Chapter 6

Trajectories of Change in the Middle Paleolithic of Italy

Steven L. Kuhn

Dept. of Anthropology, University of Arizona, Tucson, AZ 85721-0030

ABSTRACT

This paper examines the idea that there are few if any long-term cultural evolutionary trends in the Middle Paleolithic. First, the general notion of Mousterian stasis is examined. Second, patterns of directional change in lithic technology (laminarity) in two Italian Middle Paleolithic sequences are discussed. Trajectories of change over time trend in opposite directions in the two cases and show very different relationships with the succeeding Upper Paleolithic. Results from this and other papers suggest that Middle Paleolithic hominids were more than capable of altering their behavior, but that there is no generalized tendency for Mousterian industries to develop in the direction of the Upper Paleolithic. This conclusion is difficult to reconcile with progressive views of human cultural evolution. The concept of rugged fitness landscapes may provide a more satisfactory explanatory framework.

INTRODUCTION

Conventional wisdom among many scholars has been that the Middle Paleolithic was an interval of remarkable stasis, a period during which there were few if any significant evolutionary developments in hominid behavioral tendencies or capacities (Mithen 1996: 123; Kuhn and Stiner 1998a; Gamble 1999:422–423; Klein 1999:442). But what is really meant by this? The Middle Paleolithic in its broadest sense encompasses a set of behavioral adaptations and technological strategies that persisted for more than 150,000 years in the face of a wide range of environmental conditions and profound shifts in climate. It is simply inconceivable that Mousterian hominids could have been successful in occupying territory

from the Persian Gulf to the Russian Plain without being able to alter their ways of doing things. Moreover, there is quite a bit of temporal and spatial variation in the archaeology of the Middle Paleolithic and in Mousterian technology: the explanation of "Mousterian assemblage variability" has been a major point of contention for Paleolithic archaeologists over the past 50 years (*e.g.*, Bordes 1961; Binford and Binford 1969; Rolland and Dibble 1990). The mere existence of such variation implies differentiation, which means that some kind of change had to have occurred.

In emphasizing the static nature of the Middle Paleolithic, I believe that scholars actually make two separate, and unequally defensible, assertions. One is that no major technological innovations occurred during the Middle Paleolithic, that nothing significant was added to the human technological repertoire (Kuhn and Stiner 1998a). This would seem to be a fairly safe claim within the limits of current knowledge. Virtually the entire technological and behavioral repertoire documented at the end of the Middle Paleolithic around 35,000 years ago was already in place 200,000 years earlier at the end of the Lower Paleolithic. For the most part, Mousterian variability represents the recombination of a variety of behaviors with great time depth. Arguably the only real technological novelties associated with the Middle Paleolithic are the use of ochre and the hafting of projectile points and other stone elements (Callow and Cornford 1986; Shea 1988), though some researchers assert that these practices can also be found in the late Lower Paleolithic (*e.g.*, Barham 2002). So, from this perspective, the stasis of the Mousterian relates mainly to the lack of novelty.

A second aspect to claims about stasis during the Middle Paleolithic is that there are few if any sustained directional trends in technological evolution. As a result of the fundamental work of F. Bordes on the Mousterian in Western Europe, it is commonly believed that though Mousterian assemblages may vary through time within any one stratified site, there is little or no consistent directionality to these changes. In other words, while the Mousterian may have changed over time it was not going anywhere in particular. This view is far from universal, however. In the eastern Mediterranean Levant there is clearly a highly generalized pattern of change over time in Levallois technology (Garrod and Bate 1937; Jelinek 1981; Bar-Yosef 1998), and some researchers have long argued that at least limited temporal trends in technology and typology can be found in western Europe as well (Mellars 1970, 1986). Perhaps more importantly though, even where trends can be detected the question remains as to whether they anticipated the Upper Paleolithic. For example, in the well-known sequence from Tabun Cave in Israel, it is actually the earliest assemblages that seem most Upper Paleolithic in character, due largely to the presence of blades. Similarly, many of the more recent Middle Paleolithic assemblages in southwest Europe are characterized as Quina or Denticulate Mousterian (Mellars 1970, 1996), neither of which is known for high frequencies of Upper Paleolithic elements.

This paper, like many others in this volume, is concerned mainly with the second claim, relating to long-term, directional trends in Middle Paleolithic technology. In considering the problem it is important to separate the question of

whether trends *per se* exist from the question of whether they anticipate the Upper Paleolithic. Simply asking whether there is evidence for directional change within Middle Paleolithic technologies mainly implicates the general adaptive and behavioral capacities of the hominids. It is an entirely different issue to ask whether any changes observed anticipated the direction of specific Upper Paleolithic cultural trends. In principle we should not be surprised to find that Mousterian hominids (Neandertals and anatomically modern *Homo sapiens*) were fully capable of change and even some level of innovation but that they were following evolutionary trajectories quite different from those documented for hominids in Eurasia after 50,000 years ago. The distinction can be illustrated by looking at two Middle Paleolithic sequences from Italy. Both show definite technological trends. However, those trends are in rather different directions, and appear to have rather different relationships to the Upper Paleolithic industries that followed.

STUDY SAMPLES

Two study samples are discussed below, one from a series of sites in coastal Latium, in the west-central part of the Italian peninsula, and the other from a single site on the northern Ligurian coast. I would not argue that the assemblages from this small sample of caves are representative of the entire range of variation within the Italian Middle Paleolithic. The samples are chosen to illustrate just a part of the variability present in the Mousterian sequences of this area.

The sample from Latium includes a series of Mousterian assemblages from several sites in the region southwest of Rome. They represent a time range between Oxygen Isotope Stage 5a and roughly 36,000 years BP. The assemblages all belong to the so-called "Pontinian," a distinctive regional variant of the Mousterian manufactured using small flint pebbles from fossil marine beaches and characterized by diminutive artifacts and an abundance of heavily reduced scrapers. Results from research on the assemblages from Latium have been extensively published elsewhere (Kuhn 1992, 1995a, 1995b; Kuhn and Stiner 1992). A limited amount of data is also available for a single early Upper Paleolithic (Aurignacian) assemblage, from layer 21 at the site of Grotta del'Fosselone (Blanc and Segre 1953). The Aurignacian at Fossellone has yielded a single conventional ^{14}C date of *ca.* 27,000 years BP, but this determination is somewhat suspect.

The second sample discussed here comes from the site of Riparo Mochi. Riparo Mochi is located in the Balzi Rossi near Ventemiglia, very close to the French/Italian border, and is one of the complex of sites often referred to as the "Grimaldi caves." Riparo Mochi, which preserved a deep sequence of Middle and Upper Paleolithic deposits, was excavated on and off between 1939 and 1959 by L. Cardini of the Istituto Italiano di Paleontologia Umana. The Mousterian at Riparo Mochi has been exposed over a depth of more than 4 m. Although strata drawings indicate that much finer sedimentary subdivisions could be made (Kuhn and Stiner 1992), the entire Middle Paleolithic sequence was given a single stratigraphic designation (layer I). Unlike the Upper Paleolithic deposits at the site,

the Middle Paleolithic at Riparo Mochi was excavated in arbitrary 10 cm levels instead of along natural stratigraphic divisions. No dates are currently available for the Middle Paleolithic at Riparo Mochi. However, the overlying layer G, yielding an early Upper Paleolithic (proto-Aurignacan) industry (Laplace 1977) is dated to between 35,000 and 36,000 years BP, roughly the same age as the most recent Mousterian layers in Latium (Kuhn and Stiner 1998b; Kuhn and Bietti 2000). There may have been a brief hiatus in the occupation of Riparo Mochi, represented by sparse, mixed remains in layer H, but there is no major disconformity in the stratigraphic sequence. Based on geological criteria it has been argued that the Mousterian sequence at Mochi fits into the later half of the Upper Pleistocene, that is into Oxygen Isotope Stages 4 and 3 (de Lumley 1969). Chronologically it probably corresponds roughly with the last half of the Latium sequence.

The technological trends discussed in this paper involve changes in blank form and core reduction technology. Of particular interest for the present discussion are changes over time within each area in the degree of laminarity, the numbers of blades and blade-like pieces, as well as associated technological strategies. Blade blanks are not exclusive to the Upper Paleolithic, and their presence in the Mousterian is itself no surprise (Bar-Yosef and Kuhn 1999). However, blade technology of one form or another ***is*** a widely shared feature of the early Upper Paleolithic in Eurasia. This paper examines blade production not because it is somehow essentially modern, but because that is the direction lithic technologies in western Eurasia eventually followed subsequent to the Mousterian. Typological trends in the Italian Mousterian have been discussed by other researchers. Mussi (1990) and others (*e.g.*, Palma di Cesnola 1996) recognize an increase in the numbers of denticulate-dominated assemblages over time in the peninsula as a whole, although the trend is not clearly expressed in the Latium area.

Two kinds of observations are summarized below. One concerns the frequencies of different dorsal scar patterns. Parallel, longitudinal scar patterns with previous removals originating from the proximal or distal parts of a blank are hallmarks of blade technologies, whether prismatic or Levallois, whereas multidirectional scar patterns are more typical of discoid and centripetal Levallois blank production methods. The second set of observations concerns a simple index of elongation of complete flakes and blanks, the length/width ratio. Obviously, one can and should examine technological practices in much greater detail than this: there is more to it than just the shape of the blanks and the orientation of dorsal scars (for more detailed analysis, see Bietti and Grimaldi 1995; Kuhn 1995a, 1995b). Nonetheless, these are commonly recorded variables with a fair degree of technological significance.

In both Mochi and the Latium sites there are distinct trends in the relative degree of elongation and frequencies of parallel dorsal scar patterns in the Middle Paleolithic assemblages (Figures 1 and 2). In neither sample are the trends absolutely monotonic, nor should they be expected to be: nonetheless, they do represent statistically significant trends. More interestingly, however, the trends observed are in opposite directions. In Latium there is a distinct increase in laminarity in the Middle Paleolithic assemblages over time (Figure 1a, 1b). This is a result of heavier emphasis on unidirectional cores, both Levallois and non-Levallois, and

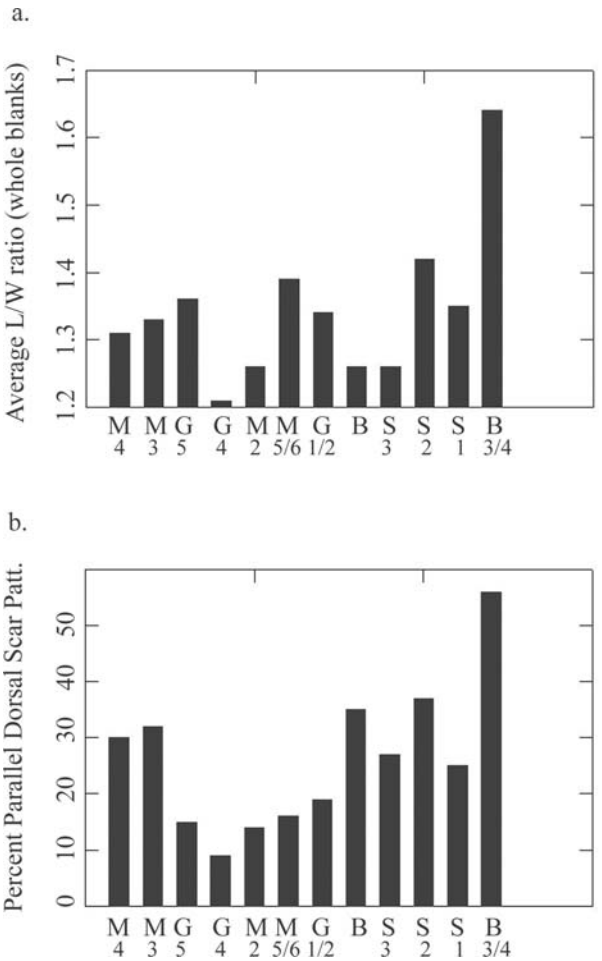

Figure 1. Technological trends in Latium Middle Paleolithic. Bars indicate: a. average length/width ratios of retouched pieces; b. percent blanks with parallel, longitudinal dorsal scar patterns. Age decreases from left to right. Key to assemblage designations: M = Grotta dei Moscerini; G = Grotta Guattari; S = Grotta di Sant'Agostino; B = Grotta Breuil.

a decreasing emphasis on centripetal Levallois and bipolar technology through time (Kuhn 1995a). In contrast, at Riparo Mochi the highest levels of laminarity occur in the lower part of the sequence: over time there is a shift away from heavy reliance on unidirectional Levallois technology to almost exclusive use of discoid technology at the top of the Mousterian sequence (Figure 2a, 2b). It is not clear whether the comparatively low frequencies of blades and parallel scar patterns in the earliest levels (cuts 72-68) are genuine or an artifact of very small sample sizes.

Interestingly, parallels can be found for both of these trends in other Italian sites. There is a general (though not universal) tendency for discoid core technology to dominate late Mousterian assemblages, particularly in northern Italy (Kuhn

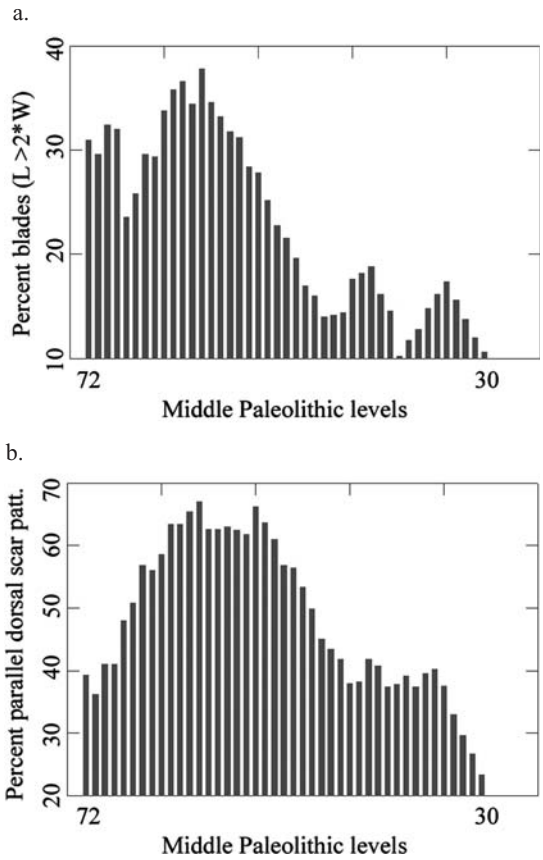

Figure 2. Technological trends in Middle Paleolithic of Riparo Mochi. Bars indicate running averages over ranges of five arbitrary 10 cm levels for : a. proportion technical blades (length > 2*width); and, b. proportion blanks with parallel longitudinal dorsal scar patterns. Depth increases from right to left.

and Bietti 2000; Peresani 1995–96). On the other hand, a few so-called "terminal Mousterian" assemblages from outside the Pontinian area, such as the one from the open-air site of San Francesco in Liguria (Tavoso 1988) are distinctively laminar in their blank production.

It is also important to point out that the trends in laminarity in both study areas seem to represent shifts in the frequency of different technological elements, not the appearance of entirely new forms of technology. There is evidence that many if not all of the basic manufacture strategies were present throughout both Middle Paleolithic sequences. Discoid reduction is strongly represented throughout the Mochi sequence, even in the earliest layers with the highest incidence of blades and parallel dorsal scar patterns. Likewise, something akin to centripetal recurrent Levallois method is found in all of the assemblages from Latium, even the

most recent. In other words, the observed trajectories of change represent shifting emphases within a set of alternatives rather than the introduction of entirely new sets of technological procedures.

It is clear that trends in laminarity in Latium and Liguria differ in direction. They also differ in their relationship with the succeeding Upper Paleolithic. Interestingly, however, in neither region does the early Upper Paleolithic seem to represent a further extension of trends that began in the Middle Paleolithic, at least in this feature of lithic technology. In Latium, the earliest Upper Paleolithic (from Fossellone and Grotta Barbara), which is not in fact very early, has a relatively low frequency of blades, especially in that portion of the assemblages manufactured using the local pebble raw materials. In fact, blanks from Fossellone are somewhat less elongate on average than the more recent Mousterian assemblages (Figure 3a). So although the frequency of blades increases over time in the Mousterian of Latium, it does not continue to do so in the Aurignacian. At Riparo Mochi,

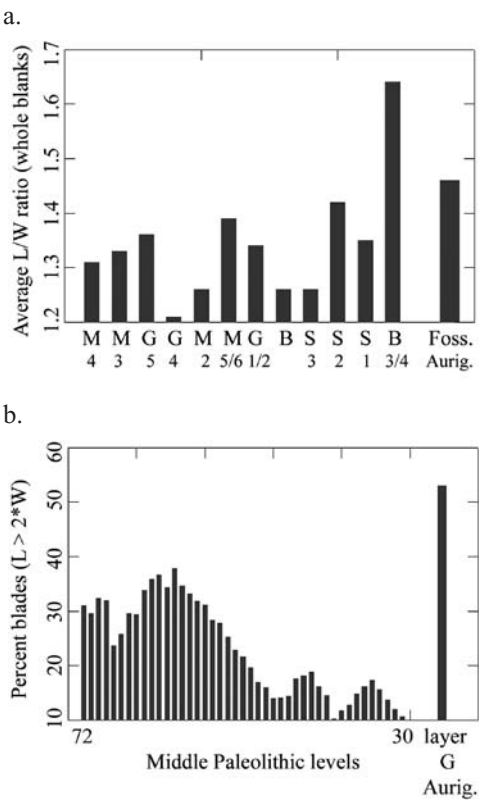

Figure 3. Middle Paleolithic technological trends compared with early Upper Paleolithic: a. average length/width ratios of retouched pieces from Latium Mousterian sites and Aurignacian of Riparo Salvini; b. a. proportion technical blades (length > 2*width) in Mousterian and "proto-Aurignacian" of Riparo Mochi.

there is an abrupt and pronounced reversal of the Mousterian trend away from laminarity with the earliest Upper Paleolithic. The industry of layer G, classified as "proto-Aurignacian", is typified by high frequencies of retouched bladelets and blade blanks (Figure 3b).

DISCUSSION AND CONCLUSION

Compared to later time periods, the Middle Paleolithic does appear to be an interval of relative stasis, at least with respect to the generation of novel forms of technological behavior. However, the Neandertals and their contemporaries were not locked into a single way of doing things. Given the range of habitats and climates they inhabited, Middle Paleolithic hominids must have been highly flexible. That flexibility seems to have been manifest mainly though redeploying and recombining a limited range of technological options, and not as the development of entirely new technological solutions. Moreover, as this paper and many others in the current volume demonstrate, many sites and regional sequences do in fact show evidence for sustained, directional trends in technology and perhaps in foraging as well. However, as is the case in Italy, the trajectories of technological change seem to vary from region to region, and even from site to site. Moreover they do not necessarily lead towards classical Upper Paleolithic patterns. The general trend in Latium is towards a pattern of blank production that is similar to Upper Paleolithic prismatic blade technology in its general features, though quite different in its specifics. At Riparo Mochi, the trend is for a greater emphasis over time on typically Middle Paleolithic technological options. Yet no one would suggest that Neandertals in Latium were on the road toward the Upper Paleolithic whereas the occupants of Riparo Mochi were only becoming more "Mousterian" over time.

The inconsistent directions of local trajectories of change do not necessarily mean that Neandertals and their contemporaries were simply taking a random walk through the Upper Pleistocene. Instead we are probably seeing a trend towards increasing regional diversity in the Middle Paleolithic over the course of the Upper Pleistocene, behavioral differentiation in response to specific ecological, demographic and social conditions. The trends documented here and elsewhere probably represent responses to localized environmental and demographic conditions, within constraints imposed by raw materials as well as the technological knowledge base of local populations. In Latium, the changes in technology seem to be linked to shifts in land-use at a regional scale. The increasing emphasis over time on relatively efficient methods for producing laminar blanks is accompanied by declining levels of scraper reduction and lower retouch frequencies, as well as by evidence for increasing provisioning of sites with hunted game. These results are interpreted as reflecting an overall increase in the duration of individual site occupation events and concomitantly lower levels of residential mobility, responses to changes in the terrestrial habitat brought on by declining sea levels (see Stiner and Kuhn 1992; Stiner 1994; Kuhn 1995a). At Riparo Mochi we currently lack

independent evidence from faunal remains or other sources in the Middle Paleolithic layers that might help to reconstruct activities. I suspect the patterns observed in the Mochi sequence reflect very local changes in how Mousterian hominids used this particular shelter, which is part of an extensive complex of caves and shelters in the surrounding Balzi Rossi. However, the fact that late Mousterian assemblages in the northern Mediterranean are often dominated by discoid reduction suggests that there may be a larger, regional trend as well.

Of course, there are many other elements of behavior that we could measure and compare across regions over the course of the Upper Pleistocene, and we should also expect to see different kinds of trends, played out at different spatial scales, when looking at different variables. For example, frequencies of retouched pieces and the intensity of retouch/reduction both decline over time in ***both*** Riparo Mochi and the Latium caves. This could indicate broadly similar trends in patterns of site use, though much more research would be needed to test such an hypothesis. Long-term tendencies in large game acquisition may show greater local and regional diversity over this same interval simply because these are so closely conditioned by the abundance of game animals (Grayson and Delpech 1998; Grayson *et al.* 2001; Stiner 2002). Even so, some very broadly expressed trends in things such as patterns of small game exploitation (*e.g.*, Stiner *et al.* 2000; Stiner 2002) may express the influence of more global ecological and demographic factors.

If this and the other contributions to the present volume share a single general theme, it is that the changes associated with the transition from Middle to Upper Paleolithic in Eurasia do not necessarily represent a shift from one stable state to another. Both the Middle and the Upper Paleolithic are dynamic and variable, although the dynamism may be expressed at different temporal and spatial scales and in different domains of behavior. Another theme that develops out of the results presented here, as well as of those discussed in other papers, is that the Mousterian could change without necessarily becoming the Upper Paleolithic.

This second notion is rather more difficult to reconcile with common perceptions of the long-term evolution of Paleolithic cultures. Prevailing views of cultural evolution tend to be "accretive" and progressive. Earlier culture complexes are treated as incomplete or impoverished versions of later ones, lacking certain key characteristics, the addition of which mark major transitions in cultural evolution. The history of human cultural achievement can be represented as a single time line, punctuated by major innovations or thresholds in human culture. Change ("progress") in the Middle Paleolithic is thus measured in terms of its distance from the Upper Paleolithic and "modern human behavior". Such a view is almost certainly a legacy of early culture evolutionist thinking, and it diverges radically from modern notions of evolution as a historically contingent process based on random production and subsequent reduction of novelty. Moreover, it does little to help us understand such variation and change as existed within the earlier phases of human cultural evolution.

The concept of fitness landscapes may be more useful in understanding the dynamism of the Middle Paleolithic. The term was originally coined by Wright (1932) and has been much elaborated over the intervening 70 years (*e.g.*, Perelson

and Kaufman 1991). A fitness landscape is a theoretical topographic construct describing the influence of a range of different factors on the fitness of a population of organisms. High points on the landscape represent adaptive configurations of relatively greater fitness, whereas topographic low points represent areas of reduced fitness. In a simple fitness landscape, all factors converge to create a single Mt. Fuji-like peak, a single behavioral and/or physical phenotype that provides a near-optimal adaptive solution to a wide range of environmental problems. Organisms that can maintain higher levels of fitness will be evolutionarily successful, so selection will tend to drive populations toward the single peak from anywhere in the simple fitness landscape.

A more interesting, and probably more widely applicable construct is the rugged fitness landscape (*e.g.*, Palmer 1991). Rugged fitness landscapes are characterized by many fitness peaks of varying heights (local sub-optima) separated by "valleys" representing adaptive states of lower fitness. Selection will still drive populations towards adaptive configurations that result in higher levels of fitness, but on a rugged landscape the populations will tend to climb the peak closest to their starting position. This may or may not be the highest peak on the landscape. However, once a population has begun to ascend a particular fitness peak it is very difficult for it to shift to another, even one that provides greater maximum fitness, because shifting between peaks necessarily involves a reduction in fitness, something that evolutionary processes do not generally promote. Fortunately for the denizens of rugged fitness landscapes, severe environmental or demographic perturbations may serve to dislodge a population from its current sub-optimal fitness peak, providing at least the opportunity for it to begin climbing an even higher one that happens to be accessible.

The notion of rugged fitness landscapes may help us understand how on one hand the Mousterian could have been changeable and dynamic, yet on the other how it seems to show so few consistent trends in the direction of the subsequent Upper Paleolithic. If we conceive of the fitness landscape inhabited by Upper Pleistocene hominids as consisting of a single, Fuji-like peak, then the fact that few if any Middle Paleolithic populations successfully climbed to the level of the Upper Paleolithic would have to mean that they were simply incapable of changing, and that nothing much really happened in Eurasia between 250,000 and 40,000 years ago. If, on the other hand, we imagine a very rugged fitness landscape, with many peaks and troughs, then the evidence makes more sense. Middle Paleolithic populations were in fact evolving behaviorally, their fitness was increasing locally, but as it happens they happened to be ascending a peak (or more likely several peaks) different from the one that anatomically modern Upper Paleolithic populations eventually climbed. In other words, the Middle Paleolithic was not just an unfinished version of the Upper: despite the historical course of the Middle-to-Upper Paleolithic transition, there were many different evolutionary trajectories that Mousterian populations could have followed, and in fact did follow. Ultimately, learning what happened to the hominids responsible for the Middle Paleolithic is much more than a matter of deciding whether they could or could not change, or where it was situated on the slopes of "Mt. Modernity".

It requires that we understand the particular local fitness peaks that particular Middle Paleolithic populations occupied, the evolutionary trajectories they might have been following, and the difficulty of making the transition from one peak or trajectory to another. This seems a daunting task, but as many of the contributions to this volume attest, we may already have a great deal more basic evidence than seems at first.

ACKNOWLEDGEMENTS

Research in Italy was supported by the L.S.B. Leakey Foundation, Fulbright Fellowship programs, and an N.S.F/NATO postdoctoral fellowship. I am grateful to my co-editor Erella Hovers and to the many participants in this symposium and volume for their insights and stimulating ideas.

REFERENCES CITED

Barham L. 2002. Systematic pigment use in the Middle Pleistocene of south-central Africa. *Current Anthropology* 43: 181–190.

Bar-Yosef O. 1998. The chronology of the Middle Paleolithic in the Levant. In T. Akazawa, K. Akoi and O. Bar-Yosef (Eds.), *Neandertals and Modern Humans in Western Asia*, pp. 39–56. New York: Plenum Press.

Bar-Yosef O. and S.L. Kuhn 1999. The big deal about blades: laminar technologies and human evolution. *American Anthropologist* 101: 322–338.

Blanc A.C. and A. Segre 1953. *Le Quaternaire du Mont Circé*. IV Congress INQUA, guide à l'excursion au mont Circé. Rome.

Bietti A. and S. Grimaldi 1995. Levallois debitage in central Italy: technical achievements and raw material procurement. In H.L. Dibble and O. Bar-Yosef (Eds.), *The Definition and Interpretation of Levallois Technology* (Monographs in World Prehistory 23), pp. 125–142. Madison: Prehistory Press.

Binford S. and L. Binford 1969. Stone tools and human behavior. *Scientific American* 220: 70–82.

Bordes F. 1961. Mousterian cultures in France. *Science* 134: 803–10.

Callow P. and J.M. Cornford 1986. *La Cotte de St. Brelade, Jersey: Excavations by C.B.M. McBurney, 1961–1978*. Norwich: Geo Books.

Gamble C. 1999. *The Paleolithic Societies of Europe*. New York: Cambridge University Press.

Garrod D.A.E. and D.M.A. Bate 1937. *The Stone Age of Mount Carmel*. Vol. 1. Oxford: Clarendon Press.

Grayson, D. and F. Delpech 1998. Changing diet breadth in the early Upper Palaeolithic of southwestern France. *Journal of Archaeological Science* 25: 1119–1129.

Grayson D., F. Delpech, J.-P. Rigaud and J. Simek 2001. Explaining the development of dietary dominance by a single ungulate taxon at Grotte XVI, Dordogne, France. *Journal of Archaeological Science* 28: 115–125.

Jelinek A. 1981. The Middle Paleolithic of the Levant from the perspective of Tabun cave. In J. Cauvin and P. Sanlaville (Eds.), *Préhistoire du Levant*, pp. 265–80. Paris: CNRS Editions.

Klein R. 1999. *The Human Career: Human Biological and Cultural Origins*. 2nd Edition. Chicago: University of Chicago Press.

Kuhn S.L. 1992. Blank form and reduction as determinants of Mousterian scraper morphology. *American Antiquity* 57: 115–28.

Kuhn S.L. 1995a. *Mousterian Lithic Technology: An Ecological Perspective*. Princeton: Princeton University Press.

Kuhn S.L. 1995b. A Perspective on Levallois from a "non-Levallois" assemblage: the Mousterian of Grotta di Sant'Agostino (Gaeta, Italy). In H.L. Dibble and O. Bar-Yosef (Eds.), *The Definition and Interpretation of Levallois Technology* (Monographs in World Prehistory 23), pp. 157–170. Madison: Prehistory Press.

Kuhn S.L. and A. Bietti 2000. The late Middle and early Upper Paleolithic in Italy. In O. Bar-Yosef and D. Pilbeam (Eds.), *The Geography of Neandertals and Modern Humans in Europe and the Greater Mediterranean*, pp. 49–76. Cambridge MA: Peabody Museum, Harvard University.

Kuhn S.L. and M.C. Stiner 1992. New Research on Riparo Mochi, Balzi Rossi (Liguria): Preliminary Results. *Quaternaria Nova* (Italy) 2: 77–90.

Kuhn S.L. and M.C. Stiner 1998a. Middle Paleolithic creativity: reflections on an oxymoron? In S. Mithen (Ed.), *Creativity in Human Evolution and Prehistory*, pp. 146–164. London: Routledge.

Kuhn S.L. and M.C. Stiner 1998b. The earliest Aurignacian of Riparo Mochi (Liguria, Italy). *Current Anthropology* 39 (supplement): S175–S189.

Laplace G. 1977. Il Riparo Mochi ai Balzi Rossi di Grimaldi (Fouilles 1938–1949): les industries leptolithiques. *Rivista di Scienze Preistoriche* 32: 3–131.

de Lumley H. 1969. *Le Paléolithique inférieur et moyen de midi Méditerranén dans son cadre geologique.* Gallia Préhistoire (Supplement 5). Paris: CNRS Editions.

Mellars P. 1970. The chronology of Mousterian industries in the Périgord region of south-west France. *Proceedings of the Prehistoric Society* 35: 134–170.

Mellars P. 1986. A new chronology for the Mousterian period. *Nature* 322: 410–411.

Mellars P. 1996. *The Neanderthal Legacy: An Archaeological Perspective from Western Europe.*, Princeton: Princeton University Press.

Mithen S. 1996. *The Prehistory of the Mind: A Search for the Origins of Art, Religion and Science*. London: Thames and Hudson.

Mussi M., 1990. Le peuplement de l'Italie a la fin du Paléolithique moyen et au début du Paléolithique supérieur. In C. Farizy (Ed.), *Paléolithique moyen récent et paléolithique supérieur ancien en Europe* (Mémoirs du Musée de Préhistoire d'Ille de France no. 3), pp. 251–262. Nemours: APRAIF.

Palma di Cesnola A. 1996. *Le Paléolithique inférieur et moyen en Italie*. Grenoble: Grenoble: Jérôme Millon.

Palmer R. 1991. Optimization on rugged fitness landscapes. In E. Perelson and S. Kaufman (Eds.), *Molecular Evolution on Rugged Fitness Landscapes*, pp. 3–25. Redwood City CA: Addison.

Perelson E. and S. Kaufman (Eds.) 1991. *Molecular Evolution on Rugged Fitness Landscapes*. Redwood City, CA: Addison: .

Peresani M. 1995–96. Sistemi tecnici di produzione litica nel Musteriano d'Italia. *Rivista di Scienze Preistoriche* 47: 79–167.

Rolland N. and H.L. Dibble 1990. A new synthesis of Mousterian variability. *American Antiquity* 55: 480–99.

Shea J.J. 1988. Spear points from the Middle Paleolithic of the Levant. *Journal of Field Archaeology* 15: 441–450.

Stiner M. 1994. *Honor among Thieves: Zooarchaeological Perspectives on Neandertal Foraging Ecology*., Princeton: Princeton University Press.

Stiner M. 2002. Carnivory, coevolution and the geographic spread of the genus *Homo*. *Journal of Archaeological Research* 10: 1–63.

Stiner M.C. and S.L. Kuhn 1992. Subsistence, technology, and aadaptive variation in the Middle Paleolithic. *American Anthropologist* 94: 306–39.

Stiner M.C., N. Munro and T. Surovell 2000. The tortoise and the hare: small game use, the broad spectrum revolution, and Paleolithic demography. *Current Anthropology* 41: 39–73.

Tavoso A. 1988. L'outillage du gisment de San Francesco à San Remo (Ligurie, Italie): nouvel examen. In J.K. Kozlowski (Ed.), *L'Homme de Neanderthal: La Mutation* (ERAUL 35), pp. 193–210. Liège: Université de Liège.

Wright S. 1932. The roles of mutation, inbreeding, crossbreeding and selection in evolution. *Proceedings of the 6th International Congress on Genetics* 1: 356–366.