

Final Report
Stone Tool Function and Behavioral Changes Among Modern Humans in Southern Germany

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Research Objectives: What behavioral changes accompany the disappearance of Neandertals, the appearance of anatomically modern humans, and the associated technological changes that occur ca. 40-28,000 years ago? Are these behavioral changes reflected in changing patterns of stone tool function? Does the new technology (different tools, more tool types) reflect changing behaviors that gave modern humans a selective advantage? Or did modern humans just use new tool forms to do the same old things?

The amount of literature and time devoted to the study of the transition from the Middle to the Upper Paleolithic and the corresponding rise of modern humans and the disappearance of Neandertals is vast. Many recent publications, such as *Rethinking the Human Revolution* (Mellars et al., eds., 2007), *Neanderthals Revisited: New Approaches and Perspectives* (Havarti and Harrison, eds., 2007), and *Neanderthal Lifeways, Subsistence and Technology One Hundred Fifty Years of Neanderthal Study* (Conard and Richter, eds., 2010), emphasize new or novel methods for examining this critical time period. While these new volumes certainly offer new perspectives, we continue to make arguments about behavioral changes without a full understanding of behavior. One area that is particularly lacking is an understanding of stone tool function and use.

In an effort to address this situation, stone tools from the site of Hohle Fels in southwestern Germany were examined through use-wear and residue analyses. Hohle Fels provides a rare opportunity to compare directly the changes in stone tool use in the late Middle and early Upper Paleolithic. The cave of Hohle Fels contains stratified deposits that span the Middle to Upper Paleolithic transition. I have previously investigated stone tool function at Middle Paleolithic sites in France (La Quina, Hardy 2004) and the Crimea (Starosele and Buran Kaya III, Hardy et al. 2001) as well as Aurignacian tools from southern Germany (Hohle Fels, Vogelherd, and Geißenklösterle, Hardy et al. 2008). Thus, we have data on stone tool function in both the Middle and early Upper Paleolithic to compare. The comparison, however, is complicated as the sites involved are widely separated geographically and temporally.

In 2007, excavations at Hohle Fels reached Middle Paleolithic deposits and allowed the opportunity to look at changes in stone tool function across the transition in the same location with little temporal change. The Middle Paleolithic levels (AH VI-VIII) date to 35,760-39,580 b.p. while the lowest Aurignacian level (AH Va) dates to 31,750-32,550 b.p. (Conard and Bolus 2008). Climatic conditions and available resources would have been similar. For both the Middle Paleolithic and Aurignacian levels, the area around Hohle Fels was an open habitat with a cold environment. Fauna are dominated by cold adapted species (reindeer, horse, and arctic lemming) with smaller numbers of species that prefer warmer climates (red and roe deer). Based on zooarchaeological analyses (Munzel and Conard 2004), subsistence patterns are also

similar, including hunting of horse and reindeer with small animals and fish being equally rare. Data on plants is insufficient to evaluate.

Technology, however, changes dramatically (see Figure 1). The Middle Paleolithic levels contain typical Mousterian tools, with a dominance of sidescrapers and other flake forms. The Aurignacian, by contrast, includes blades, endscrapers, and burins typical of the early Upper Paleolithic. In addition, the Aurignacian levels also contain a rich organic technology including split-based bone points, ivory figurines, and even musical instruments (Conard 2009; Conard et al., 2009). Thus, by examining stone tool function at Hohle Fels, we can see if the changes in technology also reflect changes in tool use while the variables of environment and resources remain roughly comparable.

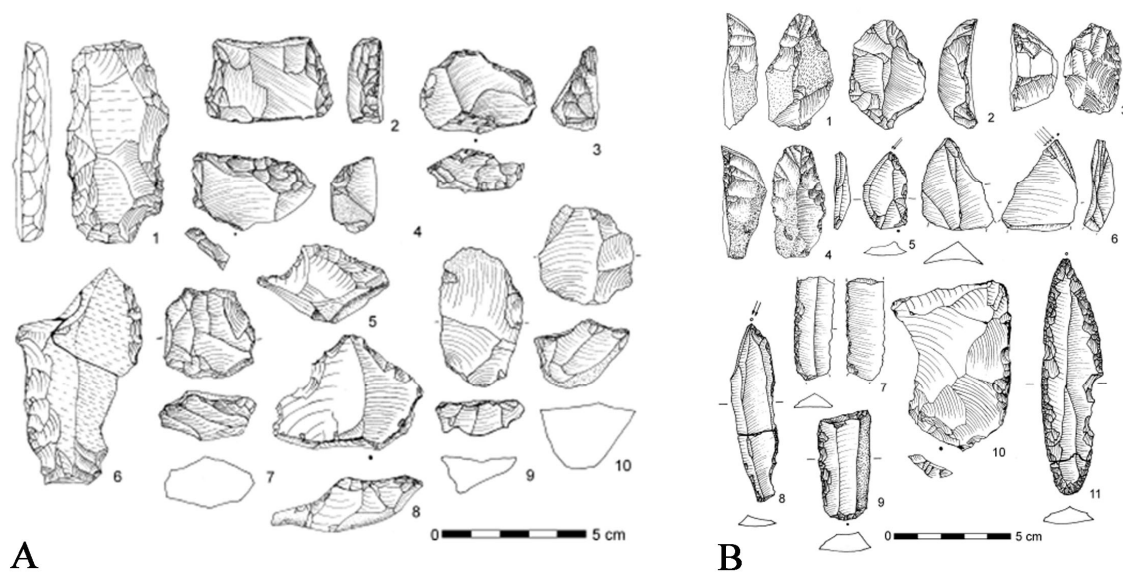


Figure 1: Comparison of Middle Paleolithic (A) and Aurignacian (B) stone tools in the Swabian Jura (modified after Conard, 2011).

A total of 78 artifacts (38 Aurignacian, 40 Middle Paleolithic) were examined under reflected light at magnifications ranging from 50-1000x for the presence of use-wear and residues. (Added to the previous work at Hohle Fels, Vogelherd, and Geißenklösterle, we now have a sample of over 200 tools from the Aurignacian and Middle Paleolithic with which to investigate patterns of tool use.) Artifacts were handled as minimally as possible prior to microscopic analysis.

Tables 1 and 2 provide comparisons between the Aurignacian and Middle Paleolithic samples. Tool use in both time periods is remarkably similar. Hafting, often with resin as a mastic, is present in both samples (Figures 2-3). A similar range of materials is exploited in both time periods, including wood, bone, and hide. One slight difference is the evidence for processing starchy plants in the Middle Paleolithic. This difference could represent the exploitation of the resource by Neanderthals and not modern humans, or it could be a result of sample bias. One Middle Paleolithic endscraper appears to have been hafted and used to process both animal and bird tissue (Figure 4). Feather residues are only found in the Middle Paleolithic level on this one tool. While it is often considered beyond Neanderthal capabilities, evidence for

exploitation of avian resources for Neanderthals is becoming more common (Hardy et al., 2001; Hardy and Moncel, in press; Blasco and Ferneadez Peris, 2009; Peresani et al., 2011).

Table 1: Summary of stone tool function

Middle Paleolithic	Activity	Aurignacian (Va)
X	Scraping wood	X
X	Scraping bone	X
	Cutting wood	X
X	Scraping hide	X
X	Thrusting/projectile	X
X	Perforating hide	
	Scraping hard material	X
X	Scraping soft material	
X	Scraping unknown	

Table 2: Frequency of used materials

Material	Middle Paleolithic (n=40)	Aurignacian (n=38)
Wood	22.5%	39.5%
Starchy plant	5%	---
Soft plant	---	2.6%
Animal	5%	5.2%
Bone	2.5%	5%
Hide	17.5%	15.8%
Hard/high silica	7.5%	10.5%
Soft	2.5%	2.6%
Unknown	37.5%	26.3%
Hafted	15%	15.8%

HF2006-3294.1
AH VII
scraping mammal/bird

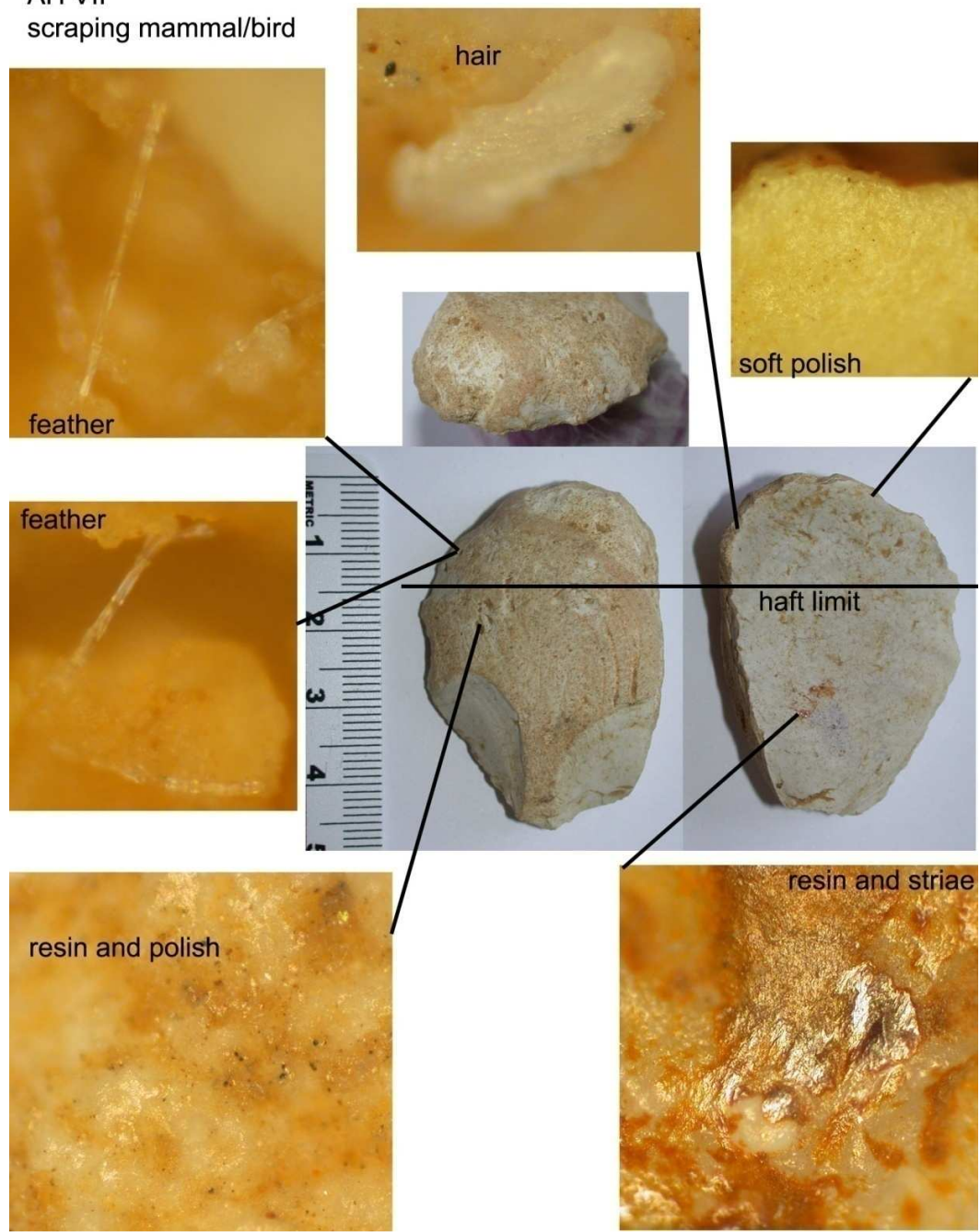


Figure 2: Middle Paleolithic endscraper showing evidence of hafting with mastic and use on mammalian and avian tissue.



Figure 3: Aurignacian endscraper on blade hafted with resin and used to process mammalian tissue.

Another interesting artifact from the Middle Paleolithic levels is a hafted perforator which seems to have been used to pierce hide (Figure 4). Perforating of hide would possibly imply use of the tool in making clothing. This is another activity that is not supposed to be found

with Neanderthals (Gilligan, 2007) and suggest that we should look for similar evidence at other sites.

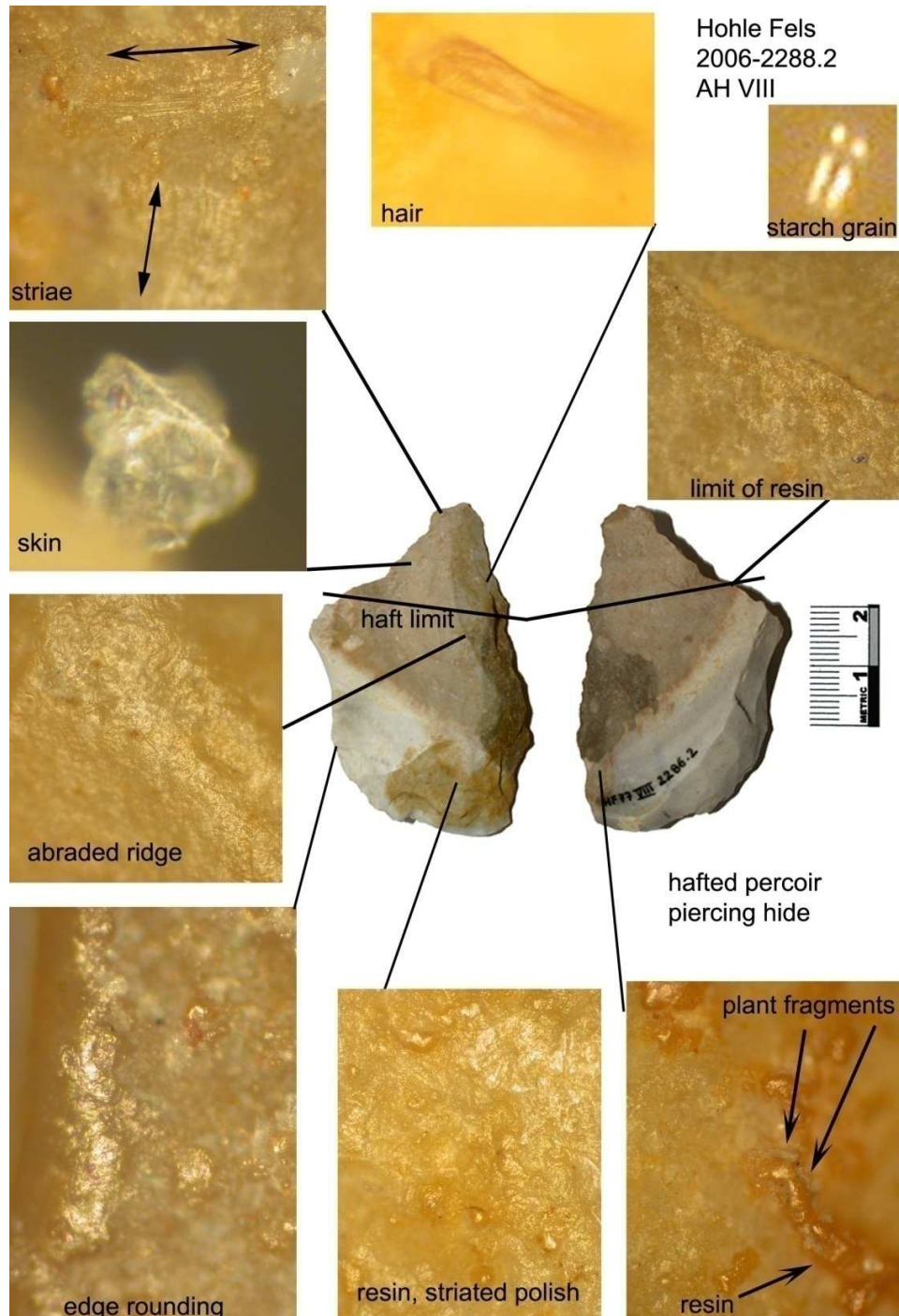


Figure 4: Middle Paleolithic perçoir hafted with resin and used to pierce hide.

Overall, this study has produced remarkable results. At the same site, with very similar environments and resources, Neanderthals and modern humans appear to have been doing much the same with their stone tools. This evidence does not support the idea that changes in tool function formed part of the *Kulturpumpe* hypothesis. The results do provide evidence of a technology that exploits perishable materials (wood and plants) which are otherwise not viable archaeologically. At present, this suggests that exploitation of different resources is not a likely factor in Neanderthal extinction, at least in southwestern Germany. The disappearance of Neanderthals in this region may more likely involve demographic differences as reflected by differential site density (Conard et al., in press; Mellars and French, 2011).

To date, the work from this grant has been presented at the Paleoanthropology Society meetings in Chicago in 2009. Some of the data have appeared in an article in *Mitteilungen der Gesellschaft für Urgeschichte* (a publication of the local museum in Blaubeuren, Urgeschichtliches Museums Blaubeuren; Hardy, 2009). The full analysis is being prepared for submission to *Journal of Human Evolution*.

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