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Afterthoughts about the Neanderthal insulation hypothesis

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Abstract. This paper extends an earlier proposal in *Rock Art Research* (Vol. 25, No. 1, pp. 101–116) that the Neanderthal lineage adapted to cold climates by acquiring one or more forms of biological insulation. It also adjusts parallel proposals concerning Initial Upper Palaeolithic (IUP) population dynamics. Topics covered include:

• A refined wording of the insulation hypothesis.

• An explanation of why Neanderthal cranial and neck robusticity may have evolved independently from that of the lower body, suggesting why such robusticity may not be incompatible with the insulation hypothesis.

• Explanations of why the functionally hairless bodies of cold-weather Inuits, Fuegians and Tasmanians may not be strong counter-arguments against the fur component of the insulation hypothesis.

• A second insulation hypothesis, this time concerning Holocene Tasmanian women, whose adaptations to apnea diving and long-distance swimming in cold water may provide a partial explanation for the disappearance of bone tools and a change of diet in Tasmania before 3500 BP.

• Proposals for why Neanderthals and Early Moderns may have had different motivations for making coverings, including clothing.

• Fossil and lithic evidence supporting the previous article's contention that a wave of genes derived largely from African Moderns spread from Asia into Europe during the IUP, creating a western Eurasian population with only modest admixtures of indigenous archaic populations. This involves evidence for an association between the earliest Aurignacian, Bohunician and Bachokirian behavioural packages and certain late Middle Palaeolithic and IUP Asian sites.

• An argument that the changing morphology of Europeans during the transition from the Middle Palaeolithic to the Upper Palaeolithic can not be explained by anything as simple as in-situ evolution from robusticity to gracile traits, since the process on the bulbous chins of Moderns throughout the world shows that our lineage actually acquired a bony process during its period of overall gracilisation — a process which first appears in early African Moderns, before becoming generalised.

• A discussion of the relevance of the ulcer-creating bacteria, Helicobacter pylori, to the contention that Middle Palaeolithic European Robusts (Neanderthals) account for a large part of the legacy of modern Europeans.

• Most importantly, a review of evidence that Neanderthals collected seeds and starchy plant storage organs, which contained their greatest energy potential during the autumn and winter. This provides a partial explanation for how Neanderthals could have built up a seasonal sub-cutaneous fat layer for insulation before the advent of weather-tight clothing.

KEYWORDS: ***Neanderthal – Osteology – Evolution – Sexuality***

First, an acknowledgement: this paper grew out of a rich discussion between the author and Robert G. Bednarik after *RAR* referees had accepted an initial article outlining a Neanderthal insulation hypothesis. Bednarik's probing questions and observations incited the author to reflect further — and led to the following extensions. While our editor deserves credit for encouraging the author to supply additional arguments, he is in no way to blame for the responses.

Secondly, a matter of diction: the insulation hypothesis does not exactly postulate 'fat' or 'corpulent' Neanderthals, but muscular individuals with a well-distributed insulatory layer that varied according to climatic range and season but whose weight was sufficient at times to account both for aspects of their skeletal anatomy and their survival in frigid zones before they acquired the capacity to make weather-tight clothing.

Next, the observation that robusticity of the skull, cranial bone thickness or neck muscle attachments are unconnected to fat deposits forces one to examine whether such robusticity derives from the same influences that affect bones as far away as the pelvis and femur. There could be mutually reinforcing explanations for such heavily built upper busts.

1. The legacy factor. Head and neck robusticity of earlier hominins would have been passed onto cold-weather Neanderthals unless behavioural or environmental factors which favoured such morphology changed. Apparently such changes came much later (if at all) for Neanderthals than they did for early African Moderns.
2. The hypothesis that *Homo erectus* skulls such as the thick craniums from Zhoukoudian needed to be robust in order to survive violence among males, perhaps over females (Boaz and Ciochon 2004a, 2004b). Head and neck gracilisation among Moderns may correspond in part to their adoption of social/sexual behaviours that differed from their predecessors'.
3. The implications of the incessant raiding observed among foragers and tribal hunters (Chagnon 1997). Such societies experience an average annual combat mortality rate of 0.5% (Keeley 1996; confirmed by LeBlanc and Register 2003). If the world had suffered the same rate during the 20th century, there would have been 2 billion combat deaths (all reiterated in Wade 2006). Francesco d'Errico (2003) points out that

> [e]ven when carefully shaped by retouch, Middle Paleolithic stone spear-tips have a large, thick base, implying a large, heavy shaft [with] a low velocity but high penetration power at short distances ... In contrast, stone and bone spear-tips used by Upper Paleolithic hunters are similar in that both types are thin, straight, and light: they are made to travel at high speed and to be cast from afar. This allows them to penetrate the ... body and injure vital organs.

Although true bone points occur in Châtelperronian and Uluzzian assemblages, Villa and d'Errico (2001) dismissed earlier 'bone and antler points' from Mousterian sites such as Vaufrey, Combe Grenal, Camiac, and Pech-de-L'Azé I as well as from Torralba and Ambrona as natural phenomena. Thus, earlier 'Neandertals may have preferred ... robust and heavy weapons (such as cudgels and thrusting spears) for closer-range hunting' (all d'Errico 2003) — and interpersonal violence. In an aside, the St. Césaire Neanderthal fossil displays clear evidence of such violence (Zollikofer et al. 2002). Beginning with the shift from thrusting spears to high-velocity javelins, combat and hunting have been carried out at ever greater distances — *moving the more distant target increasingly from the small head to the larger trunk*. A gradual shift from head to body wounds as causes of death may have reduced the need for cranial robusticity.
4. Heavy wear on Neanderthal incisors suggests that they were often used as a clamp — in which case the stress of keeping hides taut with the head while scraping, cutting or butchering could have favoured individuals with especially strong upper busts and their genetic endowment.

Next, the second insulation candidate which I mentioned, fur, seems to stir more controversy than the idea that cold-weather Neanderthals had subcutaneous insulation which waxed and waned with the seasons. Unfortunately, evidence for fur is even less likely to have survived than indirect evidence for fatty insulation, unless a Neanderthal mummy is found. Meanwhile, this aspect of the insulation hypothesis rests on:

(a) Circumstantial evidence derived from the survival of the Neanderthal lineage without weather-tight clothing — *unlike* Inuits — through three main glacial and three interglacial periods between 300 000 and 30 000 years ago — and perhaps even longer.
(b) The very real possibility of finding Neanderthal genes for thick body hair.
(c) The validation of theories and evidence suggesting that Moderns dispersed into Europe and that they only acquired a modest admixture from Neanderthals — suggesting some impediment to cross-breeding, such as incompatible visual cues for mating. I only broached the last scenario because the furry part of the insulation hypothesis grows more probable if IUP European Moderns turn out to have a low admixture from Neanderthals.

The recent genetic finding that two Neanderthals had red hair is relevant to the last two points. First, because the discovery makes it clear that further findings about their hair may be up-coming. And, secondly, because the discovery seems to suggest that modern redheads could have inherited their hair coloration from Neanderthals — lending credence to the idea of in-situ evolution from Middle Palaeolithic European Robusts to the gracile Europeans of today. On closer examination, it suggests the opposite since the mutation found in the two Neanderthal remains 'was not found in approximately 3700 modern humans analyzed' and appears to have 'evolved independently in both modern humans and Neanderthals' (Lalueza-Fox et al. 2007).

Moving on, several apparent counter-examples to the fur component of the insulation hypothesis come to mind. These include the Inuit who have occupied an environment even more frigid than northern Neanderthals, although the Inuit have less hair than many human groups. This is quite true, but their very success may support the fur component, since Inuits survive frigidity by mastering technologies that include the manufacture of weather-tight and adjustable (fur) clothing.

Another counter-example could be the Yahgan — who survived cold despite the fact that they were neither hairy nor heavily clothed. But they were not nearly as isolated from warmer weather populations as cold-weather Neanderthals who were contained by a combination of seas, ice caps and deserts. As important as easy gene flow with peoples to the warmer north is the fact that Fuegians had only been adapting to cold for a few millennia — not hundreds — and, as the previous article pointed out, Yahgan women had already acquired thicker and probably more well distributed subcutaneous fat deposits than their generally thinner sisters to the north. This was almost certainly a response to the insulatory requirements of diving for molluscs in cold water, something which was done only by Yahgan women.

A third counter-example are the Tasmanian Aborigines — who are also known as being among the last users of a Mode 3 industry after the introduction of Mode 4 assemblages elsewhere. This is both true and paradoxical. At Rocky Cape, Tasmania, for example, 'people were using one bone tool to every two to three stone ones' 7000 years ago, one per 15 by 4000 BP, and none by 3500 BP when fish bones also disappear in favour of deepwater shells in middens (Flood 1983: 103–108). So Tasmanians abandoned aspects of their original assemblage as their diet changed. Early European visitors to Tasmania noted that the staples of the Tasmanian diet at the beginning of the 19th century were shellfish collected by women from the seafloor and muttonbirds which women — and only the women — caught by swimming through cold water to distant island hatcheries (Flood 1983: 167–171). Put the archaeological and ethnographic observations together and one cannot help but wonder whether the disappearing bone tools became irrelevant once *biological* traits — based partially on the subcutaneous fat which normally serves for sexual signally and as an energy reserve in women — swept through the female population? Once women in general had acquired an enhanced insulating layer, with matching vascular and respiratory controls, their ability to endure cold and practise apnea would have become so dependable that it may have led to a paradigm shift in subsistence strategies. European observers noted that a Tasmanian man only had to sit down for his womenfolk to begin building a sleeping shelter over him. This pampered status corresponds to that of a leisure class — a status which may have begun when men's skills and tools as hunters became less necessary with the generalisation of deep and long-distance swimming abilities among women.

Finally, the fact that Tasmanians never acquired Mode 4 lithic industries begs us to question whether technology and genetic groups are always unrelated, since Tasmanians were both technologically and genetically isolated after being stranded on their island (Pardoe 1991). Their almost complete extinction also provides an unfortunate example of the devastating success within historic times of immigrants (bearing genes) who benefited from such advantages as more virulent diseases and effective technologies.

One might also ask why the biologically insulated natives of northern Eurasia, who had survived several stadial peaks, should suddenly discover a need for clothes (if indeed they ever did)? And why the purported bald-bodied newcomers should develop such a tradition when they had never had a previous need for clothing? The first question is most pertinent: if Neanderthals were naturally insulated by buffering fat, specialised capillary systems or body hair, or any combination of the three, then, indeed, very few may have had much incentive to don clothing. All the same, the article explains why some Neanderthals may have been influenced by the potentialities of new Mode 4 industries to make better *coverings*, even if they may have started by improving tents or baby slings, for example, rather than clothing. The mentioned reasons include the ability to enhance one's image and status while raising survival rates, both for the young and individuals with insulation deficiencies.

But clothing also has a symbolic function, much like jewellery. Francesco d'Errico 'and others have proposed ... that it was precisely the ... contact between anatomically modern people and Neandertals and the consequent problems of cultural and biological identity that stimulated an explosion in the production of symbolic objects on *both* sides' (d'Errico 2003, citing d'Errico et al. 1998; Zilhão and d'Errico 1999). The adoption of clothing by Neanderthals could have been another expression of this phenomenon.

To answer the second question, the purported newcomers, whose tropical ancestors probably already had at least some clothing such as loin-cloths and slings for social-sexual reasons or carrying children and food, would have been forced to steadily extend and perfect clothing to take advantage of resources in colder zones. Early clothing probably had nothing to do with cold but, once in place, was an exaption that unleashed its own potentialities for coping with harsh climates. Bald-bodied early Moderns would have had a greater incentive to explore the possibilities of this exaption and Mode 4 industries for making garments more extensive and ultimately weather-tight than already insulated Neanderthals.

The fact that it would have taken several millennia for bald-bodied Moderns to perfect the techniques for making fully protective garments argues against the misconception that any somewhat robust early Moderns entering Europe during the IUP would have been fresh from Africa. Although genetic data are rapidly being refined, the studies cited in the previous article suggested that the main lineage that led to today's non-African peoples might have left Africa via islands exposed by low sea levels at the southern end of the Red Sea, the Gate of Grief. Mutations accumulated along the way suggest that this population then expanded slowly around southern Asia towards Sunda and Sahul, with eddies moving inland across Asia and turning back towards Europe (digested from Ke et al. 2001; Thomson et al. 2000; Underhill et al. 2000; Wade 2006: 74–90). If this itinerary is even remotely correct, then, before expanding into Europe, any Asian populations descended largely from African Moderns would have had over ten millennia to adapt to lower sunshine by becoming paler and mastering the manufacture of more weather-tight clothing as they pushed incrementally north. They apparently also had the time to acquire a modest admixture of genes from archaic Asian populations (Garrigan et al. 2005a, 2005b), which could account for some of the archaic osteological features in IUP Eurasian Moderns.

While we are on the subject of the descendants of such immigrants, I should mention evidence concerning another immigrant, the bacterium *Helicobacter pylori*, which causes ulcers in present humans. According to a fresh study '*H. pylori* seems to have spread from east Africa around 58 000 yr ago ... our results establish that anatomically modern humans were already infected by *H. pylori* before their migrations from Africa' (Linz et al. 2007). If Neanderthals had left a significant genetic legacy among modern Eurasians, they should also have bequeathed their own ulcer-creating bacteria to their descendants.

My attempt to demonstrate how the insulation hypothesis jibes with evidence for low admixture in UP Moderns raises the challenge of defining when Moderns, the bulk of whose ancestors had left Africa within the previous 15 000 years, entered Europe. If populations of *Asian* Moderns did enter Europe (as they would so many times in later pre-History, swamping the peninsular gene pool), then I would have to place the date farther back than the 28–29 ka BP Cioclovina cranium (Jacob 2007) which K. Harvati, P. Gunz and D. Grigorescu analysed to 'evaluate its morphology for evidence of admixture between Neanderthals and early modern Europeans.' Their '...results show(ed) Cioclovina to be entirely modern' (Harvati et al. 2007).

So we must move back to the ≈40 500 cal. BP (≈35 000 ^{14}C BP) Oase 2 cranium which 'shares affinities with the penecontemporaneous northeast African Nazlet Khater 2 remains'. Comparison of the Oase 2 cranium to 'Late Pleistocene human samples documents a suite of derived modern human and/or non-Neandertal features' (Rougier et al. 2007). In light of evidence that the Oase specimens retained derived modern human aspects, if I must nominate a number for the arrival of Moderns (or their genes) in eastern Europe, I would feel most comfortable hovering around 45 000 calendar years BP with a series of regional asterisks.

Next, one might ask where the preserved technological evidence for immigrating Moderns lies. Several lithic analyses comfort the idea of an arrival of Moderns or cultures associated with swamping waves of genes around 45 ka ago. The first analyses which seem pertinent in developing a working hypothesis were performed by Gilbert Tostevin. He used changes in

> flintknapping behaviours within and between regions to test hypotheses of diffusion versus independent innovation as the prime mover for the appearance of the Upper Paleolithic in each region. ... The results strongly suggest that the pattern of change in central Europe is related to the changes in the Levant and eastern Europe. Two discontinuities are evidenced in all three regions between 60 and 30 ka B.P. ... the Middle Paleolithic assemblage in each region is succeeded by ... an extremely different technological style. Whether 'transitional' or 'Upper Paleolithic', these three Post-Middle Paleolithic assemblages are in fact quite similar to *each other*. The pair-wise comparisons between Boker Tachtit level 1 and the earliest Bohuncian assemblage, Ss-IIIa-4, in central Europe, ... and between Boker Tachtit level 1 and the first non-Middle Paleolithic assemblage in eastern Europe, Korolevo II Complex II ... are extremely surprising given their geographical separation ... parsimony favors the conclusion that all three assemblages share the same behavioral package that diffused from one region to another, appearing first in the Levant at 47/46 000 B.P., next in central Europe by 42 000 B.P., and finally in eastern Europe by 38 000 B.P. ... the current data supports the conclusion that these three assemblages (Boker Tachtit level 1, Ss-IIIa level 4, and Korolevo II Complex II) represent the diffusion of a phenomenon we may call the Bohuncian Behavioral Package ... the first of two diffusion events evidenced by the research. The second is the 'Aurignacian Behavioral Package', which introduced a distinctive new suite of knapping options to the Levant (Kebara Cave Unit II) and central Europe (Ss-IIa-4 and Ss-IIIa-3) ... As with its predecessor, the Aurignacian Behavioral Package did not possess sufficient antecedents within any of the three regions studied to warrant an in situ appearance (Tostevin 2003, citing also Tostevin 2000a, 2000b).

An analysis by Janusz Kozłowski has special relevance in light of Tostevin's reference to the 'Aurignacian Behavioral Package'. Kozłowski concluded that 'the Typical Aurignacian ... derived from the ... Bachokirian in southeastern Europe' (Kozłowski 2004). Kozłowski's demonstration of links between the Aurignacian and older Bachokirian makes Churchill and Smith's conclusion that the only initial Upper Palaeolithic human fossils from Europe which did not show morphological affinities with Neanderthals were from Bachokirian and Aurignacian contexts all the more cogent (Churchill and Smith 2000). Furthermore Kozłowski found that

> the local origin of (the Bachokirian) industries in the Balkans ... from the Moustero-Levallosian *has not been confirmed* ... typological features indicate links with the Near Eastern Emirian/Ahmarian tradition (Kozłowski 2004).

So let us look at the Asian sources mentioned by both Tostevin and Kozłowski. While there is extensive data from the Levant, the data from central Asia, though lacunal, is already tantalising. First there are dates from strata 8–11 at Ust-Karakol-1 in the Altai which contained an Aurignacian assemblage, including 35 100 ± 2850 C^{14} BP for level 10 (SOAN-3259) (Otte and Derevianko 2001), suggesting that the Asian Aurignacian may not be a late flux from Europe. Second, there is 'material from Warwasi rock-shelter (Iran)' where Olszewski and Dibble propose that 'the Baradostian industry ... be re-named the Zagros Aurignacian'. They go on to say that '[t]his reassessment has important implications for the origins of this industry and its possible spread into Europe and the Levant' (Olszewski and Dibble 1994). Third are dates from Boker Tachtit layer 1 — 46 930 ± 2420 (SMU-259), 47 280 ± 9050 BP (SMU-580) and >45 490 (SMU-184) (Tostevin 2003 for further references) — and from Kebara, which 'indicate the presence of early Ahmarian industries around 43–36 ka while the Levantine Aurignacian is dated to 36–32 ka' (Bar-Yosef et al. 1996).

I am not advancing this evidence for non-European origins for the Bohuncian and Aurignacian dogmatically but rather to suggest that we should not be in a rush to judgement based on the lop-sided collection of data from just one end of the geographical spectrum, Europe. So, in answer to a need to identify a tradition and dates with immigrants, I can only suggest that Moderns may have brought both Behavioural Packages from Asia around the dates that I have cited.

This also raises the question of whether gracilisation was all that was happening to Europeans during the IUP, as the plotting of averages of traits drawn from throughout the body might indicate on a graph, or whether, on the other hand, such graphs might obscure nuances and exceptions? For example, the generalisation offered by such a curve does not seem to account for the bone process — where none existed among Neanderthals — on our bulbous chins. It would also seem odd that Moderns around the world would exhibit exactly the same added feature if they did not share gracile, bulbously-chinned ancestors. It is noteworthy that the oldest fossils that fit these criteria occur in Africa and the Levant.

I would like to conclude by encouraging J. J. Snodgrass and W. R. Leonard to re-examine Neanderthal energetics through the lens of the insulation hypothesis (Snodgrass and Leonard 2007), and by mentioning four tool and nutritional studies which seem highly relevant. The first concerns the diet of the immediate European ancestors of Neanderthals, *Homo heidelbergensis*, and was performed by Alejandro Pérez-Pérez on the extensive collection of human teeth from the Sima de los Huesos at Atapuerca. His comparison of the microscopic evidence of abrasion on the teeth with the patterns of dental wear found among modern populations with known diets led him to '... conclude that the humans of Sima de los Huesos consumed very abrasive vegetable foods such as seeds, roots, and tubers ...'. Their teeth '... wore out very quickly, and we know that a meat diet causes little dental wear' (Arsuaga 2002: 172–3, citing Pérez-Pérez et al. 1999). This evidence establishes that Neanderthals evolved from a population which was already proficient at — and apparently dependant on — finding edible plants.

Bruce Hardy was involved in the next two articles involving the place of plants in the Neanderthal diet. First he demonstrated that Neanderthals could have gathered 'high energy starchy USOs' — underground storage organs of plants — which 'are at their maximum energy storage in late fall/winter ... throughout the Neandertal range, even during the coldest periods of the Middle Paleolithic'. These include '*Typha latifolia* (cattail), *Polygonum bistorta* (mountain bistort), *Arctium lappa* (greater burdock), *Sagittaria sagittifolia* (arrowhead), and *Pastinaca sativa* (wild parsnip), among others' (Hardy 2007). While the following observation is not systematic, I have often noticed the same degree of soil sheen around the tips of Middle Palaeolithic lanceolate handaxes found around clayey depressions on plateaus in the Yonne (where they also appear most commonly) (Hure 1921: 47) as is found on Neolithic flint hoes (Fig. 1). This suggests that these Mousterian lanceolate bifaces were used for digging up and processing bulbs and tubers found in the bogs.

The second study involving Hardy was of the implications of '[s]tone tool function at Starosele and Buran Kaya III' in which the following points are made:

> Ambrose has suggested that ... Neandertals may have differed trophically from anatomically modern humans by having a higher incidence of plants in their diet (Ambrose 1998) ... Plant foods ... are available in extreme cold environments, at least periodically or seasonally (Cachel 1997 and Roebrooks et al. 1992) ... starchy material ... occurs on the working area of tools [at both sites] and may, therefore, represent food residue (all in Hardy et al. 2001).

As an aside, I suspect that any Neanderthal predilection for eating plants would have been more seasonal, regional and opportunistic than absolute. The fourth article I must cite shows that there is 'clear and repetitive evidence for the exploitation of mature grass panicles, inferred to have been collected for their seeds' by Amud Neanderthals (Madella et al. 2002).

Put together, the evidence for Neanderthal gathering of edible plant materials, the starchy residues on the working areas of their tools, and the soil sheen on elongated bifaces from bog environments show both that:

- Neanderthals had the dietary means to build up fatty insulation for the winter.
- The general perception of them as being narrowly focused on eating meat is probably as wrong as other pre-conceptions about Neanderthals which have been questioned in this pair of articles.

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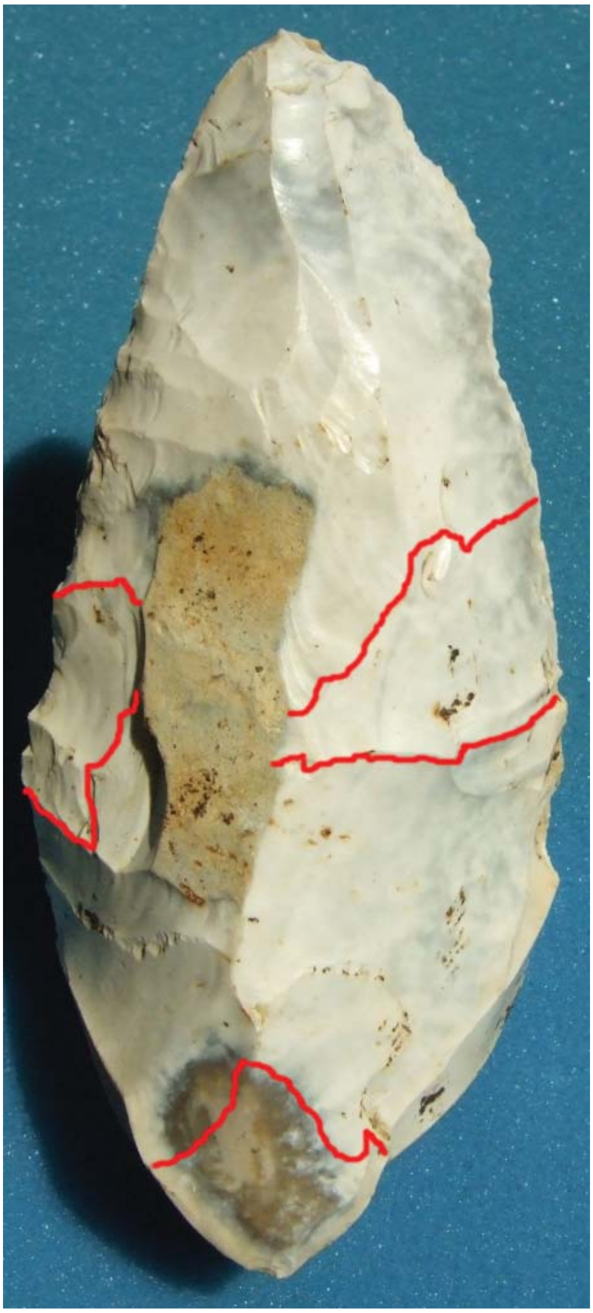

Figure 1. *The soil sheen on this Middle Palaeolithic (MAT) biface from the edge of a clayey depression on a plateau is most intense between the tip and first line and again below the line around the spur at the base. Lesser soil sheen is also visible on ripples and arises between the two lines in the mid-section. Villecien, Yonne.*

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