Neanderthals and Modern Humans in the European Landscape During the Last Glaciation

Tjeerd H. Van Andel and William Davies (eds.)

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This edited volume discusses the multi- and interdisciplinary Stage 3 Project, an interesting and ambitious eight-year undertaking concerned with questions regarding the interplay between climatic, environmental, flora, and faunal variables and the effects of changes in these on both Neandertals and anatomically modern humans (AMHs) during Oxygen Isotope Stage 3 (OIS-3). For reasons discussed below, the actual interval covered is from about 60,000 to 20,000 years ago (OIS-4 to early OIS-2). The book is composed of a foreword, prologue, 14 chapters, and an epilogue, and includes 22 contributors from archaeology, palynology, paleoclimatology, geology, biological anthropology, and paleontology, among other disciplines. The Stage 3 Project, as van Andel explains in the Prologue, had two main questions. First, could existing information be used to reasonably simulate paleoclimatic and landscape changes during OIS-3?; and, second, in what ways, if any, does Middle and Upper Paleolithic archaeology reflect changes in glacial climate? The volume chapters deal with aspects of these questions using a number of different lines of evidence.

Seven chapters describe the background to the project, the methodologies used, the available databases, and issues that arose with the computer simulations for OIS-3 paleoclimates. Because each chapter is written as a stand-alone contribution, there is some repetition of the methodologies and the methodological issues from chapter to chapter. Chapter 1 (The Stage 3: Project: Initiation, Objectives, Approaches) by T. H. van Andel provides the background to the project, including the realization that the then-recent findings from the Greenland ice cores indicated that the last glacial climate was far more complex than originally believed. The frequency of the millennial fluctuations in cold and warm intervals, termed Dansgaard/Oeschger (D/O) oscillations, meant that previous explanations for the demise of the Neandertals and the eventual success of AMHs in glacial Europe should be, at the very least, reexamined, if not reformulated. To model OIS-3 climate, the Stage 3 Project used supercomputers, but even with supercomputers, generating paleoclimates at the time scale of the D/O intervals would have required far in excess of several months of supercomputer time per simulation. The Stage 3 project thus chose to model three "larger" climatic intervals within OIS-3—a Stable Warm phase at the beginning of OIS-3, a Cold Phase within OIS-3, and the Last Glacial Maximum (LGM) in early OIS-2. These simulations were proofed for validity using data that had been held in reserve from the modeling process.

Key among the issues facing the Stage 3 Project was the conversion of radiocarbon dates to the calendar years of the Greenland ice-core (GISP2) and the Lago Grande di Monticchio (Italy) pollen core, as well as sites dating earlier than about 45,000 cal bp. These problems are dealt with extensively in Chapter 3 (Archaeological Dates as Proxies for the Spatial and Temporal Human Presence in Europe: A Discourse on the Method) by T. H. van Andel, W. Davies, B. Weniger, and O. Jöris. Radiocarbon dates were converted using the CalPal calibration curve (http://www.calpal.de/). For the period up to about 38,000 cal bp, standard deviations are mainly <±1000 years. Ages between 38,000 and 45,000 cal bp usually have standard deviations between ±1000 and ±2000 years. Ages greater than 45,000 cal bp, are, as the authors note, subject to quite high standard deviations, ranging from ±4000 to ±8000 years, which creates serious calibration problems.

Modeling of the glacial environments is discussed in several chapters. Chapter 2 (Glacial Environments I: The Weichselian Climate in Europe Between the End of the OIS-5 Interglacial and the Last Glacial Maximum) by T. H. van Andel is an overview of the entirety of the last glacial interval. Chapter 5 (Glacial Environments II: Reconstructing the Climate of Europe in the Last Glaciation) by E. Barron, T. H. van Andel, and D. Pollard provides background on the models used for climate simulation, as well as the modeling strategies, and the results of the simulations. Chapter 6 (Glacial Environments III: Palaeo-vegetation Patterns in Late Glaical Europe) by B. Huntley and J. R. M. Allen looks at how climate and vegetation patterns potentially interact, and the distribution of past vegetation communities during different climatic intervals. Climate simulations, as well as data from pollen, mammalian, and other databases, suggest that the Fennoscandian icesheet was far less extensive during OIS-3 than previously thought. One key question asked by several of the authors is how widely manifest beyond northern and maritime (Atlantic and Mediterranean) Europe were the effects of the numerous D/O oscillations recorded in the Greenland ice cores? But, perhaps more problematic is the fact that the individual D/O oscillations cannot yet be tied one-to-one with data available from existing pollen or other records. For the moment, then, climate and vegetation simulations must treat larger intervals of time. To this end, as mentioned previously, three intervals were modeled: Stable Warm, Early Cold, and LGM. A simulation of modern conditions using the modeling parameters was also run. This served as a test of model and simulation validity against which the results of the Stable

Warm, Early Cold, and LGM simulations could be assessed (Chapter 5, Barron et al.). Interestingly, the model simulations for the modern period, the Stable Warm phase, and the LGM all appear to be relatively reasonable. The simulation for the Early Cold phase, however, was deemed too warm, and despite modifications to the model for this period, this problem (too warm) remained. Most of the chapters in the volume thus use the Stable Warm and the LGM simulations, and assume that the LGM simulation can serve as a proxy for the Early Cold phase, while realizing that conditions of the LGM were actually colder/more extreme than the Early Cold phase. What is perhaps most interesting, however, is that the vegetational patterning, and associated mammalian faunal communities, during OIS-3 have no modern analogues. This means that current communities in the Arctic or northern Europe cannot be used as representative of conditions encountered by Neandertals and AMHs in glacial Europe.

Mammalian faunas are treated in Chapter 7 (Mammalian Faunas of Europe during Oxygen Isotope Stage Three) by J. R. Stewart, T. van Kolfschoten, A. Markova, and R. Musil, and in Chapter 10 (The Middle and Upper Palaeolithic Game Suite in Central and Southeastern Europe) by R. Musil. The dated mammalian databases (bats and marine mammals are excluded) available for western and central Europe are examined in Chapter 7, yielding some 119 taxa from 294 sites. Steward et al. make several comparisons between modern climate and mammalian distributions, as well as paleodistributions of mammals and the climate simulations, primarily using *Lemmus* sp. (lemming), *Alopex lagopus* (arctic fox), *Spermophilus* sp. (sousliks), *Apodemus sylvaticus* (wood mouse), and *Talpa* sp. (moles). The 119 taxa are grouped into extant ubiquitous, extant cold tolerant, extant continental, extant temperate, extant upland/montane, extant southern European peninsular endemics, extinct cold, “interglacial survivors” (including Neandertals), and *Equus hydruntinus* (extinct ass). Mammalian communities are examined in 10 European regions defined by vegetation/pollen—Fennoscandia, Northwest, North Central, Northeast, Southwest, Alpine, Southeast, Mediterranean West, Mediterranean Central, and Mediterranean East. Generally speaking, the greatest distinctions in communities are to be found along the North-South cline. Musil’s faunal presentation in Chapter 10 focuses more narrowly on a smaller portion of Europe, which he divides into seven faunal provinces—comprising the area from southern Poland to Bulgaria. Noting the non-analogue glacial environments, Musil makes the valuable observation that faunal distributions appear to be linked more closely to maritime versus continental factors rather than to cold versus warm phases.

Seven other chapters discuss aspects of the hominin presence in glacial Europe, ranging from examinations of site patterning and distributions to specific discussions of factors that may have influenced the extinction of the Neandertals and the success of AMHs. Site distributions and patterning are the focus of Chapter 4 (The Human Presence in Europe During the Last Glacial Period I: Human Migrations and the Changing Climate) by T. H. van Andel, W. Davies, and B. Weniger. In Chapter 8 (The Human Presence in Europe During the Last Glacial Period II: Climate Tolerance and Climate Preferences of Mid- and Late Glacial Hominids) by W. Davies and P. Gollop, such distributions are investigated specifically with reference to larger scale regional climatic changes. And, in Chapter 11 (The Human Presence in Europe During the Last Glacial Period III: Site Clusters, Regional Climates and Resource Attractions), W. Davies, P. Valdes, C. Ross, and T. H. van Andel combine information from site distributions, topography, climate, and potential resources to discuss long-term shifts in settlement patterning, and how this might be interpreted in terms of Neandertal and AMH responses. The Chapter 4 discussion divides the European archaeological record into the broad categories of Mousterian (representing Neandertals), Early Upper Paleolithic (EUP) and Aurignacian (both representing early AMHs), and Gravettian (representing later AMHs). Across this broad region, the responses of Neandertals and early AMHs are relatively similar. Both seem to have site distributions that contract toward the south during the lead-up to cold intervals—for Aurignacians this pattern is only after 45,000 cal bp, with Neandertals showing a similar response in earlier cold climatic intervals as well as during this period when they presumably coexist with Aurignacian populations. The contraction of Neandertal and early AMH populations effectively creates areas isolated from each other, and opens up the potential for extinction of local groups. Interestingly, it is only the Gravettian (later AMH) populations that seem better adapted to colder conditions and perhaps a more highly mobile lifeway. Davies et al. ask the significant question of whether both Neandertals and early AMHs represent lifeways that are highly adapted to boreal or temperate conditions and to relatively sedentary occupations.

Davies and Gollop (Chapter 8) delve further into the questions raised in Chapter 4, in particular, if the adaptations of Neandertals and AMHs to the glacial environment were similar, if climate affected either population directly, and why Neandertals became extinct but AMHs survived. They use four climatic intervals—Stable Warm (59,000–43,0000 cal bp), Transitional (43,000–37,000 cal bp), Early Cold (37,000–30,000 cal bp), and LGM (27,000–16,000 cal bp). The tolerances for temperatures and snow cover/days appear to have been similar for Neandertals and early AMHs, as are their preferences for areas with the mildest winter temperatures and snow depths/days. However, both Neandertals and early AMHS also demonstrate increasing tolerances/preferences for colder conditions in the Early Cold period. After about 37,000 cal bp, Aurignacian and Neandertal populations appear to diverge in tolerances/preferences, with Aurignacian groups found at colder sites. This pattern is one that increases and peaks with later AMH groups in the Gravettian, and Davies and Gollop suggest, contra genetic evidence, that the Gravettian is an *in situ* European development. There is no real resolution regarding Neandertal extinction, other than the possibility that Neandertals were less flexible in their responses to climatic changes, reaching a point of no return.

The influence of topography on site distributions and resources is a factor in addition to climate and climate change in Chapter 11. Three case study areas—the Dordogne, the Ardennes, and the Danube Basin—are examined by Davies et al. They conclude that Neandertal and AMH populations are affected mainly by temperature and wind chill during cold periods, and by humidity and precipitation during warm periods. These three small regions contain clusters of sites, particularly during the colder intervals, and may have been attractive, according to Davies et al., because of their available resources. Davies et al. thus argue that these site clusters should not be considered "refugia." Quite interestingly, as climatic conditions become colder, the number of open air sites increases (particularly those of Gravettian association). Whether or not these were actually occupied during the winter is a significant question which, lacking seasonality data, currently cannot be addressed.

What about the fate of the Neandertals and the success of modern AMHs during OIS-3? Three chapters take on this topic—Chapter 9 (Neanderthal Thermoregulation and the Glacial Climate) by L. C. Aiello and P. Wheeler, Chapter 12 (Neanderthals as Part of the Broader Late Pleistocene Megafaunal Extinctions?) by J. R. Stewart, T. van Kolfschoten, A. Markova, and R. Musil, and Chapter 13 (Climatic Stress and the Extinction of the Neanderthals) by C. Stringer, H. Pälike, T. H. van Andel, B. Huntley, P. Valdes, and J. R. M. Allen. In Chapter 9, Aiello and Wheeler closely examine the long-standing assumption—based on various body features and form—that the Neandertals are a cold-adapted species. Using wind chill and temperature data, estimates of basal metabolic rate, and energetic costs, they calculate thermoregulatory aspects for both Neandertals and AMHs. They also factor in the increased muscle mass of Neandertals and allow for an assumed higher meat/fat diet for Neandertals. Significantly, all of these "extras" in the favor of Neandertals are actually less of an advantage than might be thought, as AMHs without these could have easily compensated simply by adding 1 clo (a clothing unit equivalent to a modern business suit). In comparing Neandertals, early AMHs, and late AMHs, Aiello and Wheeler conclude that Neandertals tended to select sites with the warmest winter temperatures/wind chills, while Aurignacian and Gravettian groups could (and did) occupy considerably colder sites. Neandertals were able to compensate for somewhat colder intervals and for time away from shelters perhaps through the addition of roughly tailored skins or possibly because they had hairier bodies. Ultimately, however, Aurignacian and Gravettian groups, especially the latter, had access to better insulation or other behavioral modifications compared to Neandertals.

Both Chapters 12 and 13 also examine the impact of climate on the Neandertals but from a somewhat different perspective than Aiello and Wheeler in Chapter 9. Stewart et al. (Chapter 12) discuss Neandertals as part of the "interglacial survivor" fauna. Setting Neandertals into mammalian communities and their differences in tolerances to environmental conditions allows Stewart et al. to generate three broad temporal groups. These are a group that does not experience changes in its occurrence through time (although it does include some taxa that became extinct at the end of the Pleistocene), a group that exhibits a significant decrease over the course of OIS-3 (some become extinct early in the Late Pleistocene; it includes Neandertals and herbivores but not carnivores), and a group that initially increases and later decreases. In terms of their frequency and distribution, Stewart et al. point out that Neandertals are most similar to the interglacial survivors (*Elephaas antiquus* and *Stephanorhinus kirchbergensis*), and should be considered a European endemic species. Stringer et al. also examine climate stress on the Neandertals, suggesting that there were two periods of climatic stress. The first was at about 65,000 years ago, but Neandertals survived this stress period by retreat into refugia. These populations were able to expand from the refugia and recolonize parts of Europe when climatic conditions ameliorated. The second stress period for Neandertals was around 30,000 years ago, but the amplitude of the cold stress and its length were much greater than in the period at 65,000 years ago. Stringer et al. thus conclude that Neandertals likely became extinct because of the combination of small population size and competition with early AMHs for the same resources. They indicate that some early AMH groups also may have gone extinct.

M. M. Lahr and R. A. Foley, in Chapter 14 (Demography, Dispersal and Human Evolution in the Last Glacial Period), present a wider look at climatic pulses during OIS-3 by placing these into the context of hominin migrations from Africa, as well as those into Europe. They factor in biogeographic models for faunal exchange, OIS-3 climates, and paleoanthropological and genetic data. Africa is influenced mainly by North-South gradients, while Europe is characterized by East-West clines. The authors note that migration out-of-Africa is more likely during the interglacials when the Sahara would not constitute a major obstacle, but that hominin populations may have been characterized by a "flux and fragility" situation. In other words, hominin populations were not stable in either numbers or distributions. Lahr and Foley suggest that the biogeographic model of faunal expansions out-of-Africa works reasonably well for hominins prior to OIS-6, but that AMHs do not leave Africa in the interval between OIS-6 and OIS-4. Interestingly, contrary to the predictions of the biogeographical faunal expansion model, AMHs do initially enter Europe during OIS-3—which lacks the interglacial conditions necessary for out-of-Africa—and Lahr and Foley indicate that perhaps this AMH expansion occurs during the small-scale warm D/O oscillations of OIS-3. Alternatively, early AMHs might have benefited from as yet undetermined behavioral advantages or competitive interactions with Neandertals. The authors postulate that both populations (Neandertals and early AMHs) benefited from retreat into refugia, where population continuity was maintained, although early AMHs may have outcompeted Neandertals in these regions.

The Epilogue by T. H. van Andel aptly concludes the volume, serving as an extremely helpful summary of many of the main points made by the chapter authors. Van Andel reiterates the results (and problems) of reconstructing the climates of OIS-3, of reconstructing and interpreting hominin presence in Europe during the last glacial period, and of Neandertal extinction. One quite interesting question asked by van Andel is if Neandertal populations might have become extinct at the end of each glaciation, only to recolonize Europe from the Middle East each time, except, of course, for the last time (after 30,000 cal bp). And, as is the case with much research, the answers to the questions posed by the various scholars in this volume are fewer than the new research questions generated.

As a contribution to research in glacial Europe, this volume edited by van Andel and Davies is an exceptional effort. The wealth and density of information available in this one source is outstanding, and interested parties can access even greater detail through the Stage 3 website (http://www.esc.cam.ac.uk/oistage3/Details/Homepage.html). Virtually all chapters are accompanied by extensive tables, and graphics, including some in color. While there are occasional problems with seeing some levels of information on various figures, primarily because the symbols appear to have been printed too lightly on the maps, most figures can be read easily and serve as important visuals to points made in the text. Small typographic errors in the text also occasionally distract one's attention. Several of the chapters offer summaries of their main points and the volume could have been improved had this aspect been carried over into each of the chapters, some of which, because they contain massive amounts of data grouped into various regional or temporal categories, can be difficult at times to follow.

Overall, however, this volume should be in the library of everyone interested in Paleolithic topics. The questions raised by the various authors are well worth considering, especially those instances in which both Neanderthal and early AMH populations appear to have reacted in similar ways to climatic and associated changes. The fact that many Aurignacian sites follow similar patterns to those of Neandertals, particularly prior to 30,000 cal bp, should generate a host of "red flags" for those interpretations of AMH expansion into Europe as the result of their alleged advantages (i.e., symbolic behavior or new organic technologies). While it may be true that symbolism or new technologies in some part eventually proved advantageous to AMH survival in glacial Europe, the fact that they do not seem to have been an advantage for 10,000 or more years is a quite compelling signal that we should perhaps be thinking "outside the symbolism/technology box"—perhaps the recent advances in genomic genetics of Neandertals and in new considerations of gene flow between AMHs and archaic humans, including Neandertals, will aid in this endeavor (e.g., Hawks and Cochran 2006; Noonan et al. 2006). The simplification of Gravettian settlement at the height of the LGM (as discussed in Chapter 11) may also be a further reflection of the inadequacy of symbolism/technology as THE explanation for hominin persistence in cold climes. Undoubtedly our explanations will need to be based on multiple factors.

Finally, the scope of the Stage 3 project was indeed enormous, as were its ambitions to model the climates of OIS-3 in order to better understand the hominin groups of glacial Europe. To the credit of the authors, all are quite careful to point out and discuss the assumptions and limitations not only of the models and simulations, but also of the databases available. For some researchers reading this volume, these limitations and other issues may impact too greatly on the results. But, I think that such a perspective would be too limiting. If attempts at "big picture" reconstructions based on decent sets of data are never broached or made available for testing, we will be constantly arguing only about entirely speculative interpretations. It is in this regard that I think this volume serves as both a highlight of research in the last decade of the twentieth century, but also as a guide to more accurate, informative, and insightful reconstructions of the prehistoric past as we begin the twenty-first century (and the new millennium). Efforts by others using the Genetic Algorithm for Rule-Set Prediction (GARP: Anderson 2001; Banks et al. 2006) and Ecocultural Niche Modeling (ECNM: Banks et al. 2006) reflect such endeavors on-going at the time of the Stage 3 Project, and also show great future potential.

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