
| **Total** | 4 | 5 | 12 | 14 | 16 | 11 | 12 | 5 |
| ***% Total*** | *9* | *12* | *28* | *33* | *37* | *26* | *28* | *12* |

9
12 12
28 28
33 26
37

very similar. This supports Tostevin's conclusion regarding the spread of the Bohunician reduction technique.

Overall, this approach provides the most compelling argument presented thus far for the separation of the Aurignacian and Bohunician industries at Stránská Skála, however, it must be remembered that this approach is limited because "...it is virtually impossible to come up with an independent test of an argument about ethnicity or "technological traditions" in the remote past." (Kuhn 1995). In the next section, I will discuss other criteria which are often used to differentiate Aurignacian industries and how they relate to the Aurignacian industries at Stránská Skála.

## 7. The Missing Lithic and Non-Lithic Elements of Aurignacian Assemblages at Stránská Skála

There are several other aspects of the Aurignacian assemblages at Stránská Skála which are relevant to the question of their definition as a separate industrial complex. Firstly, the Aurignacian assemblages at this site do not contain bladelets, whereas many other European Aurignacian assemblages do. The presence of bladelets is often considered to be a characteristic of Aurignacian assemblages, and they are present in some of the French Upper Palaeolithic assemblages where the Aurignacian industry was first described (see *e.g.* Le Brun-Ricalens 2005; de Araujo Igreja *et al.* 2006).

According to Bar-Yosef and Kuhn (1999), while the incidence of blade industries waxes and wanes throughout prehistory, it is the presence of bladelets which signifies a major shift between Middle and Upper Palaeolithic assemblages. Unfortunately, there are many assemblages identified as Aurignacian (including those at Stránská Skála) which do not contain bladelets. To complicate matters even further, Middle Palaeolithic levels at some sites have been reported to show evidence of bladelet production. For example, the Mousterian levels at two sites in Spain, Cueva del Castillo and Cueva Morin, have reportedly produced this evidence (Fernandez *et al.* 2004) and a mid-Middle Palaeolithic layer at Combe Grenal, France, has produced clear evidence for bladelet production (Peter Hiscock, personal communication 2006). Therefore, it would appear that the presence or absence of bladelets is not a suitable criterion for distinguishing Aurignacian industries.

The Aurignacian assemblages at Stránská Skála do not contain any organic artefacts. Organic artefacts such as bone points, pendants and beads, are generally considered to be one of the defining characteristics of Aurignacian cultures. This absence of organic artefacts should not be used as evidence that they were never present, because preservation of organic material is very poor at Stránská Skála. Even faunal remains are very rare; only one mammoth tooth and several horse teeth were found at SS (Stránská Skála) III, and few horse and bison bone fragments were found at SSIIIb (Musil 2003). The people who manufactured the younger Aurignacian industries may or may not have manufactured more organic artefacts than their Bohunician predecessors. However this claim cannot be tested, because no organic artefacts have been recovered associated with any Stránská Skála assemblages.

Pieces of ochre are the only archaeological material with potentially symbolic significance found at Stránská Skála. Watts (2002) argues that the presence of ochre is good evidence for symbolism, and that there is very little ethnographic, archaeological or experimental evidence for use of ochre for utilitarian purposes. In contrast, Wadley (2005) argues that lithics covered with red ochre from some South African sites (Rose Cottage, Sibudu Caves) were hafted and the ochre was part of the adhesive used for hafting the tools. Her replication studies convincingly demonstrate that ochre does have practical merit under certain circumstances so its presence in archaeological sites does not prove symbolism. The ochre found at Stránská Skála was recovered from site III, which yielded a large Bohunician assemblage. Interestingly, there are no reports of any ochre being found associated with any of the Aurignacian assemblages excavated at Stránská Skála. Bone artefacts and ochre use tend to be especially prevalent in Aurignacian assemblages, however in the case of the Aurignacian assemblages at Stránská Skála these elements are absent.

## 8. Discussion of Industrial Trends at Stránská Skála

As discussed previously, lithic assemblages classified as belonging to a particular typological industry are widely assumed by typological practitioners to be homogeneous and to be reflecting a common cultural heritage. Unfortunately, the definitions of these industries are fraught with serious difficulties such as a large degree of intra-site and inter-site variability, and sampling error due to small sample sizes (*e.g.* Churchill, Smith 2000; Straus 1995).

As many of the claims regarding the lithic differences between the Aurignacian and Bohunician industries are directly testable, a number of statistical tests were employed to test the similarities and differences between the two industries. All of the lithic variables used in this research are direct lithic economy proxies of procurement and utilisation of raw material. This investigation begins with the comparison of the Aurignacian and the Bohunician by performing t-tests on the differences between flake weight and flake size (length, width and thickness), flake elongation and intensity of retouch. The t-test is a very robust statistical test, which assesses whether the means of two samples are statistically different from each other. Flake length was defined as the distance from the ringcrack to the distal end along the axis of percussion. Width was defined as the distance between the lateral margins of the flake measured at the midpoint, at right angle to the measured percussion length. Thickness was defined as the distance between the ventral and dorsal surfaces measured at the intersection point of length and width. Flake elongation was defined as length/width. The Elongation Index as used in this research refers to the mean value of elongation for a given sample of flakes. The % of length retouched is the proportion of the artefact circumference that has retouch scars, expressed as a percentage. Most of the samples used for analyses presented in this paper include only complete, retouched flakes, but some samples include all retouched flakes (i.e. complete and broken). The disadvantage of including broken flakes in all samples is that some flake attributes cannot be measured reliably because all broken flakes have a missing segment (or segments). The advantage of including all flakes is increased sample size, which in turn has the advantage of decreasing sampling error and increasing the power of the test. Flake width and MGIUR (see below) can still be validly measured on transversely broken, as well as complete flakes, so for these tests, all retouched flakes are included in the sample. MGIUR can still be measured on broken flakes because it is only dependent on differences in flake thickness, which can still be measured on transversely broken flakes.

It can be argued that size is one of the most important functionally linked characteristics of flakes because it directly influences its utility. Larger tools were probably more effective than smaller tools because of their greater potential for resharpening or renewal (Kuhn 1995:34). One measure used to measure the intensity of retouch is the percentage of length retouched and a second measure used in this research is the Mean Geometric Index of Unifacial Reduction (MGIUR). The resharpening of tools is an economical tactic for producing sharp, usable edges while minimizing the cost of transporting multiple tools or bulky raw materials, and has been observed ethnographically (see Kuhn 1990). The MGIUR is a useful and reliable measure of reduction or resharpening, and is particularly useful for unifacial flakes. The index score is always less than 1 and the higher the number the more intense the retouch. Kuhn (1990) describes two methods of arriving at the index of reduction. The simplest way is to measure the thickness of the flake at the termination of retouch scars (t) and the maximum medial thickness of the flake (T). The Index is then obtained by simply dividing T by t (i.e. t/T) (Kuhn 1990). The second method of obtaining the Index is by measuring the angle of retouch (a) and the depth of retouch or extension of retouch scars (D). The Index is then calculated using the formula [sin a(D)/T] (Kuhn 1990). In this project, the former method is used to calculate the Index.

Dibble (1995) has criticised the Kuhn Index, citing its unresponsiveness to retouching on flakes, which have flat dorsal surfaces parallel to the ventral surface (the 'flat-flake' problem). However, Hiscock and Clarkson (2005a) point out that even flakes with very flat dorsal surfaces may often have cross-sectional variation caused by the outward curvature of the ventral face. Hiscock and Clarkson (2005a, b) conducted experimental testing that confirmed that the MGIUR performs well as an absolute measure of reduction, especially in comparison to a number of alternative techniques, and the flat-flake problem is not an obstacle for this index. Most recently, Clarkson and Hiscock (2008) have further demonstrated both the efficacy of this index over other measures of reduction and its resilience to the effects of varying reduction strategies, retouch placement, blank type and raw material type.

The results of the t-tests on Stránská Skála assemblages indicate that, based on the selected attributes of retouched flakes, the retouched flakes recovered from the Aurignacian and Bohunician units at Stránská Skála are very similar (see Tab. 1).

The only statistically significant differences are in some aspects of flake size; the retouched flakes become shorter (Fig. 5) and less wide (Fig. 6) in the younger (Aurignacian) assemblages, compared to the older (Bohunician) assemblages. There is no corresponding change in flake thickness. The decrease in flake weight, which would be expected to covary with flake size, is evident (see Fig. 4) and only just fails to reach statistical significance, probably because of several extreme values (outliers) which are also causing the very large standard deviations.

There is no change in average retouch intensity over time (Fig. 7), which suggests that the reduction in flake size evident in Aurignacian assemblages cannot be attributed to more material being removed from the flakes

Tab. 6: Clarkson Index Patterns at Bohunician SS2a5 (N = 18) and retouch frequency of individual flake segments for SS2a5. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 6: Charakteristiky Clarksonova Indexu v bohunickém souboru SS2a5 (N = 18) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS2a5. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| Retouch Invasiveness Score | Flake segment | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 1 | 6 | 4 | 6 | 3 | 4 | 5 | 5 |
| **1.0** | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 |
| **Total** | 1 | 6 | 4 | 6 | 3 | 5 | 5 | 5 |
| ***% Total*** | *6* | *33* | *22* | *33* | *17* | *28* | *28* | *28* |

6
33 28
22 28
33 28
17

Tab. 7: Clarkson Index Patterns at Bohunician SS3 (N = 94) and retouch frequency of individual flake segments for SS3. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 7: Charakteristiky Clarksonova Indexu v bohunickém souboru SS3 (N = 94) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS3. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| Retouch Invasiveness Score | Flake segment | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 4 | 16 | 25 | 29 | 22 | 32 | 32 | 22 |
| **1.0** | 1 | 2 | 1 | 8 | 16 | 6 | 3 | 3 |
| **Total** | 5 | 18 | 26 | 37 | 38 | 38 | 35 | 25 |
| ***% Total*** | *5* | *19* | *28* | *39* | *40* | *40* | *37* | *27* |

5
19 27
28 37
39 40
40

through retouching. The Aurignacians were retouching flakes at a very similar intensity to the Bohunicians, which means that the smaller size of the Aurignacian flakes is not due to greater intensity of retouch. This result is confirmed by two separate measures of reduction; the MGIUR and the percentage of flake length retouched (see Tab. 1). Both of these measures of reduction suggest that there is no statistically significant difference in the amount of retouch the flakes have received.

Even more surprisingly, there is no statistically significant difference in the Elongation Index between the two industries. The average length/width ratio value is statistically the same between the Aurignacian and the Bohunician retouched flakes, which seems to contradict previous claims that there are more blades among the Aurignacian implements than among the Bohunician implements. However, this result may be an 'artefact' of averaging and I will return to this problem in the next section.

It is clear from these results that, contrary to expectations, the differences between the younger Aurignacian and the older Bohunician retouched flakes are far smaller than would be expected. Although a large degree of difference has been argued for these industries, especially for the knapping domains (Tostevin 2000a, b, 2003a) and core reduction strategies (Svoboda, Škrdla 1995; Škrdla 1999, 2000a, b, 2003a), this is not being reflected in the size, shape, or retouch intensity of retouched flakes.

## 9. The Invasiveness of Retouch

The central tendency values measuring retouch intensity (based on the MGIUR) between the Aurignacian and the Bohunician assemblages at Stránská Skála (Tab. 1 and Fig. 7) clearly show that retouch intensity is not different between the two industries. Another way we can measure the retouch intensity is using the Clarkson Index. This index also measures the intensity of retouch, but in contrast to Kuhn's MGIUR, it records the intensity of flat retouch and the location of retouch on the flake. It

Tab. 8: Clarkson Index Patterns at Bohunician SS3a4 (N = 67) and retouch frequency of individual flake segments for SS3a4. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 8: Charakteristiky Clarksonova Indexu v bohunickém souboru SS3a4 (N = 67) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS3a4. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| | **Flake segment** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Retouch Invasiveness Score | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 2 | 11 | 8 | 20 | 34 | 15 | 15 | 8 |
| **1.0** | 0 | 2 | 4 | 1 | 6 | 4 | 1 | 0 |
| **Total** | 2 | 13 | 12 | 21 | 40 | 19 | 16 | 8 |
| ***% Total*** | *3* | *19* | *18* | *31* | *60* | *28* | *24* | *12* |

3
19 12
18 24
31 28
60

requires qualitative assessments of the area covered by retouch scars on the dorsal and ventral surfaces of the flake. Each surface plane of the flake is conceptually divided into eight areas, so when a flake is complete it has sixteen segments. These segments are labeled as proximal end, left proximal, right proximal, left medial, right medial, left distal, right distal, and distal end. The extent of invasiveness for each segment is estimated and recorded as 0 = no retouch, 0.5 = retouch scars extend to less than the halfway point between the mid-line of the flake (i.e. the y-axis) and the lateral edge, and 1.0 = retouch scars extend further than the halfway point (Clarkson 2002b). This index is simple to use, versatile and relatively robust. It has also been demonstrated experimentally that the Clarkson index corresponds closely to artefact weight (Clarkson 2002b). As originally conceived by Clarkson (2002a), it includes scores from both the dorsal and ventral flake surfaces, so that the total number of segments on a complete flake is sixteen. In the following analysis, a slightly modified version of the Clarkson Index is used. Since retouch on the ventral surface is relatively rare on flakes at Stránská Skála, I am only interested in looking at the dorsal surface. Therefore, the 'modified' Clarkson Index (MCI) score is out of eight, rather than out of sixteen.

Tabs. 2–9 present the MCI patterns for each Aurignacian and Bohunician assemblage separately. The columns record the location of the dorsal retouch on the flake, based on the subdivision of each flake into the eight segments. The % Total row has the calculated percentage of the total number of flakes, which have dorsal retouch in that particular segment. A schematic 'flake diagram' with the corresponding percentages of retouched segments is presented in conjunction with each table for each assemblage. The MCI for each assemblage at Stránská Skála is calculated. The MCI value is a fraction (out of eight).

The Mean Clarkson Index (MCI) for the Aurignacian assemblages is 1.40. The number of segments where retouch extends to less than half-way to the midline (i.e. value 0.5) of the flake is always higher than for segments where retouch encroaches past the half-way mark to the flake midline (i.e. value 1.0) for each segment of each flake. The four Aurignacian assemblages are relatively lightly retouched and this is reflected in the relatively low MCI value. The retouch tends to be steep rather than flat and invasive. These assemblages are dominated by steep retouch so the Clarkson Index is not particularly useful for measuring reduction on these artefacts. However, it is still capable of quantifying the invasiveness of the retouch (Clarkson 2002a).

The MCI for Bohunician assemblages at Stránská Skála is 1.70. This is somewhat higher than the younger Aurignacian assemblages. As in the Aurignacian assemblages, the number of segments with the value of 0.5 is also always higher than the number of retouched segments with a value of 1. That is, invasive retouch is relatively uncommon in all of the assemblages at Stránská Skála. Furthermore, the diagrams show that the retouch also tends to concentrate in the distal portion of the flakes, with the highest occurrence of retouch on the distal-end segment.

The diagrams also reveal that although the Bohunician flakes tend to be slightly more invasively retouched than Aurignacian flakes, the patterns in location of retouch tend to be quite similar between the two groups of assemblages.

A chi-square test ($\chi^2$ = 6.6075, df = 7, critical $\chi^2$ value at p = 0.05 and 7 df is 14.07; $H_0$ is retained) reveals that the Aurignacian and Bohunician patterns of retouch location are statistically indistinguishable (see Tab. 10). In other words, the retouch patterns and retouch intensity (as measured by MCI) are remarkably similar between the Aurignacian and the Bohunician industries, suggesting that the flake reduction methods remained similar over time at Stránská Skála. The results of the MGIUR index also indicated that the intensity of retouch is very similar (and statistically indistinguishable) between the Aurignacian and Bohunician industries at Stránská Skála. This finding presents further supporting

Tab. 9: Clarkson Index Patterns at Bohunician SS3b (N = 46) and retouch frequency of individual flake segments for SS3b. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 9: Charakteristiky Clarksonova Indexu v bohunickém souboru SS3b (N = 46) a procentuální výskyt retuší na jednotlivých segmentech úštěpů v souboru SS3b. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| Retouch Invasiveness Score | **Flake segment** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **0.5** | 2 | 7 | 15 | 11 | 14 | 10 | 12 | 9 |
| **1.0** | 0 | 1 | 1 | 3 | 3 | 0 | 2 | 2 |
| **Total** | 2 | 8 | 16 | 14 | 17 | 10 | 14 | 11 |
| ***% Total*** | *4* | *17* | *35* | *30* | *37* | *22* | *30* | *24* |

4
17 24
35 30
30 22
37

Tab. 10: Contrasting the MCI Patterns (raw scores and percentages) Between the Aurignacian and the Bohunician Retouched Flakes and Average Retouch Frequency of Individual Flake Segments for Aurignacian (left) and Bohunician (right) Assemblages at Stránská Skála. The diagram represents a flake with the platform at the top and distal end at the bottom. *Tab. 10: Porovnání charakteristik MCI (hrubá data a procenta) mezi retušovanými úštěpy aurignacienu a bohunicienu a průměrné frekvence retuší na jednotlivých úštěpech v aurignackých (vlevo) a bohunických (vpravo) souborech ze Stránské skály. Diagram znázorňuje úštěp s patkou nahoře a distálním koncem dole.*

| **Industry** | **Flake segment totals and percentages** | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Proximal end | Left proximal | Left medial | Left distal | Distal end | Right distal | Right medial | Right proximal |
| **Aurignacian** | 26 | 56 | 83 | 80 | 117 | 94 | 93 | 59 |
| **Bohunician** | 10 | 45 | 58 | 78 | 98 | 72 | 70 | 49 |
| **% Aurignacian** | 9 | 20 | 29 | 28 | 41 | 33 | 33 | 21 |
| **% Bohunician** | 4 | 20 | 26 | 35 | 44 | 32 | 31 | 22 |

9 | 4
20 21 | 20 22
29 33 | 26 31
28 33 | 35 32
41 | 44

evidence that the Aurignacian and Bohunician retouched implements at Stránská Skála are extremely similar.

## 10. Differences in Proportions of Retouched Blades

I have already discussed some of the previous research which detected differences in the lithic reduction sequences between the Aurignacian and Bohunician assemblages. One of these claims maintains that the target artefact in the Bohunician reduction strategy is the Levallois point, whereas the target artefact in the Aurignacian strategy is the blade (*e.g.* Škrdla 2003a, b). If this is correct, and if the blades were subsequently retouched, we can expect that there will be more retouched blades in the Aurignacian assemblages than in the Bohunician assemblages. It has already been determined that there is no overall difference in flake elongation between the younger and older assemblages at Stránská Skála. However, it is necessary to examine this issue further because the difference in elongation could still apply in a somewhat narrower context.

For example, if the Aurignacian knappers were selectively choosing blades for retouching, a difference in elongation could still be demonstrated if we consider 'true blades' only (i.e. retouched flakes with a length/width ratio which is greater than or equal to 2.0, instead of the length/width ratio average).

The results reveal that 26.6% of retouched Aurignacian flakes are true blades, and 21.4% of retouched Bohunician flakes are true blades. The Chi-Square test for Goodness-of-Fit reveals that this difference is statistically significant ($\chi^2 = 5.9268$, df = 1, critical $\chi^2$ value at p = 0.05 and 1 df is 3.84; $H_0$ is rejected). This statistically significant result would appear to confirm that true blades are indeed being selected for retouch at a higher rate in the Aurignacian

Tab. 11: Proportions of True Blades in Stránská Skála Assemblages. *Tab. 11: Poměry pravých čepelí ve stránskoskalských souborech.*

| Assemblage | Retouched flakes EI >= 2.0 (N; %) | | Total No. of retouched flakes |
|---|---|---|---|
| SS2 | 6 | 27.3 | 22 |
| SS2a3 | 4 | 23.5 | 17 |
| SS2a4 | 56 | 28.0 | 200 |
| SS2a5 | 5 | 27.8 | 18 |
| SS3 | 22 | 22.9 | 96 |
| SS3a3 | 9 | 20.9 | 43 |
| SS3a4 | 13 | 19.4 | 67 |
| SS3b | 8 | 18.6 | 43 |
| SS Aurignacian | 75 | 26.6 | 282 |
| SS Bohunician | 48 | 21.4 | 224 |

Tab. 12: T-tests of Elongation Index Values for Stránská Skála Assemblages. Note: p values in bold – correlation is significant at the 0.05 level (2-tailed). *Tab. 12: T-testy hodnot čepelového indexu úštěpů ze stránskoskalských souborů*

| Assemblage | Flakes | Mean | Std. Dev. | t | df | p | N |
|---|---|---|---|---|---|---|---|
| SS2 Aurignacian | Retouched | 1.63 | 0.62 | -0.123 | 19 | 0.901 | 10 |
| | Unretouched | 1.66 | 0.72 | | | | 25 |
| SS2a3 Aurignacian | Retouched | 1.45 | 0.77 | -0.715 | 6 | 0.520 | 8 |
| | Unretouched | 1.77 | 0.71 | | | | 4 |
| SS2a4 Aurignacian | Retouched | 1.83 | 0.71 | 0.000 | 120 | 1.000 | 104 |
| | Unretouched | 1.83 | 0.62 | | | | 54 |
| SS3a3 Aurignacian | Retouched | 1.84 | 0.97 | 0.300 | 36 | 0.766 | 20 |
| | Unretouched | 1.75 | 0.79 | | | | 26 |
| SS2a5 Bohunician | Retouched | 2.00 | 1.29 | -0.150 | 14 | 0.886 | 11 |
| | Unretouched | 2.06 | 0.92 | | | | 29 |
| SS3 Bohunician | Retouched | 1.78 | 0.87 | 2.179 | 69 | **0.032** | 44 |
| | Unretouched | 1.45 | 0.53 | | | | 44 |
| SS3a4 Bohunician | Retouched | 1.65 | 0.58 | 0.000 | 82 | 1.000 | 36 |
| | Unretouched | 1.65 | 0.58 | | | | 50 |
| SS3b Bohunician | Retouched | 1.49 | 0.68 | -0.141 | 30 | 0.889 | 24 |
| | Unretouched | 1.52 | 0.60 | | | | 14 |

assemblages than in the Bohunician assemblages. This result offers some support for the differentiation of Aurignacian and Bohunician assemblages at Stránská Skála. More specifically, the claim that there are more blade implements in the Aurignacian industry than in the Bohunician industry is vindicated (to some extent) by this result. Additionally, the higher number of true blades being selected for retouch in the Aurignacian could be interpreted as evidence for Škrdla's (2003a, b) result that blades are the 'target artefact' in the Aurignacian reduction strategy and in general, as confirmation of previous research which showed that blades are more common in the Aurignacian than in the Bohunician (*e.g.* Svoboda 1987b).

One of the criteria for distinguishing Aurignacian and Bohunician assemblages is the 'bladeyness' of the assemblage. One of the often-quoted differences between the Aurignacian and Bohunician assemblages at Stránská Skála is an increased proportion of blades in the Aurignacian assemblages, compared to the Bohunician assemblages (*e.g.* Svoboda 1987b). The results presented here indicate that the difference in Elongation Index between the Aurignacian and Bohunician assemblages is not statistically significant (see Tab. 1), although true blades are being selected for retouching more often in the Aurignacian (see Tab. 11). The mean Elongation Index of the Aurignacian assemblages is 1.79, and the mean Elongation Index of the Bohunician assemblages is 1.70.

Although the Aurignacian value for the Elongation Index is higher, the corresponding 2-tailed significance level is 0.357, which is far from the 0.05 (5%) significance value required for the difference in means to be statistically significant. Tostevin (2000b) also found that the mean Elongation Index values are not statistically different between Aurignacian assemblages (SSIIa3 and SSIIa4) and the Bohunician (SSIII) assemblage at Stránská Skála. In fact, his sample included many unretouched flakes as well. The mean Elongation Index was actually greater in the Bohunician assemblage (mean=1.83, s.d.=0.73, n=421) than in the Aurignacian assemblages (mean=1.73, s.d.=0.75, n=470, p=0.06) (2000:184). The p level indicates that if we took a 6% level of probability (instead of the standard 5%), the Elongation Index of the Bohunician assemblages would actually be statistically higher than in the Aurignacian assemblages. Tostevin's results are based on much larger samples which also includes many unretouched flakes, corroborating the findings of this research that the mean bladeyness between Aurignacian and Bohunician flakes is statistically indistinguishable.

To examine this issue in greater detail, the mean Elongation Index values for all of the Stránská Skála assemblages were calculated and the values for retouched flakes and unretouched flakes were compared using t-tests (Tab. 12). This test also involves samples of unretouched flakes. Relatively small samples of unretouched flakes were selected from the collections in a systematic manner. The results show that within most of the assemblages (Aurignacian and Bohunician) there is very little difference in the average Elongation Index between retouched and unretouched flakes. In fact, retouched and unretouched flakes in one of the Bohunician assemblages (SS2a5) have a noticeably greater mean Elongation Index (2.00 and 2.06 respectively) than any of the Aurignacian assemblages.

Only one assemblage has a statistically significant difference in elongation between retouched and unretouched flakes; however, this difference can be confidently attributed to raw material factors. Seventy-six percent of retouched flakes in this assemblage is on the imported material radiolarite, whereas all other Stránská Skála assemblages have much lower proportions of radiolarite (see Nejman 2006). These results indicate that blank shape (as captured by the length/width ratio) may not be a major determinant in selection of blanks for retouching, because the elongation does not vary between retouched and unretouched flakes. This result is particularly significant because it indicates that from the whole population of flakes which were available for retouching, the knappers do not appear to have selected more elongated flakes. In other words, selection of blanks with a higher Elongation Index does not appear to have been a preferred strategy.

Extensive evidence from two different sources (this research and Tostevin 2000b) indicates that there are no statistical differences in the Elongation Index between the Aurignacian and Bohunician flakes at Stránská Skála, except in the narrower context of selection of true blades for retouching. This is the case for both retouched and unretouched flakes. Also, there are no major intra-assemblage differences in elongation between retouched and unretouched flakes. These findings disagree with previous claims made about greater proportions of blades in the Stránská Skála Aurignacian assemblages, although the finding that true blades are more often chosen for retouching in the Aurignacian assemblages does give some support to this claim.

It remains to be explained why the retouched flakes are smaller in the Aurignacian assemblages than in the Bohunician assemblages. Given that Aurignacian assemblages always overlie the layer with the Bohunician industry, it means that at Stránská Skála there is a temporal change towards a diminution in size of the retouched flakes being manufactured and retouched. It must be remembered that this difference, although statistically significant, is only 3 millimetres, so it may be inconsequential and further interpretations should possibly be considered as speculative. Increased reduction as a result of more intensive retouching does not appear to be the cause of this trend because the slight differences in the MGIUR values are not statistically significant. Therefore, the MGIUR values suggest that the retouched Aurignacian flakes have not had more material removed from them by retouching than the Bohunician flakes. A possible cause of this pattern is that, in the Aurignacian assemblages, flake blanks selected for retouching were already smaller than in the Bohunician assemblages. However, this explanation still begs the question of why this was the cause. This problem will be explored in detail in a future publication.

Although the results presented so far bring us closer towards characterising the nature of the lithic assemblages recovered from the chronostratigraphic units typologically classified as the Aurignacian and Bohunician, they do not unequivocally support or reject these classifications. Some of the results, however, do undermine the assumptions on which these typologies are based. For example, there is very little difference between the two industries in the elongation (shape), the intensity of retouch of the retouched implements, and the patterns of locations of retouch on the implements. The cores are also very similar in mean size (Nejman 2006). Although these characteristics are not the specific criteria that had been used to classify these assemblages, one would expect

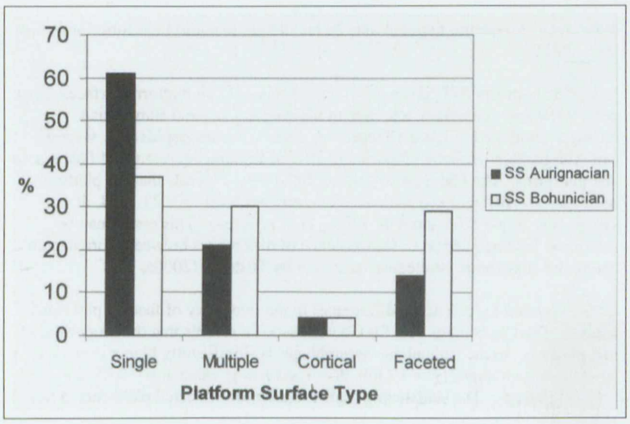


Fig. 8: Platform surface types of retouched flakes of Aurignacian and Bohunician assemblages at Stránská Skála. Faceted platforms are much more common in the Bohunician assemblages than in the Aurignacian assemblages, which could be an indicator of the 'Bohunician reduction strategy'. The category 'other' was excluded from this graph to emphasize the differences between determinable platform surface types. The differences between Aurignacian and Bohunician are statistically significant ($\chi^2$ = 16.3062, df = 3, critical $\chi^2$ value at p = 0.05 and 3 df is 7.81; $H_0$ is rejected). *Obr. 8: Typy povrchu patek na aurignackých a bohunických retušovaných úštěpech ze Stránské skály. Facetované patky jsou běžnější v bohunicienu než v aurignacienu, což může být interpretováno jako indikátor bohunické redukční strategie. Kategorie 'other' byla z tohoto grafu vyjmuta, aby se zdůraznily rozdíly mezi typy povrchu patek, které jsou určitelné ('other' zahrnuje patky, které byly poškozené nebo roztříštěné). Rozdíly mezi aurignacienem a bohunicienem jsou statisticky významné ($\chi^2$ = 16.3062, stupeň volnosti = 3, kritická $\chi^2$ hodnota při p = 0.05 a 3 stupních volnosti je 7.81; $H_0$ je vyřazena).*

Tab. 13: The Industrial Differences in Flake Platform Dimensions Between Retouched Flakes at Stránská Skála. Note: p values in bold – correlation is significant at the 0.05 level (2-tailed). *13: Rozdíly v rozměrech patek retušovaných úštěpů ze Stránské skály.*

| Attribute | Industry | Flakes | Mean | Std. Dev. | t | df | p | N |
|---|---|---|---|---|---|---|---|---|
| Platform width | Aurignacian | Complete only | 11.97 | 7.67 | -2.731 | 262 | **0.007** | 127 |
| | Bohunican | | 14.62 | 8.06 | | | | 137 |
| | Aurignacian | All | 12.10 | 7.41 | -2.837 | 469 | **0.005** | 217 |
| | Bohunician | | 14.07 | 7.56 | | | | 254 |
| Platform Thickness | Aurignacian | Complete only | 4.23 | 2.75 | -1.736 | 262 | **0.007** | 127 |
| | Bohunician | | 4.84 | 2.96 | | | | 137 |
| | Aurignacian | All | 4.21 | 2.76 | -1.982 | 469 | **0.048** | 217 |
| | Bohunician | | 4.72 | 2.78 | | | | 254 |

Tab. 14: Platform Surface Types of Retouched Flakes at Stránská Skála. *Tab. 14: Typy patek na retušovaných úštěpech ze Stránské skály.*

| SITE | PLATFORM SURFACE TYPE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Single (%,n) | | Multiple (%,n) | | Cortical (%,n) | | Faceted (%,n) | | Other (%,n) | | Total N |
| SS2 | 25 | 3 | 8 | 1 | 8 | 1 | 25 | 3 | 33 | 4 | 12 |
| SS2a3 | 75 | 9 | 25 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 12 |
| SS2a4 | 41 | 56 | 12 | 16 | 1 | 2 | 9 | 12 | 37 | 51 | 137 |
| SS2a5 | 25 | 4 | 56 | 9 | 0 | 0 | 19 | 3 | 0 | 0 | 16 |
| SS3a3 | 29 | 8 | 21 | 6 | 7 | 2 | 11 | 3 | 32 | 9 | 28 |
| SS3a4 | 32 | 14 | 23 | 10 | 0 | 0 | 27 | 12 | 18 | 8 | 44 |
| SS3 | 26 | 19 | 20 | 15 | 7 | 5 | 31 | 23 | 16 | 12 | 74 |
| SS3b | 41 | 12 | 21 | 6 | 0 | 0 | 3 | 1 | 34 | 10 | 29 |
| SS Aurignacian | 40 | 76 | 14 | 26 | 3 | 5 | 10 | 18 | 34 | 64 | 189 |
| SS Bohunician | 30 | 49 | 26 | 40 | 3 | 5 | 24 | 39 | 18 | 30 | 163 |
| TOTAL | 36 | 125 | 19 | 66 | 3 | 10 | 16 | 57 | 27 | 94 | 352 |

that, if the degree of difference between the industries was as large as claimed in the literature, these differences would also be reflected in the retouched implements. Instead, only very few differences between the two industries were detected by this analysis. The main difference is the slight diminution in size of the retouched flakes (as detected by a decrease in flake length and width) accompanied by a decrease in flake platform size in the Aurignacian period. This may reflect a change in hominid behaviour regarding their use of the landscape – the arguments for what these differences mean will be developed in a later publication.

## 11. Flake Platform Dimensions

As discussed earlier, the retouched Aurignacian flakes are slightly smaller than retouched Bohunician flakes. T-tests comparing platform dimensions for retouched flakes indicate that, on average, platforms on Bohunician flakes are also larger than on Aurignacian flakes. The values for mean platform width and mean platform thickness for complete retouched flakes and all retouched flakes (see Tab. 13) are greater for flakes from Bohunician assemblages than for flakes from Aurignacian assemblages. It has been shown that some dimensional attributes of flake size correlate significantly with flake platform size (Dibble 1997), so these results are more likely to be showing a statistically significant relationship between the mechanical properties of flakes (i.e. covariance of flake attributes) than independent differences between Aurignacian and Bohunician assemblages. At the same time these results can be considered as corroborative evidence for the diminution of flakes over time at Stránská Skála and confirming the finding that retouched flakes at Stránská Skála are noticeably smaller in the Aurignacian assemblages than in the Bohunician assemblages.

## 12. Flake Platform Surface Types

In the context of investigating the industrial differences at Stránská Skála, it is useful to also look at the frequencies of different types of flake platform surfaces. One of the arguments used for the uniqueness of the Bohunician reduction strategy is that flake platforms on retouched Bohunician flakes are usually faceted, and the flake platforms on retouched Aurignacian flakes are usually not faceted (Škrdla 2003a). Svoboda (1987b) also found that the Bohunician assemblage SS3a4 has more faceted platforms than the Aurignacian assemblage SS3a3. Moreover, it is conceivable that some of the flakes with faceted platforms could be contamination from the underlying Bohunician layer due to cryogenic processes, which have been well documented at Stránská Skála (*e.g.* Svoboda 1991; Svoboda *et al.* 1996, 2002). Cyclical freezing and thawing of sediment typically causes contamination of the younger layers by older layers from below due to the upward movement

Tab. 15: Platform Surface Types of Unretouched Flakes at Stránská Skála. *Tab. 15: Typy patek na neretušovaných úštěpech ze Stránské skály.*

| SITE | PLATFORM SURFACE TYPE | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Single (%,n) | | Multiple (%,n) | | Cortical (%,n) | | Faceted (%,n) | | Other (%,n) | | Total N |
| SS2 | 36 | 9 | 44 | 11 | 4 | 1 | 8 | 2 | 8 | 2 | 25 |
| SS2a3 | 25 | 1 | 50 | 2 | 0 | 0 | 0 | 0 | 25 | 1 | 4 |
| SS2a4 | 44 | 24 | 22 | 12 | 6 | 3 | 2 | 1 | 15 | 8 | 48 |
| SS2a5 | 41 | 12 | 38 | 11 | 0 | 0 | 3 | 1 | 17 | 5 | 29 |
| SS3a3 | 42 | 11 | 39 | 10 | 4 | 1 | 8 | 2 | 8 | 2 | 26 |
| SS3a4 | 38 | 19 | 40 | 20 | 4 | 2 | 6 | 3 | 12 | 6 | 50 |
| SS3b | 57 | 8 | 14 | 2 | 14 | 2 | 7 | 1 | 7 | 1 | 14 |
| SS Aurignacian | 41 | 45 | 32 | 35 | 5 | 5 | 5 | 5 | 12 | 13 | 109 |
| SS Bohunician | 42 | 39 | 35 | 33 | 4 | 4 | 5 | 5 | 12 | 12 | 93 |
| TOTAL | 42 | 84 | 34 | 68 | 4 | 9 | 5 | 10 | 12 | 25 | 202 |

of artefacts (Svoboda 1991). This process has also been demonstrated in cave sediments (*e.g.* Hahn 1987).

According to Dibble (1981), platform faceting is a particular strategy for controlling the exterior platform angle, which in turn significantly affects the dimensions of the resulting flake. Overhang removal may be an attempt to control platform thickness (Dibble 1981).

In this work, the flake platform types have the following definitions: single – one surface plane, multiple – more than one surface plane, cortical – some or all of the platform surface is covered by cortex, faceted – presence of negative scars from flaking. Category 'other' refers to platform surfaces which were shattered, absent or indeterminate. Tab. 14 lists numbers and percentages of the types of flake platform surfaces, firstly in each assemblage separately, and then in the Aurignacian and Bohunician assemblages combined. Fig. 8 represents these patterns graphically. Overall, 14% of Aurignacian retouched flakes, and 29% of Bohunician retouched flakes have faceted platforms. The Chi-Square Test for Relatedness reveals that the platform surface types are different at a statistically significant level ($\chi^2$ = 23.1158, df = 4, critical $\chi^2$ value at p = 0.05 and 4 df is 9.49; $H_0$ is rejected). This result may be considered as lending support to the existence of differences between Aurignacian and Bohunician knapping strategies, as argued by Tostevin (2000a, b).

It is also important to look at the differences in the frequency of faceted platforms themselves. The Chi-Square Test for Goodness-of-Fit reveals that the proportion of faceted platforms in the Bohunician assemblages is significantly higher than in the Aurignacian assemblages ($\chi^2$ = 7.7368, df = 1, critical $\chi^2$ value at p = 0.05 and 1 df is 3.84; $H_0$ is rejected). The statistically higher incidence of faceted platforms in the Bohunician assemblages is consistent with the presence of the Bohunician reduction strategy. In the conventional characterisations of the Bohunician reduction strategy, it is claimed that only the target flakes have faceted platforms. Other flakes which were knapped during an earlier stage of the lithic reduction process tend to have fewer faceted platforms than flakes from later stages of the lithic reduction process (Svoboda 1987b). Therefore, this finding of an elevated incidence of faceted platforms in the Bohunician flakes is good circumstantial evidence for the presence of one particular aspect of the hypothesised Bohunician reduction strategy. This finding does not, of course, prove the existence of the Bohunician reduction strategy, but it is consistent with one of the claims made regarding its existence. Tostevin and Škrdla (2006) found that 42–45% of retouched and unretouched Bohunician flakes showed some platform preparation however, the results of their study are not easy to compare with the results of this research because the platform types are defined differently, the sample sizes differ and some of the assemblages used for analysis are different.

Svoboda (2003) shows that the 'target' form of the Bohunician industry (i.e. the Levallois points) are often unretouched. To test whether it is the unretouched Levallois points, assumed to be the 'target artefacts', that have a high incidence of faceted platforms, the platform surface types of a random sample of unretouched flakes from each assemblage were recorded (see Tab. 15). The patterns are represented graphically in Fig. 8. It is apparent from these results that faceted platforms on unretouched flakes are rare in all analysed assemblages at Stránská Skála. More importantly, the proportions of faceted platforms do not increase in the Bohunician assemblages; on average, only 5% of Aurignacian and 5% of Bohunician unretouched flakes have faceted platforms.

These results do not give support to the claim that there are significantly more unretouched flakes with faceted platforms in the Bohunician assemblages than in the Aurignacian assemblages. The Chi-Square Test for Relatedness confirms this ($\chi^2$ = 0.2860, df = 4, critical $\chi^2$ value at p = 0.05 and 4 df is 9.49; $H_0$ is retained). There is no statistically significant difference in the frequency of faceted platforms on unretouched flakes between the Aurignacian and Bohunician at Stránská Skála.

The frequency distribution in Fig. 9 and the results of the chi-square test clearly demonstrate that the frequencies of platform surface types between the Aurignacian and the Bohunician industries are statistically indistinguishable in the unretouched flakes sample, but that they vary at a statistically significant level in retouched flakes. This could be pointing to a difference between the Aurignacian and Bohunician knapping processes, specifically in the choices the knappers made in what kinds of blanks they retouched. In terms of flakes with specific types of platform surfaces, the Aurignacian and Bohunician knappers had very similar choices available to them because the proportions are very similar (see Fig. 9). Assuming this explanation is on the right track, it seems that the Bohunician knappers were preferentially selecting blanks with faceted and multiple platforms for retouching, whereas the Aurignacian knappers were preferentially selecting blanks with single platforms over blanks with multiple and faceted platforms.

To sum up, the evidence for significantly more faceted platforms among the Bohunician retouched flakes, and the higher incidence of true blades among Aurignacian retouched flakes, is consistent with the results of previous studies of core reduction strategies.

## 13. Discussion and Conclusion

Based on the few temporal differences in lithic patterns at Stránská Skála, it appears evident that, *behaviourally*, there do not appear to be major shifts between the Aurignacian and the Bohunician at this site. This is of course based on lithic patterns only, as other articles of material culture did not get preserved. If this interpretation is correct, the behaviours often associated with Aurignacian cultures were already present in this part of Europe dating to the oldest (Bohunician) assemblages found at Stránská Skála. Chronologically speaking this is a tenable proposition, since assemblages classified as Aurignacian have been reported from several parts of Europe dated to the 40 ky BP mark (including the Aurignacian at Willendorf II, Lower Austria, where the oldest Aurignacian dates are 37.9 and 38.8 thousand BP, and Geissenklösterle, South Germany, dated to as early 38.4 thousand BP, and Grotte des Fées in France dated to 36-39 thousand BP). These dates are not different to even the oldest $^{14}$C dates for the Bohunician industry at Stránská Skála, however it must be remembered that dates for Aurignacian occupation in Moravia itself (including at Stránská Skála) are invariably younger than dates for the Bohunician occupation.

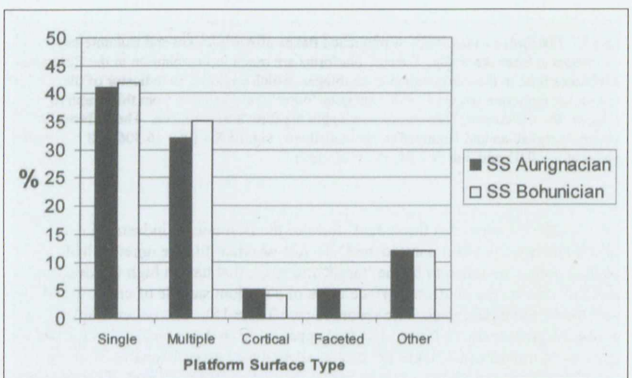


Fig. 9: Platform surface types of unretouched flakes of Aurignacian and Bohunician assemblages at Stránská skála. There are very few differences between Aurignacian and Bohunician flakes. Differences in platform surface types at Stránská skála are present only between retouched flakes. *Obr. 9: Typy povrchu patek na aurignackých a bohunických neretušovaných úštěpech ze Stránské skály. Rozdíly mezi aurignacienem a bohunicienem jsou nevýrazné.*

The dating evidence at Stránská Skála (see Svoboda 2003) is therefore consistent with the proposition that the Bohunician is behaviourally equivalent to the Aurignacian. If this proposition is true then it is very likely that the Bohunician industry at Stránská Skála was manufactured by anatomically modern humans. This view is supported by indirect archaeological evidence (see Škrdla 2003c; Tostevin 2000b). The lithic evidence presented in this work offers supporting, if indirect, evidence for the hypothesis that the Bohunician assemblages at Stránská Skála were manufactured by modern humans.

The recent research which found significant differences in behavioural steps of the knapping domains between the Aurignacian and Bohunician assemblages (Tostevin 2000a, b, 2003a) was briefly introduced earlier. After reconstructing the lithic operational sequence of each assemblage, Tostevin (2000b) concluded that two separate diffusion events, the Bohunician Behavioural Package and the Aurignacian Behavioural Package, are the best explanation for the available evidence. Although the research presented in this work has found no significant differences between the Aurignacian and Bohunician industries at Stránská Skála, it must be remembered that this apparent disparity is not unexpected since the methodologies and datasets of these two research approaches are quite different. The datasets for the research presented in this paper are drawn largely (but not exclusively) from only one of the knapping domains as defined by Tostevin (2000b) i.e. tool manufacture, whereas Tostevin's research utilized knapping products from a number of stages of artefact manufacture.

Tostevin (2000b) analyzed the differences in knapping options from all five knapping domains: core modification, platform maintenance, direction of core exploitation, dorsal surface convexity system and tool manufacture. In addition, the methodology employed for the research presented in this paper is not particularly sensitive to the specific changes that Tostevin's methodology was designed to detect. The research questions of these two research projects differ significantly: Tostevin's primary focus is to detect similarities and dissimilarities between assemblages and industries by investigating knapping behavioural options at different stages of the lithic operational sequence in order to determine whether the behaviours originated through local innovation, inter-regional diffusion, or both. In contrast, the research presented in this work focuses primarily on economic aspects of hominid lifeways during this time period through the analysis of retouched flakes, and to a smaller extent, unretouched flakes. The conclusions of these two research projects are not necessarily in disagreement; it could be that although the knapping options differ between the Aurignacian and the Bohunician assemblages as Tostevin found, during the final stage of the lithic operational sequence (i.e. tool manufacture), the knappers chose to manufacture similar tools in both industries.

The lithic and environmental patterns at Stránská Skála fit better with anatomically modern humans adaptations than with Neanderthal adaptations. Finlayson (2004) argues that the long-limbed, gracile morphology of the anatomically modern humans, coupled with an appropriate social and behavioural lifestyle, fitted well with the long-range, highly mobile, system of the European plains. This description is commensurate with the Stránská Skála (and Bohunice) environment, which is dominated by open, gently undulating landscape. Conversely, the more robust morphology of the Neanderthals would have been less suited for an open plains existence and the evidence of severe limb wear appears to confirm this. Although Finlayson (2004) argues that the Neanderthal morphology was best suited for the kind of rugged terrain and close-quarter hunting that the landscape they lived in demanded, and the Moravian Karst landscape where Kůlna and other caves with known Neanderthal occupation are situated is a good example of such a landscape, this model may not strictly apply to the Moravian region since plentiful evidence exists (*i.e.* the location of MP sites and raw material sources in the open landscape) that Neanderthals would have frequently accessed, or occupied, some of the open landscapes in southern Moravia, for example the Bořitov and Krumlovian Forest regions (Neruda in print; Neruda, Nerudová in press).

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## Resumé

Přechod od středního k mladému paleolitu je jedním z nejvýznačnějších období evropské prehistorie a moravská lokalita Stránská skála je jednou z nejdůležitějších evropských EUP lokalit, které spadají do tohoto období. K analýze aurignackých a bohunických souborů kamenných artefaktů je použita takzvaná materialistická metoda. Některé výsledky těchto analýz podporují do jisté míry současné rozdělení stránskoskalských souborů do aurignacienu a bohunicienu, i když tyto důkazy nejsou jednoznačné. Například aurignačtí lovci si z polotovarů vybírali k retušování čepele častěji než bohuničtí, což by mohlo být interpretováno jako podpora pro tvrzení, že aurignacké soubory jsou více čepelové než bohunické (např. Svoboda 1993). Bohuničtí lovci si vybírali k retušování úštěpy s facetovanými patkami častěji než aurignačtí, což může být interpretováno jako nepřímý důkaz pro existenci

bohunické redukční strategie (např. Škrdla 1999). Průměrná intenzita a charakteristiky retuší na úštěpech z obou industrií se zásadně neliší. Hlavní závěr tohoto výzkumu je, že ekonomické aspekty stránskoskalských aurignackých a bohunických souborů se zásadně neliší. Několik nepřímých důkazů naznačuje, že bohunické i aurignacké soubory na Stránské skále byly vyrobeny anatomicky moderními lidmi.