Things to do in Doggerland when you're dead:
Surviving OIS 3 at the northwestern-most fringe of Middle Palaeolithic Europe

Mark J White

Department of Archaeology
University of Durham
Durham
DH1 3LE
m.j.white@durham.ac.uk

Abstract and Introduction
This paper examines Neanderthal survival skills in Britain. Its starting point is that there are major tensions between the three main sources of relevant information-archaeological, palaeoanthropological and palaeoenvironmental data and their subsequent interpretation – that make our understanding of Neanderthal survival much more precarious than is generally supposed. The paper is speculative, and proffers questions not answers. It challenges us to look past the often mute material record, and to equip Neanderthals with a number of logically prerequisite but generally archaeologically invisible survival tools and practices, beyond the well-trodden paths of mobility, hunting and planning.

Opening Gambit

The British Middle Palaeolithic is largely an archaeology of absence. Having abandoned the region during the hostile conditions of the OIS6 glaciation, Neanderthals did not reappear on the British landscape until OIS4/3 (ca 60kya), some 120,000 years later (Ashton 2002; Currant and Jacobi 2002; White and Jacobi 2002). With very little else to discuss for this period, British specialists have quite understandably devoted much attention to the reasons for this hiatus, and in doing so have become rather adept at finding environmental, ecological, adaptive, and social reasons as to why Neanderthals kept away for so long (e.g., Gamble 1986, 1987, 1992; Ashton 2002; Ashton and Lewis 2002). But as new discoveries and improved understandings of old sites enhance our knowledge of the Late Middle Palaeolithic *occupation* of Britain, it is time to shake off this obsession with absences and barriers and attend to a different question: just how did Neanderthals actually survive the still inhospitable conditions they would have encountered *upon their return*, particularly the British winters?

The question of survival strategies is particularly apposite given recent conclusions that the classic Neanderthal morphology would not have given them the degree of biological buffering previously thought (Aiello and Wheeler 2003). As a result a conflict between: a) the harsh and treeless environments inferred for OIS3 Britain and; b) the tenacious image of culturally and intellectually challenged Neanderthals (Speth 2004) - so often denied basic tools and seen as relying on physical robusticity alone – is thrown sharply into relief. Many of the issues raised here go well beyond Britain in OIS3, but this provides a useful platform from which to start, offering a geographically-legitimate region with its own set of challenges, a rich tradition of Quaternary research and a characteristic if somewhat impoverished archaeological record.

Neanderthal Environments in Britain during OIS3

A well-stocked but treeless grassland, with short, cool summers and long, cold winters marked by blasting winds, frozen ground and persistent snow. This is what Neanderthals apparently faced as they headed northwest from their more southerly glacial refugia during OIS4/3.

Often referred to as a failed interglacial, the isotopic record shows that OIS3 was actually a period of extreme climatic instability, with dramatic alternations between milder and colder conditions at millennial or sub-millennial timescales (Dansgaard-Oeschger oscillations; Dansgaard et al 1993; Van Andel 2003). On a larger scale, the period can be divided into a number of broad sub-phases: 1) an early milder phase, ca 59-43kya; 2) a period of climatic deterioration ca 42-37kya, showing more tightly-spaced clusters of cold D/O events and; 3) a cold phase starting about 37kya during which conditions were similar to those of the Last Glacial Maximum (OIS2) (Van Andel 2003; Davies and Gollop 2003).

Throughout this period, direct terrestrial access into Britain would have been practicable. Although global ice volume was reduced from its OIS4 maximum, land-ice probably limited to local ice-caps (Shackleton 1987; Arnold et al 2002; Van Andel et al 2003a, 33), sea level was still some 80m lower than present. This was sufficient for Britain to remain a peninsula of NW Europe (Barron et al 2003, 58). Mainland Britain would thus have been an 'upland' zone (at ~80m a.s.l plus land elevation) on the western fringe of the North European Plain, part of the region sometimes referred to as Western Doggerland (Coles 1998, McNabb 2001). This was bounded on the south and east by extensive, resource rich lowland basins (i.e. the present North Sea and Channel) into which several major British and European river systems would have drained, some joining the westward-flowing Channel River en route to the Atlantic, others flowing north into a greatly reduced North Sea (cf. Antoine et al 2003).

Palaeoenvironmental Reconstructions

Table 1 provides a list of OIS3 archaeological sites that have also yielded some palaeoenvironmental data. Although frequently coarse and rather patchy, these nonetheless provide the most direct approximation of the environments Neanderthals actually encountered in OIS3 Britain. These data can be supplemented by often better evidence from a growing number of non-archaeological sites claimed to be of OIS3 age (not listed here, see overviews in Jones and Keen 1993; Lowe and Walker 1997). What is most important to stress here, however, is that all apparently show a remarkably consistent and persistent set of generic environmental conditions, despite the fact that a long time period encompassing many climatic oscillations is undoubtedly represented. Accordingly, and given the temporal resolution of the data, a time-averaged palaeoenvironmental reconstruction of earlier OIS3 has been derived from these data and is discussed below.

Mollusc and insect faunas from OIS3 sites uniformly show an open, treeless environment, with taxa characteristic of grassland with local patches of marsh and bare sandy facies. Climatic indicators suggest sub-arctic temperatures. In a comprehensive review of insect assemblages from 27 British OIS 3 sites, Coope (2002) has shown that warmest month temperatures were on average just ~10°C, with the coldest months seeing lows of -20 to -27°C; these may only represent the warm D/O events and could be on the conservative side (ibid, 405-6). A marked warm period is evident beginning 43kya, when temperatures approached modern values, although critical for the argument developed below the structure of the environments inferred from the insects remains the same (Coope et al 1997; Coope 2002). Coope insists that the environment was treeless throughout OIS3, the key reasons possibly being poor soils/soil development, large herbivore grazing and slow colonisation rates combined with the rapid climatic fluctuations.

Limited pollen data has been recovered from both cave and open-air OIS3 sites. Although not without its problems (Turner 1985; Coles et al 1985) and often subject to strong criticism (e.g., Jacobi, cited in Aldhouse-Green et al 1995) it nevertheless can be noted as conforming to other proxies, being dominated by open grassland species. Arboreal pollen counts are generally very low, and while species like pine, alder, spruce, birch and willow are sometimes present, they are usually dismissed as being very far-travelled or representative of dwarf species. Based on the Lynford evidence, Boismier et al (2003) suggested that some localised patches of woodland probably existed somewhere in the landscape, although this has been disputed on the basis of the molluscs and insects neither of which show any obligate woodland species (D. Keen pers. comm. 23/10/03; Coope 2003). Campbell (1971), though, raises the intriguing possibility that trees may have occurred in sheltered situations, for example the southern side of the Mendips or ravines like Creswell Crags.

The OIS3 mammalian fauna was dominated by mammoth, woolly rhinoceros, horse, bison and reindeer (cf. Currant and Jacobi 1997, 2001, 2002). Designated the Pin Hole Mammalian Assemblage-Zone, it shows a curious mixture of ostensibly warm-adapted (i.e. red deer, giant deer) and cold-adapted species (i.e. mammoth, woolly rhinoceros, arctic fox, reindeer). None are obligate forest species, though, and the whole has again been taken to show the (?exclusive) dominance of rich open grasslands with abundant but low quality/high fibre graze (i.e. the Mammoth Steppe of Guthrie 1990). Currant and Jacobi suggest that the character of the OIS3 British fauna shows the existence of continental conditions right up to the Atlantic Seaboard, with fairly warm summers but harsh winters. The mixed mammalian assemblage may thus reflect seasonal variation, as well as the impact of the millennial-scale climatic fluctuations, not all species being present all of the time (cf. Stewart 2005). At Lynford, large numbers of dung beetles were recovered from the archaeological horizons, demonstrating that the cool-climate grassland-dwelling mammals were alive and present at the same time as Neanderthals.

The micromorphological studies relevant to Neanderthal occupation have provided no evidence of permanently frozen ground during the periods of Neanderthal presence, although the Lynford site shows the landscape was probably frozen solid in winter. Large flint nodules found within the organic silts at this site are thought to have derived from the surface of winter ice, sinking into the fine sediments during the spring thaw, while marginal debris flows may also reflect the melting and mobilisation of seasonally-frozen ground (Lewis 2003). Unit ii at Prospect Park, Heathrow (Rose et al, 2001), on the same terrace and at the same altitude as the Sipson Lane bout coupe find spot, also showed small polygonal fissures formed by desiccation and vein ice; the structural properties of the sediments being described as typical of poorly-drained frost sensitive sites under periglacial although not necessarily permafrost conditions.

The site derived palaeoclimatic data outlined above can be augmented by the generalised modelled data generated by the OIS3 Project (Barron et al 2003, Huntley and Allen 2003; Davies and Gollop 2003). For present purposes I have concentrated on their warm D/O event projections, reflecting conditions ca 45 kya and used to represent all such events between ca. 60-42 kya. These arguably represent the most favourable conditions Neanderthals could be expected to have encountered, setting the lower limits on survival demands. Again, this scale of analysis is considered appropriate to the task at hand because 1) the structure of the environment appears to be very consistent throughout and 2) the temporal resolution of the data prevents a finer examination. Dating of the OIS3 sites in Table 1 is based at best on OSL or ^{14}C estimations, with statistical uncertainties of comparable or greater magnitude to the millennial D/O oscillations (cf. Huntley et al 2003), but more often on coarse biostratgraphical or lithostratographical correlations. At best it is possible to situate sites within one of the three phases of OIS3 outlined above, but not presently to a particular D/O event, cold or warm.

Modelled temperatures show average warm event values at least 7-10°C lower than present. Summer temperatures would rarely have exceeded 8-12°C, with winter temperature ranges falling to -8°C and below. The spring thaw came late, with temperatures not exceeding 0°C until April had past (Barron et al 2003, 70). These surface air-temperatures would have been further reduced by wind-chill. Atmospheric circulation models project strong westerly airflow over Europe, creating strong zonal winds north of the transverse European mountain ranges (Barron et al 2003, 63). In Britain, wind-chill factors reduced the effective temperatures to at least 8°C in summer and -13°C in winter (Aiello and Wheeler 2003, 159; underestimates according to Coope's beetle data). (Modelled cold D/O event temperatures suggest summer values, with wind-chill, of –1°C and winter values of -27°C).

In terms of precipitation, the OIS3 project suggests that the period was not in fact terribly arid. Based on their projections of sea-surface-temperature, sea-ice coverage and atmospheric circulation patterns, Barron et al (2003, 68) concluded that onshore airflow over NW Europe may have delivered similar annual precipitation to that witnessed today, although summers may have been drier. In winter much of the precipitation would have fallen in the form of snow. Snow coverage is estimated to have lasted between 3-6 months of the year, reaching depths of 10-50mm (ibid, 67); although drifting may have left much of the landscape with a minimal coverage. However, the models also suggest that substantial winter precipitation was preceded by heavy autumn rains (ibid, 72), which, falling just as temperatures began to drop would have created a particularly unpleasant cold, wet climate. Given this level of precipitation, cloud cover, precluding much in the way of direct heating by insolation, was presumably another key factor.

How the west was won and where it got us

The reconstructions outlined above depict an environment rather hostile to human occupation. We must now return to the question: just how did Neanderthals cope with this cool-cold, treeless and moist steppic environment when they returned to Britain?

Physical Adaptations
It is cherished palaeoanthropological doctrine that Neanderthals were able to survive in Pleistocene Europe by virtue of their morphological adaptation to cold environments, whereas modern humans buffered themselves by sophisticated cultural means. This has recently been questioned by Aiello and Wheeler (2003), who present us with a more vulnerable Neanderthal who might not have been able to simply 'tough it out'.

These authors argue that, despite their body shape conforming to theoretical models for arctic adaptation in humans and other animals, Neanderthals actually had little thermoregulatory advantage over anatomically modern humans in dealing with low temperatures. Assuming metabolic rates similar to modern humans, they calculate that Neanderthals would have possessed only a 1°C advantage (27.3°C vs 28.2°C) in their lower critical temperature[1], while the minimal sustainable ambient temperature[2] would have been about 8°C for Neanderthals compared to 10.5°C for modern humans (Ibid, 148-9). Adjusting the model to give Neanderthals the elevated basal metabolic rates (BMR) documented amongst modern arctic-adapted peoples (due to factors such as high protein diets and the effects of temperature and day length on thyroid function) and adding the insulating effects of the increased muscle mass inferred from their skeletons (providing up to 5% reduction in heat loss), still returns fairly moderate lower critical and minimum sustainable temperatures, of 25.3°C and 1.9°C, respectively.

There are, however, other ways of keeping warm. If elevated BMR Neanderthals are given 1 clo of additional insulation[3] – from subcutaneous fat, hair or clothing – then the lower critical temperature becomes 16.7°C and the minimum sustainable temperature -21°C. Aiello and Wheeler reject the possibility of heat conservation solely by storing fat, as the amount required would have weighed ~52kg, and conclude that hair (1clo = 4cm of all-over body hair) but most probably clothing must have been present. Short of a Neanderthal ice-mummy, the length and coverage of their body hair will never be known, and although Guthrie (1990) reminds us that most inhabitants of the Mammoth Steppe were essentially 'woolly', excessively hirsute northern Neanderthals does raise certain issues regarding species recognition and mating networks between different regional populations of Neanderthals, and between Neanderthals and modern humans (cf. Smith et al 2005). Aiello and Wheeler's favoured solution of clothing is taken up further below.

This stimulating re-evaluation obviously elides a great deal of added complexity. Steegmann *et al* (2002) speculated that cold adaptation in Neanderthals may have depended not only on morphology but on a complex suite of physiological and genetic adaptations, including: thermogenic brown adipose tissue; small amounts of subcutaneous fat; muscle-mass; elevated BMRs; enhanced vasoconstriction and

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[1] "the lower limit of the thermoneutral zone within which a mammal can regulate its core temperature solely by controlling its thermal conductance…as the temperature falls below this level homeostasis can only be maintained by increasing internal heat production, and incurring additional energetic costs associated with this increase in heat production" (Aiello and Wheeler 2003, 148).
[2] The minimum temperature at which an animal can maintain normal body temperature by raising its basal metabolic rate to its maximum sustainable level, in humans usually about 3 times normal BMR.
[3] 1 clo = a reduction in heat loss from the skin equivalent to 38kcal/m2/hr

localised vasodilation, all intensified by aerobic fitness and ontogenetic acclimatisation. These conclusions were based on a number of studies into cold adaptations in contemporary human and non-human primates, as well as ethnographical anecdotes of 19th century Tierra del Fuegian lifestyles. Interestingly, with all this said they still hypothesised the use of a number of complementary cultural adaptations (ibid, Table 2).

For present purposes, the most important points to take from these studies are: that all of these biological solutions are energetically costly and can become maladaptive if food supply is inadequate (Steegmann et al 2002) and; that even warm event summer temperatures in OIS3 Britain are routinely below the lower critical temperatures for 1 clo of added insulation. In other words, with some biological buffering and a minimal level of artificial insulation, life in Britain would still have been regularly outside the thermoneutral zone, thermally stressed and energetically expensive. Furthermore, warm event winters may still have approached minimal sustainable temperatures, while cold event winters almost certainly exceeded them. The inferred highly active lifestyle of acclimatised Neanderthals would, of course, have helped them cope, but they could not keep this up 24/7; they could not have been constantly 'on the go', feeding as they went to fuel their energetic needs, and the problems of keeping warm during 'downtime' continues to force the issue. Indeed, while Neanderthals may have had the potential to survive extremely harsh condition, Davies and Gollop's (2003) survey of their temporal and spatial distribution indicate that they actually favoured the warmer times and places. During the earlier stable phase of OIS3 they generally shunned areas with winter temperatures below -8˚C and snow cover >50cm/60 days and preferred summer temperatures between 12-25˚C.

According to Ashton (2002), however, from the late Middle Pleistocene onwards European hominins were becoming increasingly adapted to the cooler, open environments of the Mammoth Steppe. Success was achieved via higher levels of mobility, hyper-carnivory involving more developed hunting of large herds, enhanced tool curation and greater social flexibility (Ashton 2002, Gaudzinski 1996, 1999a; Bocherens 1999, 2001; Richards et al 2000; White and Ashton 2003). These are all certainly valid aspects of such an adaptation, but to sustain Aiello and Wheeler's type of Neanderthal we surely need more sophisticated cultural solutions than just keeping on the move, looking after your tools and eating more meat.

Clothes

The probability that Neanderthals clothed themselves is widely acknowledged (albeit often tacitly) and most pictorial reconstructions show - even if just for the sake of modesty - some form of apparel. We can also safely infer from the faunal record that Neanderthals had access to animal skins, while microwear has demonstrated that hide scraping was a regular function of several stone tool types (e.g. Anderson-Gerfaud 1990). Jenkinson (1994, 74) also speculated that the frequency of scrapers in the very small Pin Hole Cave assemblage indicated skin working in a suitably cool, sheltered environment. Hayden (1993), on the other hand, assuming biological buffering in temperate climates, sees no need for clothing, which he argues is linked to social status, and costly and time consuming to produce. Nevertheless, given the modelled environments and physical adaptations outlined above, Neanderthals in Britain realistically needed clothes for much of the year.

The essential properties of cold-weather clothing are insulating the body, protecting it from the elements, and allowing the maintenance of task efficiency (Stenton 1991). Effective cold-weather clothing operates on the air-capture principal, which works best if the garments are loose fitting and the sides are closed to stop warm air being constantly replaced by cold air (Buijs1997). Well-designed clothing will also allow surplus heat and moisture to be vented (often at the neck) thus avoiding overheating, excess sweating and dehydration (Stenton 1991; Buijs 1997; Osborn 2004).

To provide anything like the type of 'personal portable environment' (Watkins 1984) described above, Neanderthal clothing would have needed to be more than the ragged loincloth, off-the-shoulder wrap or cape of popular depiction (the last of which would pin the arms inside, preventing effective action). Some form of tailoring would probably have been required (Aiello and Wheeler 2003), but the Middle Palaeolithic has thus far yielded no evidence of needlecraft technology, which first appears in the Upper Palaeolithic. However, Neanderthals certainly had access to stone tools or bone splinters suitable for piercing holes and granting them the ability to bind these with a simple stitch using some other organic material (no great leap from the bindings inferred for hafted stone tools, see Anderson-Gaufaud 1990), they should have had little problem in provisioning themselves with suitable attire to cover their bodies and regulate their core temperature. The air-capture system works best when fur is retained and worn next to the body, any additional outer layers being worn the other way round (Bujys 1997). In this case, scrapers were probably used to remove fat rather than fur, and red ochre, seen in at least a dozen Mousterian sites across Europe (Mellars 1996), may have been used as an abrasive powder, a desiccant/preservative or a pesticide (Osborn 2004). Thermal protection for infants could have been simpler but perhaps even more vital, with major implications for survival and mortality rates.

The short distal limb proportions of Neanderthals acted to keep the temperature at the extremities close to that of the core, restricting tissue damage and maintaining sensitivity (Aiello and Wheeler 2003). Yet given the evidence for seasonally frozen ground it seems rather incredible that Neanderthals in Britain would have endured the whole year without any form of artificial foot protection. On the other hand, Trinkaus's (2005) recent study of Neanderthal foot bones found no evidence for rigid footwear capable of conferring *mechanical separation* between the foot and the ground. However, he admits that this does not eliminate the possibility of soft-soled footwear, such as strap-bound furs packed with insulating fibres.

Aiello and Wheeler hypothesise a very conservative 1 clo of insulation. Most Pleistocene mammal furs would have greatly exceed this level (cf. Stenton 1991, 11), meaning that a clothed Neanderthal could have remained comfortable at temperatures far below those outlined above. Reindeer hides are particularly valued by modern arctic peoples because they are lightweight and their fur has excellent insulatory properties (clo value = 7, Ibid). The best time to procure reindeer hides is in the late summer, prior to the development of the heavy winter pelage and after the skin had repaired the damage caused by any summer parasites (Ibid, 6), which adds another interpretative dimension to the late summer/early autumn mass killing of reindeer at Salzgitter-Liebenstedt (Gaudzinski and Roebroeks 1999); especially if Bocherens *et al* (2005) are correct in their assertion that northern Neanderthals ate a lot of mammoth and rhino, but little reindeer (the reverse being true for hyaenas). One wonders whether some species were targeted as much for their hides and sinews as for their meat value (see Burch 1998 for caribou), and whether the classic 'scavenging' pattern of heads and lower limbs found in Middle Palaeolithic sites is in fact a signature testifying to the preferential transport of hides away from the kill sites (cf. Chase 1986; Mellars 1996). Indeed, such patterns find obvious parallels in medieval tanneries (Serjeantson 1989; Gidney 2000). The broad association of scraper-rich Quina assemblages with colder environments and reindeer bones is highly suggestive in this regard (cf. Mellars 1996, 329; Dibble and Rolland 1992).

So, if we are prepared to speculate just a little beyond the actual data and grant Neanderthals a few simple habits, then just keeping warm in OIS3 Britain may not have been among their greatest challenges. These lay elsewhere.

Shelter

Cave and rock-shelter sites are practically absent in south-east Britain and while more occur in the north and south-west, these do not appear to have been used as long term residential foci. The well-known occurrences in the Mendips, Creswell Crags and South Wales generally contain small lithic assemblages comprising a few handaxes, scrapers and cores, with limited evidence of extensive knapping but suggestions of maintenance and reworking of transported artefacts (Coulson 1990; Proctor et al 1996; Jacobi 2006, 54). They actually seem to reflect very short visitations, perhaps 'field camps' (Binford 1980) where mobile hunters stopped for a short time while travelling through, or perhaps places to which small task groups armed with a minimal survival kit went for very specific purposes. The elevation of some sites (e.g., Coygan, 83m OD, overlooking the Bristol Channel plain) implies that they would have been good spots for hunters to scan the local landscape for game, but this is not true in all cases. Some of the finds may represent items that were cached for an anticipated return visit (White and Jacobi, 2002).

Over large parts of their known British distribution, then, Neanderthals would appear to have been forced 'out of doors', hopelessly exposed to the elements on the treeless mammoth steppe. They may have sought out other naturally sheltered areas afforded by the local topography to site their 'base-camps' – and it is perhaps to these areas that we should direct our searches for more evidence of Middle Palaeolithic occupation (whatever and wherever they may be: see Kolen 1999, 151, for possible examples from Normandy and Britanny). But even so we might expect them to have used some form of artificial shelter during downtime.

This raises the contentious issue of Neanderthal architecture, the evidence for which is limited and equivocal (Klein 1999; Kolen 1999; Gamble 1986). A number of recent evaluations have questioned the anthropogenic nature of many putative structures or interpreted them as unintentional (re-)arrangements of natural and cultural debris: the famous 'huts' at Arcy-sur-Cure and Molodova I/4, for example, have been re-interpreted as peripheral 'enrichments' formed by Neanderthals shoving debris out of their personal space, humanly constructed but not formally structured (Kolen 1999; Gamble 1986)[4]. Discussions of Neanderthal architecture also tend to become embroiled in philosophical worries about the social and cognitive meaning of 'home', 'dwelling', 'nesting' and different types of geography (Binford 1987; Kolen

[4] Interestingly, Binford (1983) describes similarly enriched and depleted zones in areas where clearance had taken place so that hides could be laid out for processing

1999). Such approaches are no doubt important, but all too often they transmute into an entrenched viewpoint whereby Neanderthals simply didn't (or couldn't) construct artificial shelters and didn't (or couldn't) organise themselves from base camps. At best, some of the open-air 'arrangements' might be accepted as deliberate windbreaks (e.g, Ripiceni-Izvor, Romania, Gamble 1986, 256) or, if containing an integral hearth, a combination windbreak and storage heater (e.g., Vilas Ruivas, Portugal, Kolen 1999, 152, 156).

Now, from the narrow but frankly vital perspective of survival, it almost beggars belief that Neanderthals managed to survive on the cold and open treeless steppe without some form of artificial shelter, nowhere to take refuge from the wind, rain and snow or to dry-off once wet, whether semi-naked or fully clothed. Wet clothes are particularly hazardous, potentially increasing heat loss by a factor of 5 (Stenton 1991; Osborn 2004; Curtis 1995). Is the apparent absence of evidence really evidence that Neanderthals lacked the social set-up and technical know-how to build structures of any kind, even if the alternative might be hypothermia? Without shelter how did Neanderthals get through the night?

One recent suggestion is that they spent their evenings huddled together to share body heat (?under wraps) (Aiello and Wheeler 2003). This might be reasonable in caves but not in the open, exposed to the weather. The problem is not helped by the fact that in truth we don't really know what we are looking for (see also Pettitt 1997). There are numerous ethnographic examples of simple tents that could be constructed with few resources, often just skins draped and anchored around a couple of low uprights (Faegre 1978, Lee and Reinhardt 2003; Osborn 2004). Internally these form well-insulated heat traps, with skin or vegetal bedding used to raise individuals off the ground and reduce heat loss through conduction. Any patterns left behind would depend largely on the duration of use, the activities conducted within and the temporality of residential moves (cf. Binford 1980). One further consideration is that in OIS3 Britain the construction of even the simplest of structures would be hampered by the lack of wood resources on the open steppe, although other materials like bone could form a viable substitute. But with both props and hides being precious and heavy, these must have either been centrally-organised from a base camp or – accepting the oft-promoted extreme levels of mobility and lack of base-camps (e.g., Stringer and Gamble 1993, 168) - curated and frequently transported, an added burden possibly requiring some form of travois. If so, then we are possibly looking for such extremely ephemeral structures that the chances of them leaving any recognisable archaeological footprint are vanishingly small. As soon as they were dismantled and the bedding shaken off, very little would be left in the way of any characteristic patterning.

Fire

Fire is a well established part of the Neanderthal tool kit, forming not only a source of heat and a mode of drying, but also providing light, a deterrent against predators, and the means for cooking (externalising part of the digestive process and making food 'less expensive'; Aiello and Wheeler 1995). Examples of Neanderthal fire use are diverse, ranging from the large ash deposits spread out to warm the ground at Kebara, Israel (Bar-Yosef et al 1992), the arranged hearths at Abric Romani, Spain with associated pseudomorphs interpreted as overhanging wooden tripods (Castro-Curel and Carbonell 1995), to the tiny single hearth lit to accompany an ibex dinner in

Grotte de l'Hortus (Lumley 1972, Pettitt 1997). Unhindered access to fire would certainly have helped Neanderthals survive in OIS3 Britain, perhaps even attenuating the seemingly pressing needs for artificial shelter and all its concomitants.

The lack of wood once again becomes the big issue in Britain. Without it, it is difficult to see how the necessary fires could have been routinely lit and sustained. Possible hearths have been recorded at Coygan Cave (Aldhouse-Green et al 1995, 47-48) and Hyaena Den (Tratman et al 1971, 249), while Dawkins (1877, 594) talks of charcoal and calcined bone at Robin Hoods Cave, but these reports remain rather anecdotal; their association with Middle Palaeolithic occupation is not entirely secure and it is unclear precisely what material was being burnt. In the absence of wood, alternative resources could have been used - dung, grass and shrubs or even green bone - but these come at a cost. The problem with the latter is that it requires large quantities of other combustible material to generate heat sufficient for it to ignite in the first place (Thery-Parisot and Meignen 2000; Villa 2002; Hoffecker 2004; Osborn 2004). There is also the lack of significant deposits of calcined bone to consider (some was admittedly found at Robin Hoods Cave; Jacobi 2006), although this may relate to the failure to locate any real settlements. Scrubby vegetation might provide a better source, dwarf birch being particularly valuable as it is high in resin and burns well at high temperatures when fresh (Owen 2002). However, very large quantities must have been collected to maintain a scrub fire or to ignite bone, both time and energy consuming and probably unsustainable in a landscape shared with herds of heavy-weight grazers. Here too, then, there is an uneasy relationship between the environmental reconstructions and survival needs

Food, Furs and the Energetics of Foraging

At the 2003 workshop of the Leverhulme Trust's *Ancient Human Occupation of Britain Project* (AHOB), several influential British workers refused to accept that the Neanderthals at Lynford hunted the large herbivores found there, particularly the mammoths. The key reasons for this were:

- the taphonomic evidence for periods of carcass exposure and weathering
- the absence of cut-marks
- the lack of dry-flesh eating beetles or carrion fly pupae
- the lack of wood to make hunting weapons

Now, the exposure of bones at Lynford does not eliminate an active role for Neanderthals, it just means that the site was a place where bodies accumulated over a period of time, and cutmarks are often missing from modern unweathered examples of elephant and other animal butchery (Gaudzinski 1999a). The evidence from the insects is curious from any angle: if, as the combination of dung beetles and carcasses suggest, animals were living and dying in this location, you would expect to find flesh-eaters whether Neanderthals were involved or not. Rapid and comprehensive carnivore processing, cold conditions, and/or death in the water might go some way to providing answers, but clearly these data are not straightforward.

These comments notwithstanding and despite all participants accepting that the isotopic and faunal data shows Neanderthals elsewhere routinely hunted a range of large herbivores including elephants (Gaudzinski 1996, 1999a; Bocherens et al 2005), many maintained that when Neanderthals returned to Britain the lack of wood from which to construct weapons left them no other choice but to adopt a scavenging strategy. For me it is difficult to see how this could feasibly have worked.

Sorensen and Leonard (2001) have effectively shown that the frequently twinned concepts of: 1) Neanderthals as inefficient foragers, and; 2) the elevated energetic costs of living in cold conditions and leading the mobile, physically active lives implied by their skeletons (e.g., Ruff et al 1993, 1994, Trinkaus 1989) are mutually incompatible. They estimated that the average, mid-sexed Neanderthal's energy expenditure was between 3000-5500 kcal/day, requiring a return from foraging of 4400-6700 kcal/day just to sustain themselves at minimal subsistence level. We can infer from recent isotopic work (Bocherens 1999, 2001; Richards et al 2000) that the majority of this came from animal protein and fat - the latter being "one of the metabolic keys" to success in cold environments (Steegmann et al 2002, 571). Taking high-end calorific values for meat of 3000 kcal/kg (Diem 1962), the required intake of the average adult Neanderthal would therefore have required them each to have eaten ~1.85kg of fat-rich meat every day[5]. Given whole carcasses, and assuming a 60% meat return on live weights (Peter Rowley-Conwy, pers. comm. 2006), this means that a group of 10 Neanderthals would need to acquire a reindeer-sized animal every 3 days (average weight ~120kg, Banfield 1961) or horse-sized animal every 6 days (average weight ~250kg, Bökönyi 1974), not accounting for losses due to incomplete processing, decomposition and other scavengers.

If scavenging the kills of other carnivores with lower returns, more frequent access to carcasses would be demanded. Now, the Mammoth Steppe was certainly a relatively rich environment with an abundance of herbivores, and other carnivores such as lion were present to provide fresh kills. Yet, as Guthrie (1990) points out, as rich as it probably was, the Mammoth Steppe is unlikely to have played host to the density of game seen on the African or Asian Savannah. Based on the lack of elaborate social ornamentation (i.e. manes) in Upper Palaeolithic depictions of lion, Guthrie infers small prides, with males and females hunting together over very large territories, all of which points to fairly low prey density. It needs to be asked, then, whether scavenging would have even been a viable option in OIS3 Britain and whether the elevated metabolic costs of simply being there could have been met via this strategy. Remember too that Neanderthals were not the only potential scavenger in the guild, with significant competition undoubtedly coming from very sizable hyena populations which left dense accumulations of bones and probably excluded humans from the rare cave sites during certain periods (A. Currant pers. comm. September 2005). Frozen carcasses may have been a readily available resource in winter (Gamble 1987), but this raises the problem of defrosting, and hence attaining large quantities of fuel, in an environment with no wood and at a time of year when already heavily grazed plant resources were at a minimum. During the spring thaw naturally defrosting carcasses would quickly putrefy; during the modern arctic thaw, carcasses are deep in fly pupae within days (Guthrie 1990).

Another consideration is that hyper-carnivory and limited dietary breath might have caused nutritional deficiencies, meaning that as well as facing additional costs for all the reasons outlined above Neanderthals quite probably went through periods of poor

[5] In more familiar terms, this equates to a 65oz hamburger each. In reality the required values would have varied enormously depending on the age, condition and species of the animals involved; deer is generally much lower (see Diem 1962).

condition and susceptibility to disease, amplifying the problems of simply surviving at all (Hockett and Haws 2005, Trinkaus 1995; Pettitt 2000). Consuming the stomach contents of ruminants to access essential vitamins and minerals is one well-touted solution to this problem, and Owen (2002) has shown that a surprisingly large number of vegetal resources are available and indeed exploited by modern Alaskan hunters (including the leaves and stems of dwarf willow which have added medicinal properties), but these again require either early access to carcasses or are highly seasonal.

Finally, if suggestions that the OIS3 survival package included skin clothing, bedding and perhaps even rudimentary shelters are taken seriously, then Neanderthals would have required access to good conditioned pelts, not the ravaged cast-offs from lion and hyaena kills. Failure to acquire sufficient skins could quickly affect an individual's health, mobility and, consequently, ability to obtain food and reproduce successfully (Stenton 1991). This provides yet another reason to suspect proactive hunting as the main mode of carcass acquisition. But, to labour the point, without wood from which to fashion weapons could they actually manage it?

Can't see the trees; can't see the wood

Owen (2002) states that in wood-poor regions, modern hunter-gatherers are prepared to travel long distances to collect resources, especially for the production of 'long' implements. To reach the nearest stands of wood, Neanderthals might have had to go well beyond the distances over which they routinely moved stone resources (e.g. Féblot-Augustins 1999). But, the well-known emphasis on using local resources where abundant should not be confused with an inability to procure and transport all or any resources over much longer distances as and when necessary, nor with limited planning depth (cf. Roebroeks et al 1992; Roebroeks 2001; Speth 2004). Neanderthals might have collected driftwood brought down by the major European drainage systems into rivers that flowed through the now submerged lowland basins around the south and east coast, or from the seashores on the west coast. We must also seriously consider whether some areas of Britain, such as Creswell Crags or the south slopes of the Mendips, acted as cryptic refugia where stands of trees survived (cf. Stewart and Lister 2001). Indeed, Jacobi (2006, 52) has inferred that the notched artefacts from Robin Hoods Cave show woodworking was taking place in the Creswell Caves. This could perhaps explain the type of short-term usage inferred for these and similar sites, which may represent places to which people went primarily to gather wooden resources for weapons.

It is equally conceivable that the currently favoured environmental proxies and consequent reconstructions might be leading us astray (e.g. Kenward 2006) and that we need to look more critically using a *unified* multidisciplinary perspective. Take the example of Wretton, an early Devensian sequence (OIS5d-4) where the beetles show open grassland throughout, but the pollen shows at least two woodland phases (West et al 1974). Clearly we should not rely on very localised indicators alone to provide landscape pictures. Another hint that trees may have been present in situations where other proxies suggest open environments is found at Cassington, where a channel incised into the top of gravel attributed to OIS4 produced plant macrofossils and pollen that included tree birch and sporadic oak, alder and hazel, and was argued to represent trapped flood debris (Maddy et al 1998). One thing is clear, we will not progress very far if all pollen is written off as far travelled, and fragmentary wood charcoal is rejected as evidence for trees (Huntley and Allen 2003).

Without wood, short weapons could have been manufactured from bone, something similar perhaps to the mammoth rib points described from Salzgitter-Leibenstedt (Gaudzinski 1999b). As hunting in the open often precludes more stealthy styles of attack (Guthrie 1990) driving into natural traps and ambushing was one of the favoured Neanderthal tactics (e.g., as at Lynford and other European 'multiple death' sites, cf. Mellars 1996; Gaudzinski 1996). Shorter weapons could easily have serviced the close-quarter engagement this would have entailed. Nothing similar is yet known from Britain, but an enigmatic sandstone block from Lynford, similar to later prehistoric shaft-straighteners, shows an anthropogenic u-shaped groove that could have been used to manufacture some form of thin projectile of bone or antler (pers. obs; d'Errico and Debreuil in press). One of the horse bones from this site also shows a puncture wound quite conceivably produced by such a weapon (Schreve in press). Depending on their length, though, such points might still have required a shaft, implying the type of composite technologies long denied the Neanderthals but the acceptance of which is now becoming almost unavoidable (e.g. Koller et al 2001; Anderson-Gerfaud 1990; Shea et al 2001; Mazza et al 2006)[6]. Wood is again the 'normal' connective tissue in hunter-gatherer technology, but in wood-scarce settings a number of other raw materials might be expected (Osborn 2004). We should note however that the anthropogenic origin of most claimed bone points from early Palaeolithic sites has been strongly questioned (d'Errico and Villa 2001), while the ineffective use of ossiferous resources by Neanderthals is often cited as one of the key differences between them and modern humans. More recent claims may give us cause to reconsider the situation (e.g: Balver Höhle, Germany, Kindler 2005).

Seasons in the Sun
Miserable conditions and a desperate lack of resources make OIS3 Britain an unlikely holiday destination, but those wishing to deny Neanderthals any or all of the above capabilities have only one real route out of the developing paradox: Neanderthals were summer visitors only, moving into Britain for short periods and bringing the necessary equipment from elsewhere in their annual range. Furthermore, these visits may have been limited to only a few of the warmer oscillations of OIS3.

In this account Neanderthals migrated north and west during the summer from winter retreats in the lowland basins or adjacent areas of Europe, following reindeer, mammoth etc onto the upland plain of Western Doggerland: for Neanderthals a well-stocked summer feeding ground. As Guthrie (1990, 277) explains, at its most hostile extremes the mammoth steppe would have made it an excellent place to hunt, but a poor place to live. Externally provisioned summer occupation might still have been challenging, but the demands would have been greatly attenuated and perhaps required none of the 'invisible' cultural solutions hypothesised above. As a package, however, such an operation would require a high degree of long-term logistical planning; enhanced levels of co-operation; possible task divisions; finely tuned knowledge of the landscape and prey behaviour; and final-dispatch weapons - a list of

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[6] If the early Upper Palaeolithic leaf-points seen at sites such as Beedings (Jacobi 1986, 1999) are also Neanderthal products, then these potentially provide further evidence of hafted technologies in Britain during OIS3.

traits that includes much often deemed missing from the Neanderthal repertoire (cf. Roebroeks 2001; Speth 2004).

This might nevertheless seem like an attractive solution, but does it actually work? While there are undoubted cultural links – OIS3 sites in both Britain and France seem to belong to the MTA and bifaces are present in a number of other facies across Northern Europe – there are significant typological differences between the handaxes seen in Britain and the continent. In Britain the bout coupé handaxe has been singled out as an almost unique regional variant (Roe 1981, Tyldesley 1987; White and Jacobi 2002;). Conversely, other types - the exaggerated triangular form of NW France and the assorted 'Micoquian' variants - are largely absent from Britain. Chronology may explain the typological absences from Britain, certain forms being used in Europe during periods when Britain was not visited, but this cannot account for the absence of bout coupés in Europe, leaving the typological data apparently contradicting the notion of a contiguous seasonal home-range.

It is of course possible that the uniqueness of the bout coupé handaxe is a fallacy, a mere artefact of classification (Coulson 1986), and that many examples sit unrecognised in French museums. Recent broad surveys suggest that this is not the case (Soressi 2002); there are a few possible examples in the Paris Basin [7] (Tyldesley 1987) but their overall occurrence and frequency is extremely low compared to the British situation. It is also possible that the bout coupé was used exclusively in summer by peripheral task-groups – as Hopkinson (2004) has argued for the Altmühlian leaf-point - although it is hard to imagine why this would be the case for such a multi-purpose versatile object whose edges supported a number of different functions (cf. Soressi and Hays 2003). Another possibility is that the territory of the Neanderthals for whom Britain formed a summer hunting ground did not extend onto the southern and eastern 'uplands' of continental Europe, but remained fixed in the now submerged Channel and North Sea Basins, bounded by the major rivers that once flowed west and north. This certainly fits a number of known distance parameters, including the 300km seasonal movements inferred from raw material transfers in central Europe and the total area traversed by modern cold adapted hunter-gatherers over the course of several decades (Gamble 1993; Binford 1983). Both further match onto the distribution of Middle Palaeolithic sites in mainland Britain. However, it is still uncertain whether a sufficient ecological gradient existed between 'upland' Britain and the adjacent lowland plains to make winter survival there any easier (see Barron et al 2003).

Closing Comments:

After more than a century of living in the shadow of the undeniably richer continental record, the British Middle Palaeolithic is finally developing its own character. New sites, re-evaluations of existing evidence and a host of wider Quaternary studies are at last helping to unravel the timing and nature of Neanderthal settlement on this northwestern-most fringe of the Neanderthal world. As this emerging personality is revealed, however, it is showing itself to be rather schizophrenic.

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[7] Likewise there are possible pre-Devensian examples in the UK, a case of inevitable convergence in form (White and Jacobi 2002). Doubt also exists over the OIS3 context of some French material cited by Tyldesley, cf. Cliquet et al (2001) for Saint-Saens

Looked at in terms of observed hunter-gatherer environmental and social frameworks (Woodburn 1982; Binford 1980; Dale et al 2004), reconstructions of Neanderthal life in this part of Pleistocene Europe present some unique combinations. They lived in (very) cool-temperate, high-latitude environments, apparently formed small highly mobile groups (residentially and daily), and experienced conditions of extreme key-resource stress. Physically buffered to only a moderate degree, they are nonetheless widely believed to have practiced an immediate return system, used inferior and poorly organised technologies and residential logistics, and failed to effectively exploit major components of their known resource base as a raw material (i.e. bone). To some they were ineffective hunters, in Britain possibly obligate scavengers with no access even to hunting weapons. In similar circumstances and apparently with no great physiological disadvantage, Upper Palaeolithic *hunters* would be seen as being reliant on delayed return systems with socially organised storage and a whole host of complex tools and facilities of different materials (Hoffecker 2004). Granted, parts of the Upper Palaeolithic record provide better and more direct evidence for such things, but even so double standards can be detected (Roebroeks and Corbey 2000).

What I hope I have shown is that something, somewhere is not quite right. The arguments go round and round without any really satisfactory resolution, and while I have offered some suggestions about survival in OIS3 Britain these are both imperfect and speculative. Most are founded on physiological and environmental premises, but require us to make logical deductions– or leaps of faith if you prefer – that go beyond the comfort of solid evidence and there is no current possibility of satisfying the inevitable cries of *habeas corpus*. The deeper Palaeolithic record is silent on many fronts. Freaks of preservation such as the Middle Palaeolithic birch-bark pitch at Königsaue with its requisite technical know-how and apparatus (Koller et al 2001), the pseudomorphs of wooden hearth furniture at Abric Romani (Castro-Curel and Carbonell 1995), and the mighty Lower Palaeolithic spears from Schoningen (Thieme 1997), provide precious direct evidence as to the true complexity of the Neanderthal and earlier hominin cultural repertoire. Yet, these are really nothing that we could not otherwise have inferred from the demands of hafting, heating and hunting, had the scepticism inherent in the dominant paradigms of the past 30 years left more of us receptive to such ideas.

The challenge ahead is not to sit and wait for more amazing discoveries that will help fine-tune what we think we already know or provide us with new *hard-evidence* to satisfy the sceptics. We must be prepared to re-assess the cogency of our environmental panoramas, take yet another look at physical tolerances and reconsider the Neanderthal ‘settlement’ of OIS3 Britain. We must also look to populate the Neanderthal world with people equipped with knowledge, skills and material culture sophisticated enough to feasibly survive in it, whatever form these need take. Otherwise, they were already dead.

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Site	Environmental Indicators	Environments indicated	Dating of Middle Palaeolithic Levels (yrs BP)	Significant References
Aston Mills and Beckford, Hereford & Worcester, Carrant Gravels	Pin Hole MAZ	Cool, continental, steppic	Mammalian biostratigraphy, lithostratigraphy: OIS3	Waite 1977
Ash Tree Cave, Derbyshire, Stony Cave Earth	Pin Hole MAZ	Cool, continental, steppic	C14: 40,900±1800	Armstrong 1956; Hedges et al 1994
Clubb's Ballast Pit, Snodland, Kent	Pin Hole MAZ	Cool, continental, steppic	Mammalian biostratigraphy and terrace lithostratigraphy: OIS3	Tyldesley 1987
Coygan Cave, Laugharne, S. Wales	Pin Hole MAZ	Cool, continental, steppic	C14: 38,684+2713/-2024 U-series: 64k (TPQ for sediments based on flowstone inclusions)	Aldhouse-Green et al 1995
Creswell Crags: Robin Hood Cave	Pin-Hole MAZ Pollen (? Assoc. with fauna & MP archaeology)	Cool, continental, steppic Open, grass & herb dominated, some trees	C14: 30,000±2000 to 55,000±4000 MP occupation <55krs	Jacobi & Grun 2003
Creswell Crags: Pin Hole Cave	Pin Hole MAZ	Cool, continental, steppic	C14: >41,400 to 44,900±2800 ESR: 38-50,000 U-Series: 63-64,000 (terminus post quem)	Jacobi et al 1998
Creswell Crags: Church Hole Cave	Pin Hole MAZ	Cool, continental steppic	Mammalian biostratigraphy: OIS3	Currant & Jacobi 2001; Coulson 1990; Dawkins 1877
Creswell Crags: Mother Grundy's Parlour	Pin Hole MAZ	Cool, continental, steppic	Mammalian biostratigraphy: OIS3	Currant & Jacobi 2001; Coulson, 1990; Armstrong 1925,
Fenstanton Pits, Cambridgeshire, Middle Devensian Units	Pin Hole MAZ Molluscs Sedimentology	Cool, continental, steppic Terrestrial assemblage indicative of open grassland conditions, no extreme cold indicators Braided river sediments laid down under cold conditions with sparse vegetation	Mammalian biostratigraphy, lithostratigraphy: OIS3	Gao et al 2001
Fisherton Brick Pit, Salisbury, Wilts	Pin Hole MAZ Molluscs	Cool, continental, steppic Mixed assemblage, but showing cool climate & open , marshy environment	Mammalian biostratigraphy and lithostratigraphy: OIS3	Delair & Shackley 1978; Green et al 1983.
Hyaena Den., Wookey Hole, Somerset, cave earth	Pin Hole MAZ Pollen	Cool, continental, steppic Small counts from upper sequence with ? association with MP assemblage although dates appear OK. Shows open grass-herb landscape but with some trees	C14: 40,400±400 for MP related fauna. (using ultrafiltration method 45-48k BP); 39,000±1300 for base of upper sequence	Jacobi & Hawkes 1993; Currant & Jacobi 2004; Hedges et al 1996; Tratman et al 1971; Roger Jacobi, pers. comm..
Kents Cavern, Devonshire, Loamy Cave Earth	Pin Hole MAZ Pollen	Cool, continental, steppic Low counts, showing cold, open shrub-grassland, minimal tree pollen	C14 on fauna from UP levels = 34,620±800 (oldest date providing TAQ) U-series & ESR: deposition of cave earth commenced <74ka Straw suggests cave closed until 60kyrs, MP levels between 60-34ka.	Proctor 1994, Straw 1996; Hedges et al 1996; Campbell and Sampson 1971.

Lime Kiln Quarry, Mells, Somerset	Pin Hole MAZ	Cool, continental, steppic	Mammalian biostratigraphy: OIS3	Vranch 1981, Currant & Jacobi 2002; Currant pers. comm. 2005
Little Paxton, St Neots	Pin Hole MAZ	Cool, continental, steppic	Mammalian biostratigraphy and terrace lithostratigraphy: OIS3	Paterson and Tebbutt 1947, Wymer 1985
Little Cressingham, Norfolk	Pollen	Very low counts ostensibly showing open grassland with betula & salix. Correlated with Devensian deposits at Wretton which showed similar vegetation with a cold molluscan suite	Lithostratigraphy: OIS3	Lawson 1978; West et al 1974
Lynford Quarry, Mundford, Norfolk	Pin Hole MAZ Insects Molluscs Pollen Plant Macros Sedimentology	Cool, continental, steppic Treeless steppe, some bare ground; annual T° range 13 to -10°C or below Mostly aquatic – sub-arctic climates – facies related Cool, open grassland, some marshy areas/acid heath. Some tree pollen (10%) Marshy, acid heath No micromorphological evidence of permafrost; circumstantial evidence for winter freeze.	OSL: 64,000±5000 – 67,000±5000	Boismier et al 2003
Picken's Hole, Compton Bishop, Somerset, Level 3	Pin Hole MAZ	Cool, continental, steppic	Mammalin biostratigraphy: OIS3 C14: 34,365+2600/-1900 (oldest of 2 dates, new unpublished dates exceeding 40,000)	ApSimon 1986; Roger Jacobi pers. comm
Rhinoceros Hole, Wookey, Somerset	Pin Hole MAZ	Cool, continental, steppic	U-series: MP sediments probably younger than 50kyr	Proctor et al 1996
Uphill Quarry Caves, Weston-Super-Mare	Pin-Hole MAZ	Cool, continental steppic	Mammalian biostratigraphy: OIS3	Harrison 1977

Table 1: Middle Devensian localities which have yielded evidence of Middle Palaeolithic occupation and environmental data of some form. C14 assays cited uncalibrated years BP