

## A New Cultural Frontier for the Last Neanderthals: The Uluzzian in Northern Italy

Marco Peresani

Department of Biology and Evolution, Section of Palaeobiology, Prehistory and Anthropology, University of Ferrara, Corso Ercole I d'Este 32, I-44100 Ferrara, Italy (marco.peresani@unife.it). 21 III 08

### CA+ Online-Only Material: Supplement A

The Middle–Upper Paleolithic shift was a crucial event intimately involved in Neanderthal biogeography and the patchy scenario that emerges from the last marked cultural and behavioral evolution our extinct relatives underwent during the interval 50–30 k.yr. BP. In Mediterranean Europe, this behavior, considered modern, gave rise to the Uluzzian, a cultural complex confined to central-southern Italy and Greece as a consequence of the supposed retreat of archaic humans in the face of the rapid diffusion of *Homo sapiens*. The recent discovery of dwelling structures and lithic implements at Fumane Cave in northeastern Italy redraws this scenario and depicts at 33.4 k.yr. BP the northernmost frontier to which the Uluzzian spread around the Great Adriatic Plain, a pivotal region near the western edge of the Middle Danube basin, where the last Neanderthals were using very different cultural items.

The northern coastal belt of the Mediterranean Sea is recognized that one of the key areas for reconstructing the history of the Middle–Upper Paleolithic shift and the dispersal of modern humans in Europe from the easternmost regions (Mellars 1992, 2004; Bar-Yosef 2000, 2006; Kozłowski and Otte 2000; Stringer 2002). This crucial biocultural threshold involved a set of processes concerned with the biogeography of the last Neanderthals and the rapid spread of the proto-Aurignacian and Aurignacian, giving rise to a patchy scenario in which some complexes or specific assemblages document the last marked cultural evolution of our extinct relatives during the interval 50–30 k.yr. BP. During this period, behaviors that are considered modern arose and flourished in regional Mousterian entities. One of the most intriguing categories of evidence is the geographical distribution of some of these complexes, which in Mediterranean Europe are confined to peninsulas such as Italy, where Neanderthals may have invented the Uluzzian culture (Palma di Cesnola 1989). Recovered in several caves and open-air sites in central-southern Italy, Uluzzian implements or something comparable have

also been found in the Peloponnese at Klisoura Cave (Koumouzelis et al. 2001). The constrained geography of Italy, with well-defined routes of movement and communication and a more or less isolated southern extremity, makes the peninsula an ideal place to examine hypothetical migrations, refugia, and other forms of population interactions in the Late Pleistocene. During the last glacial period, the most open routes of faunal and human movement would have been to the east, around the Great Adriatic Plain, which emerged as a result of an 80-m drop in sea level.

The Uluzzian culture is documented at several open sites and in the sedimentary sequences of the Uluzzo Bay caves (Grotta del Cavallo, Grotta Bernardini, Grotta-Riparo di Uluzzo) in southern Apulia and the Cala and Castelcivita caves in Campania, where it systematically overlies the last Mousterian layers, separated from it by a discontinuity, or sterile level, that proves the absence of stratigraphic alternations between the two cultural sequences. The relationship of the Uluzzian to its remains is extremely weak and is based on two deciduous teeth found at Grotta del Cavallo (Palma di Cesnola 1989). For the most part, Uluzzian assemblages have been assigned a chronological position based on either broad paleoclimatic indicators or typological affinities with the different phases described for the reference sequence of Grotta del Cavallo. Numerical ages are available only from Grotta del Cavallo and Castelcivita, where the Uluzzian upper chronological boundary is in stratigraphic continuity; at the first site, layer Ei-ii produced a single radiocarbon determination of >31 k.yr. BP (Palma di Cesnola 1989); at Castelcivita, a handful of dates frame the Uluzzian between 33.5 and 32.5 k.yr. BP (Gambassini 1997). These measurements contrast with the first appearance of the proto-Aurignacian (a proxy for anatomically modern humans) at 37–35 k.yr. BP in northern Italy (Broglia 1996), a penetration by the bearers of this complex onto the peninsula that was slowed by existing populations that were firmly entrenched from Tuscany to Apulia and were using Mousterian and Uluzzian technologies (Kuhn and Bietti 2000). These criteria suggest that the technocomplexes were contemporaneous and that the Aurignacians spread over the peninsula at 33–32 k.yr. BP as a result of the penetration beyond a river frontier that was presumably coincident with the Po (Kuhn and Bietti 2000; Mussi 2001). Delayed colonizations by modern humans might have been induced by climatic and ecological factors, as in large zones of the Iberian Peninsula at the beginning of Heinrich Event 4 (Zilhão 2000; D'Errico and Sánchez-Goni 2003; Sepulchre 2007).

Various cultural evidence later than the Mousterian complexes suggests that Uluzzians were in a process of modernization, as indicated by larger lithic tool sets containing new implements and also by early production of bone items and the use of pierced mollusc shells (Palma di Cesnola 1989; Gambassini 1997). Uluzzian lithic technology is characterized mostly by unidirectional or bidirectional flake production

(Palma di Cesnola 1989) and multidirectional, polyhedral, and discoidal cores. Blades and bladelets were produced as well; not standardized, these products are short, sometimes covered by cortex. Tools include burins, end scrapers, side scrapers and denticulates, steeply retouched tools, and splintered pieces. Other implements with curved or arched backs are unusual in this context. Splintered pieces are prevalent in some assemblages and not in others and were used as intermediate objects to produce slits and to split bones and antlers. Bone perforators made on atrophic metapodials have been recovered at Grotta La Fabbriaca and Grotta del Cavallo caves (Pitti and Tozzi 1971; Palma di Cesnola 1989). Cylindrical bone points with fractured bases have been interpreted as rough throwing spears (Palma di Cesnola 1989). Perforated marine shells, ochre, and limonite fragments complete the cultural record. Taking the Grotta del Cavallo sequence as a reference, the Uluzzian has been divided into lower, middle, and upper periods of typological variability: semi-retouched scrapers and denticulates are in the lower period, backed pieces and splintered pieces are in the middle, and Aurignacian-type products (see Gioia 1990) are in the upper. From typological indexes, Palma di Cesnola (1989) argued that different facies can be identified in caves and open sites. Stratigraphic sequences show the Uluzzian possibly developed out of some variety of late Denticulate Mousterian (Palma di Cesnola 1989).

Although some authors produced a generalized description of the Uluzzian, many assemblages, including some from key stratified sites (Grotta La Fabbriaca, Castelcivita), simply do not fit well with the Grotta del Cavallo type of sequence (Kuhn and Bietti 2000). The ambiguity of what exactly constitutes this technocomplex is exacerbated by the fact that most of the collections were recovered at the surface from unstratified sites that had been subjected to mixing and perturbation. Data on the chronology, diffusion and land-use patterns, lithic economy, technology, and tool function are thus unavailable or remain unstudied. In particular, chronology and regional diffusion are two targets of crucial importance for depicting where the cultural frontier was positioned during oxygen isotope stage 3 (Broglia 1996; Kuhn and Bietti 2000; Mussi 2001; Peresani 2006) and how it shifted in relation to the supposed rapid spread of the Aurignacian along the Mediterranean coastal belt and around the Great Adriatic Plain. Whereas the Italian and Greek stratigraphic evidence demonstrates that the Uluzzian systematically precedes the Aurignacian, radiocarbon data sets are still insufficient and, moreover, may be affected by problems encountered for this specific time interval (limits of the method, contamination, cosmogenic events, calibration) that have been noted by various workers (Voelker et al. 2000; Muscheler et al. 2005; Giaccio et al. 2006; Huguen et al. 2006). So, if we accept the evidence that the Uluzzian extends to the southeasternmost Balkan region, new challenges may arise in investigations of its origin and diffusion routes in the central Mediterranean Europe.

Uluzzian geographic isolation from the western regions is

proven by its absence in Liguria, Provence, and the Rhône Valley, where a patchy scenario with late Mousterian, "Nèronien," and proto-Aurignacian assemblages covers the time interval in question (Palma di Cesnola 1989; Slimak 2007). Conversely, looking east, affinities with some implements from eastern Europe indicate less isolation (Palma di Cesnola 1996; Gambassini 1997). The recent discovery of remains of human occupation embedded between the local final Mousterian and the proto-Aurignacian layers at Fumane Cave in northeastern Italy may open new perspectives for reconstructing the dynamics of the late Middle Paleolithic–early Upper Paleolithic biocultural shift in the Northern Adriatic (fig. 1), a geographically and biologically privileged region during the Late Pleistocene. Closed by the Alpine chain to the north and the displaced Adriatic coast, this area was a corridor along which faunal migration waves (Sala and Marchetti 2006) from the easternmost European regions occurred and possibly in which humans were driven during that period.

### The Uluzzian at Fumane Cave

Fumane Cave lies on the southern fringe of the Venetian Pre-Alps at an altitude of 350 m between the low alluvial plains and the summit of the Monti Lessini plateau. This site belongs to a fossil complex karst system that is probably Tertiary in age and comprises several cavities that variably contributed to the formation of a sedimentary succession over 10 m thick. Explored since 1988, this conspicuous cave-fill includes tens of Middle and Upper Paleolithic levels with well-preserved Mousterian and Aurignacian paleo-living floors and traces of



Figure 1. Sketch map showing the position of the most relevant Uluzzian sites in the Italian Peninsula (2, La Fabbriaca; 3, Castelcivita; 4, La Cala; 5, Grotta Bernardini, Grotta di Uluzzo, and Grotta del Cavallo) and in Greece (6, Klisoura Cave) and the extreme northernmost evidence at Fumane Cave (1), positioned less than 300 km from the different cultural association found at Vindija (7) in Croatia.

Gravettian incursions (fig. 2). Its cultural and paleoenvironmental succession is recorded from four main macro-units (S, BR, A, D) with distinct lithological composition, pedological features, and dense archaeological remains that document the main climatic events of the last glacial cycle, from the Early Weichselian to the second half of the Middle Weichselian, and the influence those events exerted on pedosedimentary processes and human settlement (Cremaschi et al. 2005; Peresani et al. n.d.). Final Mousterian to Aurignacian occurrences are recorded in macro-unit A, a set of densely spaced and horizontal layers labeled A13 to A1 and made up of residual sands disturbed by frost heaving (A13–A12), frost-shattered breccia, and aeolian loamy matrix (A11–A1) with variable amounts of organic matter and locally affected by faunal bioturbation. Mousterian flint implements have been recovered in units A11, A10, A9, A8, A6, A5, Uluzzian implements were in units A4 and A3, and proto-Aurignacian implements were in units A2 and A1.

The final Mousterian levels are commonly characterized by lithic and faunal remains densely scattered on the ground, as in units A11, A10, A6, and A5. The presence of macromammals and hunted ungulates from units A12 to A4 indicates moist-cool climatic phases that expanded forests, which then extended over alpine grasslands. Nevertheless, *Capra ibex*,

*Rupicapra rupicapra*, and *Marmota marmota* and the birds *Pyrrhocorax graculus* and *Lagopus mutus* indicate the cave was in the proximity of an open alpine environment. In the A11 and A10 units, Cervidae progressively increased while Capridae declined, revealing a moist-temperate climatic shift and forest expansion. Despite a certain tendency toward cooler conditions observable toward the top sequence (A2, A1), the situation seems to have been fairly stable until layer A3. Flints were locally obtained and exploited by means of Levallois technology in the A11, A10, A6, A5, and A4 units and by means of discoid technology in A9 and A8 (Broglia et al. 2003; Lemorini et al. 2003). Dwelling structures, lithic assemblages, bone and antler tools, painted stones, and pierced mollusc shells occur in unit A2, in coincidence with the arrival of the first Aurignacians in this region and marking a clear discontinuity with the preceding cultural entities (Broglia and Gurioli 2004; Broglia et al. 2005, 2006).

The A3 and A4 layers consist mostly of frost-shattered slabs with variable sand content and aeolian dust that becomes more prevalent toward the outermost part of the cave. Excavation took place at different times from 1989 on and at varying distances beyond the present-day drip line and in the cave mouth, and even more extensive explorations were made in the past two years in a 20 m<sup>2</sup> area at the left of the cave

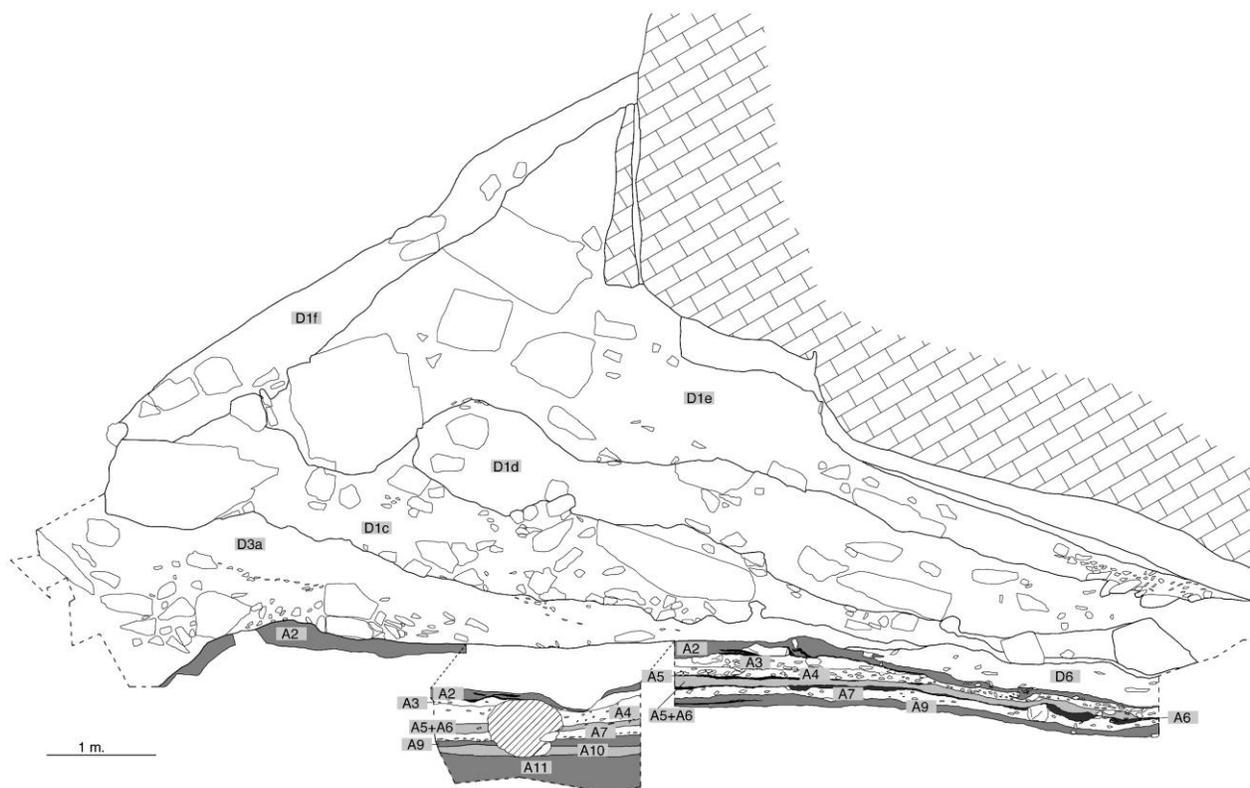


Figure 2. The stratigraphic layout at Fumane Cave viewed on the sagittal section with the A3 and A4 units over the final Mousterian sequence and buried by the Aurignacian layer A2.

mouth. Dwelling structures with hearths and a toss zone (i.e., a concentration of discarded, knapped by-products, charcoals, and a few bones) have been brought to light; flakes and bones have also been found scattered on the soil and in proximity to the combustion structures (see CA+ online supplement A). Suspected during the first exploration more than ten years ago (Bartolomei et al. 1992), a clear differentiation in lithic technological and typological features of layers A4 and A3 has been observed between the late Mousterian (A6, A5) and the directly overlying Aurignacian levels A2 and A1, and it is characterized mostly by formal blade and bladelet production, with typical retouched tools. Specifically, levels A3 and A4 contain about 300 and 500 lithic implements, respectively. A few blade and bladelet cores, flakes, and flake-cores reduced by means of direct hammer and stone percussion have been found associated with certain tools that can be framed in an Uluzzian-type association, such as backed knives, backed lunates, and one end scraper. Splintered pieces are also present (fig. 3); their interpretation as chisel-like tools or cores for the production of splinters needs functional analysis. Flint nodules and rough cobbles came provisioned mostly from the local stream and were exhaustively exploited at the site, although some cobbles or large flake-cores were introduced from more distant sources. A persistence of Mousterian technological tradition is recorded in the lowermost A4 level from Levallois flakes and cores produced using the recurrent method and shown in the shapes of side scrapers, points, and pieces thinned on the ventral face. Conjoinable flakes and

cores scattered on the A3 surface point to a certain variability in lithic production. There was no evidence of Levallois technology; large flakes were detached from flat cores, short thick flakes from core flakes, short thick blades from unidirectional cores, and large thin bladelets and flake bladelets from simple single-strike platform cores. Selected high-quality flint was specifically exploited to make these latter products. Although innovations were limited, possible further shifts in other behavioral aspects involving lithic economy, the bone industry, and fuel provisioning cannot be ruled out. Current field evidence suggests the cave was used for short-term purposes involving knapping of a limited number of flint cobbles and processing of some prey, mostly ibex and red deer. In contrast to the underlying Mousterian units, Uluzzian layers seem to record a weakening of human presence or a change in the mobility of groups. New radiometric dates, analyses, and investigations focusing on site organization, hunting, lithic technology, and tool function are in progress. Radiocarbon chronology provides three dates for level A4 (OxA-8021:  $33,300 \pm 400$  yr BP; OxA-6462:  $33,150 \pm 600$  yr BP; LTL566A:  $33,700 \pm 350$  yr BP). Despite this chronometric consistency, most of both the Mousterian and Aurignacian dates largely overlap in the interval 40–30 k.yr. BP (Giaccio et al. 2006; Peresani et al. n.d.). However, the fine stratigraphic resolution demonstrates no clear evidence of contact, exchanges, or relations between the Mousterian, the Aurignacian, and the Uluzzian and no alternation among different cultural layers.

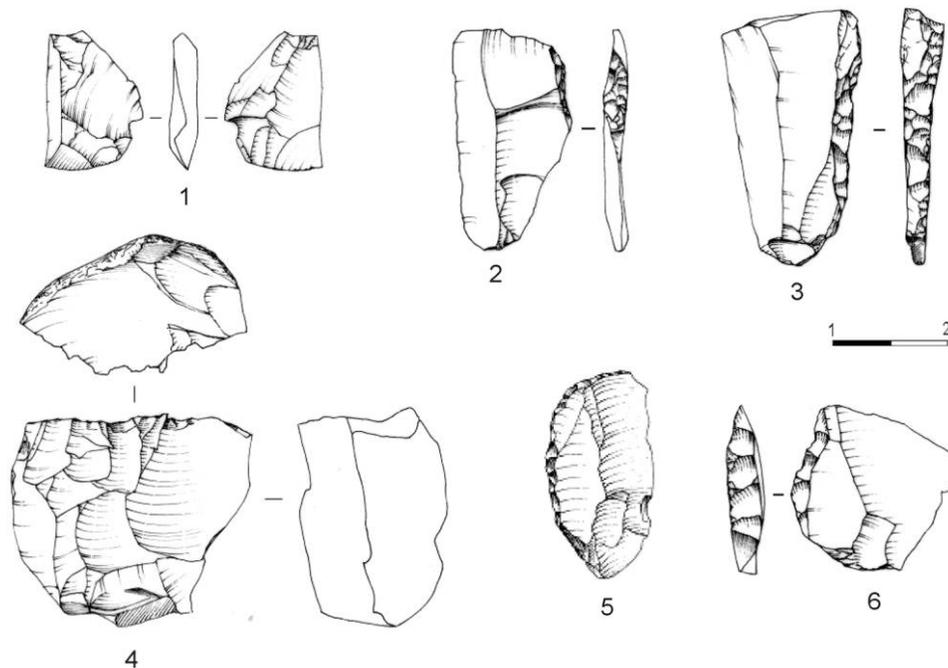


Figure 3. Uluzzian implements found in units A3 and A4: splintered piece (1), backed knives (2, 3, 6), implement with curved back (5), bladelet core (4) (drawings by S. Muratori and G. Almerigogna).

## A New Scenario around the Great Adriatic Plain

The Uluzzian at Fumane Cave is a very isolated case in the cultural scenario at the end of Neanderthal life in the North Adriatic area. Besides Fumane Cave, where evidence suggests frequent and abrupt changes in lithic technology as well as new solutions in space utilization, dwelling structures, and combustion areas, sites in the same Italian region bear witness to a certain dynamism, and more high-resolution data are needed to correlate these different situations (Peresani, n.d.). Radiocarbon chronology at the Castelcivita key site is strictly consistent with the Fumane Cave data set, and it records the first Uluzzian appearance at 34–33 k.yr. BP in both southern and northern Italy (Gambassini 1997), two regions where the persistence of some technological traditions typical of Mousterian times seems gradually to decrease along the Uluzzian sequence. Conversely, the presence of similar Uluzzian items at the extreme south of the Balkan peninsula offers an explanation for the absence of the Uluzzian in the large area that extends from the Peloponnese and the northern Adriatic. Limited site visibility, the state of research, and density of the human population may be some of the factors that should be taken into account. In contrast to the the North Italian site, no Mousterian industry in Slovenia and Croatia recorded in the interval 40–30 k.yr. BP contains items similar to those found in the A3 and A4 levels of Fumane Cave. Specifically in Croatia, late Mousterian non-Levallois industries with denticulated and notched tools have been found at a few sites on the Dalmatian coast and in Croatian Zagorje. At Vindija, layer G1 presents an assortment of Mousterian tools (denticulates, scrapers), one bifacial point, and Upper Paleolithic types of stone tools (end scrapers, dihedral burins, retouched blades; Karavanić 1995). Furthermore, a chronological correlation with Fumane Cave is provided by the revised direct radiocarbon dates obtained on human remains from the G1 layer, which is proof that Neanderthals were present in that region until 33–32 (and possibly earlier) k.yr. BP (Higham et al. 2006) and that they used other types of tools (although this is debated by scholars; see Karavanić and Smith 1998, 2000). Janković and colleagues (2006) argue that the association of late Neanderthal remains with one split-base bone point and three massive-base bone points (Mladeč type; Karavanić and Smith 1998) was not due to artificial mixing of specimens from different strata (Kozłowski 1996; Zilhão and d'Errico 1999) but rather that these artifacts were produced by the Neanderthals as a consequence of contacts with modern humans who were already present in the Balkans 35 k.yr. BP (Soficaru et al. 2006; Trinkaus et al. 2006). In any case, technological and typological features of the lithic assemblage from layer G1 rooted in the Mousterian tradition are represented in layer G3, although the single bifacial point made from nonlocal radiolarite is similar to Szeletian implements (Svoboda 2006). The whole remains markedly different from the A4 and A3 Fumane Cave assemblages. Farther east in the Balkans, reexamination of Aurignacoid industries shows that

they are clearly distinct from the Aurignacian and probably have to be included in a broad spectrum that includes a combination of Middle Paleolithic Levallois technology and the emergence of Upper Paleolithic tool sets coinciding with modifications in economic behavior (Teyssandier 2006). To this end, investigations in progress on the Fumane Cave record and on settlement dynamics in this pivotal region will help determine the timing and the modalities with which the Middle Paleolithic–Upper Paleolithic biocultural scenario unfolded and its relations with developments in the surrounding regions.

## Acknowledgments

Research at Fumane Cave is managed by the University of Ferrara and University of Milano I in a long-term project supported by the Soprintendenza per i Beni Archeologici del Veneto, the Venetian Region, Cassa di Risparmio, the Verona Foundation, Comunità Montana della Lessinia, and the Comune di Fumane. I am very grateful to the seven anonymous reviewers for comments and suggestions.

## References Cited

- Bar-Yosef, O. 2000. The Middle and early Upper Paleolithic in southwest Asia and neighboring regions. In *The geography of Neanderthals and modern humans in Europe and the greater Mediterranean*, ed. O. Bar-Yosef and D. Pilbeam, 107–56. Cambridge: Harvard University Peabody Museum Bulletin 8.
- . 2006. Neanderthals and modern humans: A different interpretation. In *When Neanderthals and modern humans met*, ed. N. Conard, 467–82. Tübingen: Kerns.
- Bartolomei, G., A. Broglio, P. Cassoli, L. Castelletti, M. Cremaschi, G. Giacobini, G. Malerba, et al. 1992. La Grotte-Abri de Fumane: Un site Aurignacien au sud des Alps. *Preistoria Alpina* 28:131–79.
- Broglio, A. 1996. The appearance of modern humans in Europe: The archaeological evidence from the Mediterranean regions. In *The origin of modern man*, ed. M. Piperno, O. Bar-Yosef, and L. L. Cavalli-Sforza, 237–49. Forlì: ABACO.
- Broglio, A., and F. Gurioli. 2004. Le comportement symbolique des premiers hommes modernes: Les données de la Grotte de Fumane (Pré-Alpes Vénitiennes). In *La spiritualité*, ed. M. Otte, 97–102. Etudes et Recherches Archéologiques 106. Liège: Université de Liège.
- Broglio, A., S. Bertola, M. De Stefani, C. Lemorini, and P. Rossetti. 2005. La production lamellaire de l'Aurignacien ancien de la Grotte de Fumane. In *Production lamellaires attribuées à l'Aurignacien*, ed. F. Le Brun-Ricalens, 415–36. Luxembourg: Musée National d'Histoire et d'Art.
- Broglio, A., M. De Stefani, A. Tagliacozzo, F. Gurioli, and A. Facciolo. 2006. Aurignacian dwelling structures, hunting strategies, and seasonality in the Fumane Cave (Lessini Mountains). In *Kostenki and the early Upper Paleolithic of*

- Eurasia: General trends, local developments*, ed. S. A. Vasil'ev, V. V. Popov, M. V. Anikovich, N. D. Praslov, A. A. Sinitsyn, and J. F. Hoffecker, 263–68. Saint Petersburg: Nestor-Historia.
- Broglio, A., C. Lemorini, M. Peresani, and P. Rossetti. 2003. Modifications culturelles et comportementales entre Moustérien et Aurignacien au sud des Alpes. In *Changements biologiques et culturels en Europe de la fin du Paléolithique moyen au Néolithique*, ed. J. Brůžek, B. Vandermeersch, and M. D. Garralda, 39–59. Bordeaux: University Bordeaux I.
- Cremaschi, M., F. Ferraro, M. Peresani, and A. Tagliacozzo. 2005. Il sito: Nuovi contributi sulla stratigrafia, la cronologia, le faune a macromammiferi e le industrie del paleolitico antico. In *Pitture paleolitiche nelle Prealpi Venete: Grotta di Fumane e Riparo Dalmeri*, ed. A. Broglio and G. Dalmeri, 12–22. Memorie Museo Civico Storia Naturale Verona 9.
- d'Errico, F., and M. F. Sánchez-Goñi. 2003. Neanderthal extinction and the millennial scale climatic variability of OIS 3. *Quaternary Science Review* 22:769–88.
- Gambassini, P. 1997. *Il Paleolitico di Castelcivita: Culture e ambiente*. Napoli: Electa.
- Giaccio, B., I. Hajdas, M. Peresani, F. Fedele, and R. Isaia. 2006. The Campanian Ignimbrite (c. 40 ka BP) and its relevance for the timing of the Middle to Upper Palaeolithic shift: Timescales and regional correlations. In *When Neanderthals and modern humans met*, ed. N. Conard, 343–75. Tübingen: Kerns.
- Gioia, P. 1990. An aspect of the transition between Middle and Upper Palaeolithic in Italy: The Uluzzian. In *Paléolithique moyen récent et Paléolithique supérieur ancien en Europe*, ed. C. Farizy, 241–50. Mémoires Musée Préhistoire Ile de France, 3.
- Higham, T., C. Bronk Ramsey, I. Karavanić, F. H. Smith, and E. Trinkaus. 2006. Revised direct radiocarbon dating of the Vindija G<sub>1</sub> Upper Paleolithic Neandertals. *Proceedings of the National Academy of Sciences, U.S.A.* 103:553–57.
- Hughen, K. A., J. A. Southon, S. J. Lehman, C. J. H. Bertrand, and J. Turnbull. 2006. Marine-derived <sup>14</sup>C calibration and activity record for the past 50,000 years updated from the Cariaco Basin. *Quaternary Science Reviews* 25:3216–27.
- Karavanić, I. 1995. Upper Paleolithic occupation levels and late-occurring Neandertal at Vindija Cave (Croatia) in the context of central Europe and the Balkans. *Journal of Anthropological Research* 51:9–35.
- Karavanić, I., and F. H. Smith. 1998. The Middle/Upper Paleolithic interface and the relationship of Neandertals and early modern humans in the Hrvatsko Zagorje, Croatia. *Journal of Human Evolution* 34:223–48.
- . 2000. More on the Neanderthal problem. *Current Anthropology* 41:838–40.
- Koumouzelis, M., J. K. Kozłowski, C. Escutenaire, V. Sitaly, K. Sobczyk, H. Valladas, N. Tisnerat-Laborde, and P. Wojtal. 2001. La fin du Paléolithique moyen et le début du Paléolithique supérieur en Grèce: La séquence de la grotte 1 de Klissoura. *L'Anthropologie* 105:469–504.
- Kozłowski, J. K. 1996. Cultural context of the last Neandertals and early modern humans in central-eastern Europe. In *The origin of modern man*, ed. M. Piperno, O. Bar-Yosef, and L. L. Cavalli-Sforza, 205–18. Forli: ABACO.
- Kozłowski, J. K., and M. Otte. 2000. The formation of the Aurignacian in Europe. *Journal of Anthropological Research* 56:513–34.
- Kuhn, S. L., and A. Bietti. 2000. The late Middle and Early Upper Paleolithic in Italy. In *The geography of Neandertals and modern humans in Europe and the greater Mediterranean*, ed. O. Bar-Yosef and D. Pilbeam, 49–72. Harvard University Peabody Museum Bulletin 8.
- Janković, I., I. Karavanić, J. C. M. Ahern, D. Brajkovic, J. M. Lenardic, and F. H. Smith. 2006. Vindija Cave and the modern human peopling of Europe. *Collegium Antropologicum* 30/3:315–19.
- Lemorini, C., M. Peresani, P. Rossetti, G. Malerba, and G. Giacobini. 2003. Techno-morphological and use-wear functional analysis: An integrated approach to the study of a discoid industry. In *Discoid lithic technology: Advancements and implications*, ed. M. Peresani, 257–75. British Archaeological Reports International Series 1120.
- Mellars, P. A. 1992. Archaeology and the population-dispersal hypothesis of modern human origins in Europe. *Philosophical Transactions of the Royal Society B: Biological Sciences* 337:225–34.
- . 2004. Neanderthals and modern human colonization of Europe. *Nature* 432:461–65.
- Muscheler, R., J. Beer, P. W. Kubik, and H. A. Synal. 2005. Geomagnetic field intensity during the last 60,000 years based on <sup>10</sup>Be and <sup>36</sup>Cl from the summit ice cores and <sup>14</sup>C. *Quaternary Science Reviews* 24:1849–60.
- Mussi, M. 2001. *Earliest Italy*. New York: Kluwer Academic/Plenum.
- Palma di Cesnola, A. 1989. L'Uluzzien: Faciès italien du Léolithique archaïque. *L'Anthropologie* 93:783–812.
- Peresani, M. 2006. Cultures et traditions du Paléolithique supérieur dans les régions nord-méditerranéennes. In *La Cuenca Mediterránea durante el Paleolítico Superior (38.000–10.000 años)*, ed. J. M. Fullola y Pericot, J. L. Sanchidrián Torti, and A. M. Marquez, 345–61. Trabajos sobre la Cueva de Nerja 6.
- Peresani, M. n.d. At the end of Middle Palaeolithic in the Italian Alps: an overview on Neandertal land-use, subsistence and technology. In *Neandertal lifeways, subsistence and technology*, ed. N. Conard and J. Richter. Dordrecht: Springer.
- Peresani, M., M. Cremaschi, F. Ferraro, C. Falguères, J.-J. Bahain, G. Gruppioni, E. Sibilía, G. Quarta, L. Calcagnile, and J.-M. Dolo. n.d. Age of the final Middle Palaeolithic and Uluzzian levels at Fumane Cave, northern Italy, using <sup>14</sup>C, ESR, <sup>234</sup>U/<sup>230</sup>Th and thermoluminescence methods. *Journal of Archaeological Science*.

- Pitti, C., and C. Tozzi. 1971. La Grotta del Capriolo e la Buca della Iena presso Mommio (Camaiole-Lucca). *Rivista di Scienze Preistoriche* 26:213–58.
- Sala, B., and M. Marchetti. 2006. The Po Valley floodplain (northern Italy): A transitional area between two zoogeographical areas during the Late Neogene and Quaternary. *Courier Forschungsinstitut Senckenberg* 256:321–28.
- Sepulchre, P., G. Ramstein, M. Kageyama, M. Vanhaeren, G. Krinner, M. F. Sánchez-Goñi, and F. d'Errico. 2007. H4 abrupt event and late Neanderthal presence in Iberia. *Earth and Planetary Science Letters* 258:283–92.
- Slimak, L. 2007. Le Nèronien et la structure historique du basculement du Paléolithique moyen au Paléolithique supérieur en France méditerranéenne. *Comptes Rendus Palevol* 6:301–9.
- Soficaru, A., A. Dobos, and E. Trinkaus. 2006. Early modern humans from the Pestera Muierii, Baia de Fier, Romania. *Proceedings of the National Academy of Sciences, U.S.A.* 103: 17196–201.
- Stringer, C. 2002. Modern human origins: Progress and prospects. *Philosophical Transactions of the Royal Society B: Biological Sciences* 357:563–79.
- Svoboda, J. 2006. The Danubian gate to Europe: Pattern of chronology, settlement archaeology, and demography of Late Neandertals and early modern humans on the Middle Danube. In *When Neanderthals and modern humans met*, ed. N. Conard, 233–67. Tübingen: Kerns.
- Teyssandier, N. 2006. Questioning the first Aurignacian: Mono- or multi-cultural phenomenon during the formation of the Upper Paleolithic in Central Europe and the Balkans. *Anthropologie* 44/1:9–29.
- Trinkaus, E., J. Zilhão, H. Rougier, R. Rodrigo, S. Milota, M. Gherase, L. Sarcina, et al. 2006. The Pestera cu Oase and early modern humans in southeastern Europe. In *When Neanderthals and modern humans met*, ed. N. Conard, 145–64. Tübingen: Kerns.
- Voelker, A. H. L., P. M. Grootes, M. J. Nedeau, and M. Sarnthein. 2000. Radiocarbon levels in the Iceland Sea from 25–53 kyr and their link to the earth's magnetic field intensity. *Radiocarbon* 42:437–52.
- Zilhão, J. 2000. The Ebro frontier: A model for the late extinction of Iberian Neanderthals. In *Neanderthals on the edge: 150th anniversary conference of the Forbes' Quarry discovery*, ed. C. Stringer, R. N. E. Barton, and C. Finlayson, 111–21. Oxford: Oxbow Books.
- Zilhão, J., and F. d'Errico. 1999. The Neanderthal problem continued: Reply. *Current Anthropology* 40:355–64.