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An Early Case of Color Symbolism

Ochre Use by Modern Humans in Qafzeh Cave[1]

by Erella Hovers, Shimon Ilani, Ofer Bar-Yosef, and Bernard Vandermeersch

Prehistoric archaeology provides the temporal depth necessary for understanding the evolution of the unique human ability to construct and use complex symbol systems. The long-standing focus on language, a symbol system that does not leave direct evidence in the material record, has led to interpretations based on material proxies of this abstract behavior. The ambiguities resulting from this situation may be reduced by focusing on systems that use material objects as the carriers of their symbolic contents, such as color symbolism. Given the universality of some aspects of color symbolism in extant human societies, this article focuses on the 92,000-year-old ochre record from Qafzeh Cave terrace to examine whether the human capacity for symbolic behavior could have led to normative systems of symbolic culture as early as Middle Paleolithic times. Geochemical and petrographic analyses are used to test the hypothesis that ochre was selected and mined specifically for its color. Ochre is found to occur through time in association with other finds unrelated to mundane tasks. It is suggested that such associations fulfill the hierarchical relationships that are the essence of a symbolic referential framework and are consistent with the existence of symbolic culture. The implications of these findings for understanding the evolution of symbolic culture in the contexts of the African and Levantine prehistoric records are explored.

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For many researchers the ability to create arbitrary relationships between ideas and their referents—that is, to construct and use complex symbolic systems—is the defining characteristic of *Homo sapiens*. Biologists, cognitive scientists, and philosophers address questions about the origins and functions of these higher cognitive abilities. In this context, it is prehistoric archaeology that provides information about the time frames and temporal depth involved in these evolutionary processes. Thus archaeologists are constantly searching for early manifestations of symbolic behavior in the prehistoric record.

Language, considered the most complex symbol system used by *H. sapiens*, is often the focus of discussion in the various disciplines which aim to understand human symbolism. Unfortunately, the prehistoric record of nonliterate societies by definition cannot contain *direct* evidence for the existence of language, an abstract entity. In the absence of such evidence, archaeologists construct ever-broadening tiers of interpretation, attempting to recognize material *proxies* for language in the archaeological record and to infer from them the cognitive faculties that underlie them. Indeed, many of the debates in the recent archaeological literature on the evolution of modern behavior and symbolism stem from disagreements among researchers about such inferences.

There is a solution to this conundrum. Ethnographic evidence suggests that in many societies there exist symbolic networks in which material objects *are* the symbols. Among these, symbolic color systems are widespread and shared by many societies. If similar systems existed in the prehistoric past, it would make sense for archaeologists to identify and study them directly through their preserved material manifestations rather than speculating about the meanings of material objects for understanding the evolution of language.

A rich prehistoric record of pigment use indicates that red and black pigments are relatively ubiquitous in Paleolithic habitation and quarry sites, from the Plio/Pleistocene to Upper Paleolithic (Late Stone Age) times (Barham 1998; Bednarik 1992*b*; Bordes 1952; d'Errico and Soressi 2002; Henshilwood et al. 2001, 2002; Marshack

1. Excavations of the Mousterian deposits at Qafzeh Cave in the years 1965–73 and 1977–79 were sponsored by the French Ministry of Foreign Affairs. The petrographic, chemical, and mineralogical analyses reported in this study were carried out in the geochemical laboratories of the Geological Survey of Israel with the help of Y. Deutsch and O. Yoffee. Geological fieldwork was conducted with the help of E. Zilberman. The geological map of the Qafzeh area (in the electronic edition of this issue) and figure 9 were drawn by N. Sharagai and S. Hoyland. J. Skidel-Rhymer made the drawings of lithic artifacts, and the photographs were taken by G. Laron at the Institute of Archaeology. We thank A. Belfer-Cohen and J. Speth, as well as six diligent reviewers, for their comments and useful suggestions on previous drafts of this paper. [Supplementary materials appear in the electronic edition of this issue on the journal's web page (http://www.journals.uchicago/edu/CA/home.html).]

1981, 1989; McBrearty and Brooks 2000; Solecki 1982; Watts 1999; Wreschner 1983). There is an increase over time in the frequency of pigment occurrence in the prehistoric record, but although it occurs at different times in different regions, in general it can be placed in the context of the Middle Stone Age/Middle Paleolithic in Africa and in Europe, respectively. It is therefore within this time period that we look for indications of the use of pigments in a symbolic rather than a utilitarian context. In this paper we examine the ochre finds from the Middle Paleolithic deposits of Qafzeh Cave, Israel, and evaluate the possibility that their occurrence was related to the operation of a symbolic cultural system.

Humans today routinely engage in symbolic behavior. It is often a premeditated activity with symbols at its core (e.g., the playing of national anthems at formal receptions for heads of states). In more mundane contexts, encoded information about socioeconomic status may be emitted purposefully by one's fashion statements or unconsciously by one's table manners, whereas the poster of a rock star symbolizes her to people who have never met her. And yet, although symbolic behavior takes place all around us, understanding it is not simple because symbols themselves are not simple (Deacon 1997). In the examples just mentioned symbolic behavior occurs in a number of referential frameworks. To the degree that symbol systems reflect the logic of thought processes in the modern human mind (Peirce 1897 and 1903, as discussed by Deacon 1997), they incorporate three fundamental forms of referential associations: (1) *Icons* point to their referents by resembling them (as in the case of the rock star poster). (2) *Indices* are mediated by some redundant physical or temporal association between sign and object (the tag of an expensive designer on one's clothes is indexical of the amount of money one can afford to invest in clothing). (3) *Symbols* are mediated by arbitrary, formal, or agreed-upon links, irrespective of the physical characteristics of either the signifier or the signified (see also Chase 1991), as is the case with flags, national anthems, and team colors.

The following discussion revolves around symbols, the most complex of these referential associations, but it is important to recognize that they invariably rest on a foundation of icons and indices. Iconic reference is the default, basic, and irreducible referential form. At the other end of the scale, symbolic reference is based on the recognition that the relationship of a sign to an object is more than just a function of their co-occurrence (which would count only as an indexical relationship). Symbols refer to things in the world indirectly and by virtue of referring to other symbols. We recognize that there is an indexical relationship between the tag of an expensive designer and the amount of money invested in buying clothes made by him, and we make the additional reference that this relationship is itself indexical of sociological status and economic ability; the tag becomes a symbol of socioeconomic success. Symbolic reference stems from *combinatorial* possibilities and impossibilities. The referential powers of symbols are derived from their positions in an organized system of other symbols. These allow the recognition of higher-order regularities, which in turn enable symbolic predictions. This process facilitates the construction (learning) of symbols and their deconstruction and use (interpreting them and thus communicating through them).

Of all the symbolic behaviors in which *H. sapiens* engages, language is judged the most complex and considered a unique trait of the species (e.g., Deacon 1997). Because it is an adaptation that confers enormous advantages on its bearers, its antiquity and the paleobiological and archaeological evidence that may indicate its existence have been the focus of intense research. The origins of language have been placed as early as 2 million years ago (Deacon 1989, 1990, 1997) and as late as the Late Pleistocene (e.g., Klein 1995, 2000; Lieberman 1991; Mellars 1996; Mithen 1996; Noble and Davidson 1996).

Language is the most powerful but not the only symbol system known to us. This observation is pertinent to archaeologists' efforts to recognize symbolism. Too often discussion of the origins and antiquity of language in the archaeological literature has been conflated with discussion of the symbolic meanings of objects. Much of the debate about language has been propelled over the years by the obvious fact that language leaves no material remains and its existence in Paleolithic cultures has to be inferred from material manifestations which *may* be indexical of it. Art, decorations and ornaments, and intentional burials are among the consensual although not unanimously agreed-upon (e.g., Humphrey 1998, Noble and Davidson 1996) such proxies in later prehistory. The ethnographic record indicates, however, that some symbol systems use material elements (tokens) to communicate complex social and cosmological messages. It is such symbol systems that should be taken as the appropriate models for the investigation of prehistoric symbolic behavior. Because much of the material lives of tokens is dictated by human decision making, symbolic transactions may be largely predictable (Robb 1998 and references therein). The attraction for archaeologists of this approach is evident. Here, material evidence need not be considered only as a proxy for language by virtue of its assumed relation to it and does not necessitate second-tier inferences. Rather, it can be studied and understood in its own right. Indeed, the pros and cons of style, standardization, and imposition of arbitrary forms in lithics as indications of symbolic behaviors have sometimes been discussed in such contexts (Ambrose 1998, Chase 1991, d'Errico and Nowell 2000, Goring-Morris and Belfer-Cohen 2001, Marshack 1989, Sackett 1983, White 1989, Wynn 1996).

Color symbolism is one of the symbolic frameworks used extensively by contemporary societies to convey information and abstract messages through material objects. Ethnographic data document the worldwide use of carefully chosen colors and patterns in body decoration in ritual and in practical and social contexts. Turner's (1966) work among the Ndembu of Zambia revealed the complex symbolism of the basic color triad—black, white, and red—in this society's life. Here three colors are symbolic, through a complex chain of associations, of human organic experiences and social relations and provide a kind of primordial classification of reality (Turner 1966, 1970). Sagona's (1994:10–26 and references therein) survey of ethnographic case studies underlines the fact that the Ndembu are not unique in their use of the basic color triad, the symbolism of the individual colors, or the significant role of the color symbol system in their cosmology. Red, in particular, has a symbolic significance that crosscuts cultural boundaries (often being associated with life, success, and victory in African, Australian, and native North American societies).

Cross-cultural linguistic studies support this hypothesis. Most languages have been found to categorize colors according to a single classificatory system which corresponds to a seven-stage evolutionary scheme of color terminology (Kay and McDaniel 1997 and references therein). Monochromatic "black" and "white" are the basic color terms used in any human language. Where more than two color terms exist, these two are universally followed by the term for "red," with terms for other colors following in a consistent sequence across languages (Berlin and Kay 1969, Kay and McDaniel 1997, MacLaury 1992). The properties structuring the universality of color categorization have been traced to and correlated with the neuro-optical processes involved in human trichromatic color vision (e.g., types of retinal receptors for different wavelengths of light, the neural machinery that measures the relativity of photon capture in the different classes of receptors), and the dimensions of human color perception (lightness, hue, and saturation) (Mollon 1997 and references therein). Trichromatism is an inherent property of human vision shared only with Old World monkeys and one genus of New World monkeys, the howlers (Dominy and Lucas 2001). The characteristic neural and physiological pathway of primate color vision and the psychophysiological organization of primate color space likely emerged as an adaptive response to regularities in the physical aspects of terrestrial environments (Shepard 1997). Frugivory (Mollon 1997) and, more recently, the consumption of leaves (a critical resource when fruit is scarce) have been implicated as having a unique value in maintaining trichromatism in Old World monkeys (Dominy and Lucas 2001).

The evolution of color terms in human languages thus appears to recapitulate physical and neuropsychological processes of color sensation and perception in the human visual cortex (Mollon 1997, Shepard 1997, Sun 1983, von Wattenwyl and Zollinger 1979).[2] By the same token, the worldwide emphasis in symbol systems on the basic color triad goes hand in hand with both the observed linguistic patterns and the neuropsychological primacy of the perception of three colors in the human brain (see Goldstone and Barsalou 1998). It would seem that the neuro-optical infrastructure underlying extant symbolic color systems has existed from the early days of the hominins (i.e., humans and their direct ancestors). While this does not necessarily mean that high cognitive faculties actually existed, it renders legitimate the search for symbolic color systems in the record of early prehistory through their direct manifestations in material objects.

The record of pigment use in the course of prehistory is consistent with the neurological and symbolic regularities discussed above. Black and red pigments were the earliest to occur in prehistory and are relatively abundant in Paleolithic sites. Of the two colors, it is red that dominates the Paleolithic color palette (Bahn and Vertut 1997:115), usually in the form of ochre, "an earthy, pulverulent, red [hematite], yellow, or brown [limonite, goethite] iron oxide that is used as a pigment" (Bates and Jackson 1980). Clearly, the ochre found in archaeological sites was not necessarily acquired and/or used for its color and in symbolic contexts. The inclusion of iron oxides in an archaeological deposit may be the result of natural depositional processes or of its use (e.g., as preservatives or medicines) because of physical or chemical properties to which color was incidental and irrelevant. Indeed, 15 years ago acceptance of archaeological finds as indications of Middle Paleolithic symbolism—including color symbolism—was a risky, not to say naïve, proposition (Bar-Yosef 1988, Chase and Dibble 1987). Since then, however, new discoveries and new analyses have been advanced as support for the claim that the mental and cognitive capacities for symbolic behavior were already in place by the Middle Paleolithic (d'Errico and Nowell 2000; Hayden 1993; Hovers et al. 1995; Hovers, Kimbel, and Rak 2000; Marshack 1989, 1996; Schepartz 1993).

When asking questions about the very earliest symbol systems, the employment of positivist tools may be the most reliable path open to us. We will apply these tools to the ochre record of Qafzeh Cave. To argue that this record results from the operation of a symbolic color system, we will have to show that other explanations for the occurrence and the characteristics of the ochre assemblage are less parsimonious than a symbolic one. In the following discussion we will demonstrate that ochre was selected and mined for its color rather than for any other property. We will review the contexts of ochre use throughout the stratigraphic sequence, including recurring associations with other finds, and show that they are consistent and specific through time. Finally, we will show that such associations fulfill the hierarchical relationships that are the essence of a symbolic referential framework. Our approach to the problem is an inductive one in the sense that we build up from the archaeological data to contextual patterning and relationships. It is this focus on context that enables us to evaluate the existence of symbol systems on their own terms.

2. The alternative, Sapir-Whorf hypothesis argues that linguistic structures affect and modify patterns of perception, thought, and cultural interactions. Despite a range of suggestive data, anthropologists and linguists disagree about the extent of the influence of language on culture.

The Site

Qafzeh Cave is known for the occurrence of skeletal remains of anatomically modern humans in the older archaeological layers (XXIV–XVII, henceforth the lower layers) of the cave's terrace (Tillier 1999, Vandermeersch 1981), at least some of which represent intentional burials (Belfer-Cohen and Hovers 1992, Tillier 1990, Vandermeersch 1981). Thermoluminescence (TL) and electron spin resonance (ESR) age estimates for these layers suggest occupation at 100,000–90,000 years ago, with an average TL date of 92,000 ± 5,000 years ago (Schwarcz et al. 1988, Valladas et al. 1988). These layers contain hearths, lithic artifacts and bones of large mammals, and abundant microfauna (Tchernov 1988). Worth noting are numerous *burnt* artifacts and thermic flint artifact debris (Hovers 1997). Human remains and microfauna are absent from the later Middle Paleolithic stratigraphic units of the terrace (layers XV–III, henceforth the upper layers), which are as yet undated, and evidence for fire in these layers is scanty. In contrast with this stratigraphic dichotomy, there is no clear stratigraphic patterning in the densities of lithic and megafaunal bone residues (Hovers 1997, Rabinovich and Tchernov 1995). Lithic technology is relatively homogeneous throughout the sequence. At the same time, the typological characteristics of the lithic assemblages are highly variable in the upper part of the sequence, whereas in the lower layers notches and denticulates predominate (Hovers and Raveh 2000). Such a typological composition may sometimes result from trampling (McBrearty et al. 1998), but in the current case the absence of typical diagnostic features of trampling implies that the typological difference is probably anthropogenic.

Other finds from the Mousterian layers of Qafzeh Cave terrace (hereafter "Qafzeh Cave") include a few unpublished *Glycymeris* sp. shells and lumps of ochre, both of which occur only in the lower layers of the terrace. None were found in the Mousterian layers in the interior of the cave, which are correlated stratigraphically with the uppermost layers of the terrace sequence (Vandermeersch 1981). A single ochre lump with clear signs of scraping was reported (Vandermeersch 1969), and this publication has often been referred to in the debate about Middle Paleolithic symbolism (e.g., Bar-Yosef 1988, Bar-Yosef and Vandermeersch 1993, Bednarik 1992*a*, Chase and Dibble 1987, d'Errico and Nowell 2000). However, the full record of ochre from the site contains numerous other finds.

The Sample

Seventy-one pieces of ochre were available for detailed study (table 1). The original field documentation indicated that additional pieces had been recovered during the excavations. Given that not a single case of misidentification was encountered during our study of the available samples, we assumed that these missing pieces had also been identified correctly as ochre. Thus, the *minimum* number of ochre pieces was 84.

For the existing pieces, the available most precise provenience was recorded. The provenience of 68 pieces, derived from the whole stratigraphic column, is known to the closest meter. Of these 38 (56%) were found in two adjacent squares (C10 and C11 [fig. 1]). On the whole, 50 pieces (73.5%) originated from 4 m^2 in the western part of the excavation. The spatial clustering occurs throughout the stratigraphic sequence of the ochre-bearing (lower) layers; the upper layers are devoid of both ochre pieces and artifacts with ochre stains.

Methods

We first present the full inventory, including mineralogical and chemical characteristics, of ochre lumps found in the assemblages and elucidate the temporal and spatial trends of ochre distribution. We go on to identify the sources of ochre, using petrographic, chemical, and mineralogical analyses to determine the characteristics of the archaeological ochres and compare them with those of such potential sources, and to assess possible criteria of selection. The technological organization of ochre utilization is studied by looking at patterns of modification of ochre lumps and indications of tool use in ochre processing. We then move to a discussion of the temporal and spatial associations of ochre with lithics, fauna, and human skeletal remains. Finally, we discuss the implications of our findings for the notion that ochre was part of a Middle Paleolithic symbolic culture.

The Munsell color chart (Munsell 1962) was used to standardize color description of all the ochre pieces. In addition, each lump was described as to its shape, hardness, and signs of modification. For the purpose of initial sorting and definition of the ochre types, all the lumps were examined under a binocular microscope (× 50 magnification), and their preliminary lithology (sand, clay, or silt) and mineralogical classification (hematite, calcite, dolomite, quartz) were recorded.

Nine pieces (#1–5 and 7–10) from the three layers richest in ochre were selected for chemical analysis. The number of pieces selected from each layer reflected its relative wealth of ochre pieces, but selection from the layer's assemblage was random. The chemical composition of these pieces was determined by inductively coupled plasma-atomic emission spectroscopy (ICP-AES) using a Jobin Yvon (JY-48) polychromator for barium, cobalt, chromium, copper, nickel, manganese, and zinc. The element content of arsenic, antimony, cadmium, selenium, lead, and uranium was detected using a Perkin Elmer Sciex Elan-6000 inductively coupled plasma-mass spectrometer (ICP-MS). After the petrographic study had been completed, 14 additional pieces were submitted to analysis by ICP-AES, bringing the frequency of chemically studied samples to 32.4% of the total assemblage. Selection of this second series of samples was based in part on outstanding features observed under the micro-

TABLE 1
Ochre from the Mousterian Layers of Qafzeh Cave Terrace

Layer and Sample	Square and Number	X (cm)	Y (cm)	Depth below Datum (cm)	*N*	Maximal Size (mm)	Weight (g)	Color (Munsell)	Description	Petrographic and Lithologic Description
XVII										
4 (Q79)	B10	–	–	–	1	31	8.94	7.5R 3/8	Fragment.	Fine-grained, hematitic limestone. Sand present in negligible amounts. Some ferruginous oolites.[b, c]
5 (Q78)	B11-128	–	–	518	1	38	18.82	7.5R 4/8	Fragment.	Fine-grained hematitic dolomite with some ferruginous oolites.[b, c]
6	B16				1	56	56.12	7.5R 3/6	Fragment with scraping marks on one face and edge (first reported by Vandermeersch 1969). Grooves in various directions.	Fine-grained hematitic siltstone containing some ferruginous oolites < 0.1 mm. Grooves on artifact surface covered with secondary calcite.
7 (Q79)	C10-288	97	18	534	1	49	41.72	7.5R 3/6	Fragment. Very hard material, with a lot of quartz.	Hematitic sandstone. Quartz grains subrounded at 0.25 mm. Ferruginous oolites in the size order of 0.2 mm.[b, c]
8 (Q79)	C11-590	–	–	524	1	45	19.27	7.5R 4/8	Fragment.	Fine-grained hematitic sandstone. Ferruginous oolites < 0.1 mm.[b]
9	A13	13	31	491	2	43	28.55	7.5R 3/8	Two pieces of the same lump, one chipped off the other.[a] One surface of the larger piece is worked.	Fine-grained (clay-sized), hematitic siltstone containing ferruginous oolites < 0.1 mm.[b, c]
13	A15	–	–	–	4	20	9.59	7.5R 4/8	Several small lumps, one covered with dark brown clay-silt with many white spots (as in #12).	Maghemitic dolomite.[b, c]
30 (Q78)	B11-119	55	55	501	2	49	19.13	5.0R 4/10	Red pigment, colors easily, coated in ashes (?).	Hematitic dolomitic sandstone. Abundant ferruginous oolites < 0.1 mm.[b, c]
33 (Q79)	C10-276	97	87	531	1	27	5.42	5.0R 3/10	Very hard lump of dark red material.	Hematitic siltstone. Few ferruginous oolitic < 0.05 mm.
51 (Q79)	C10-339	–	–	–	1	39	33.83	5.0R 5/10	Pebble-like lump of dark red material.	Hematitic dolomite. Calcite in vugs.
XVIII										
43 (Q79)	C11-498	34	72	527	1	31	7.82	5.0R 5/8	Dark red material, coated in silty ash.	Hematitic carbonatic sandstone; no ferruginous oolites.
XVIIIa										
25	A12-446	–	–	–	1	39	35.66	7.5R 3/6	Lump of bright red, relatively hard material.	Hematitic carbonatic sandstone; no ferruginous oolites.
XIX										
10 (Q79)	C10-383	70	20	601	1	58	62.67	7.5R 5/8	A fragment with scraping marks.	Hematitic siltstone with a dolomitic matrix.[b]
15 (Q79)	C11-607	–	–	546	4	36	14.69	7.5R 3/6	Two large lumps and two very small fragments of friable red material.	Maghemitic limestone.[b, c]

TABLE 1
(*Continued*)

Layer and Sample	Square and Number	X (cm)	Y (cm)	Depth below Datum (cm)	*N*	Maximal Size (mm)	Weight (g)	Color (Munsell)	Description	Petrographic and Lithologic Description
16 (Q75)	C13-58	50	50	501	1	33	25.26	7.5R 4/8	A lump of hard light red material.	Hematitic limestone and dolomite; no ferruginous oolites.[b, c]
17 (Q75)	C13-84	74	60	–	1	29	5.16	10R 4/6	A small lump of hard dark red material.	Siltstone containing abundant ferruginous oolites, < 0.2 mm.
18 (Q75)	C13-75	37	40	532	1	–	3.87	7.5R 3/6	Very friable, almost powdery dark red material.	Hematitic siltstone containing abundant ferruginous oolites < 0.05 mm.
19 (Q75)	C13-86	68	32	–	2	22	4.92	7.5R 4/8	Small lump of hard dark red material.	Hematitic siltstone containing some ferruginous oolites < 0.1 mm.
34 (Q79)	C10-368	–	–	598	1	15	1.16	5.0R 3/8	A small fragment of soft dark red material.	Hematitic siltstone containing ferruginous oolites < 0.05 mm.
35 (Q79)	C10-369	–	–	595	1	14	1.69	5.0R 3/10	A small fragment of soft dark red material.	Hematitic siltstone containing ferruginous oolites < 0.05 mm.
36 (Q79)	C10-370	56	53	598	4	18	5.03	5.0R 3/8	Three small fragments of soft dark red material + one of harder, stonelike material.	Hematitic siltstone containing ferruginous oolites < 0.05 mm. Many calcite vugs.
37 (Q79)	C11-780	11	11	589	1	13	0.73	5.0R 3/10	Fragment.	Hematitic siltstone containing ferruginous oolites < 0.05 mm.
46 (Q79)	C10-382	–	–	601	1	28	8.41	7.5R 3/4	"Flake" of very hard dark red material, one face worked to a smooth surface.	Hematitic siltstone. Few ferruginous oolites < 0.05 mm.
54 (Q79)	C10-374	20	25	500	1	51	86.22	5.0R 5/8	Large, broken concretion with concentric rings of various colors (dark on the outside, lighter on the inside). Outer layer scratches iron.	Concretion of goethitic siltstone, including shiny (pyrite?) crystals situated within depressions in the sandstone, the inner part of which is coated with calcite. Outer layer crystalline silica.[b, c]
55	C11-504	89	0	534	1	13	0.69	5.0R 5/8	Very small fragment.	Hematitic siltstone.
XXI										
1 (Q73)	B12	–	–	–	1	54	67.71	7.5R 3/8	Large piece, one surface worked and smoothed.	Hematitic siltstone containing few ferruginous oolites < 0.05 mm.[b]
3 (Q79)	C11-761	60	30	561	1	34	10.75	7.5R 3/6	Fragment.	Fine-grained hematitic limestone and dolomite. Oolithic size 0.2 mm. Contains maghemite.[b, c]
12 (Q78)	–	–	–	–	1	43	42.55	5.0R 4/8	A lump covered with dark brown clay-silt with many white spots in it (ashes?).	Hematitic siltstone containing few ferruginous oolites.
23 (Q75)	C13-72	–	–	531	1	57	39.61	7.5R 4/6	Lump of friable red-yellow material.	Hematitic limestone.[b, c]

TABLE 1
(*Continued*)

Layer and Sample	Square and Number	X (cm)	Y (cm)	Depth below Datum (cm)	*N*	Maximal Size (mm)	Weight (g)	Color (Munsell)	Description	Petrographic and Lithologic Description
26	B14-193	–	–	–	1	44	56.41	7.5R 3/6	Lump of very hard dark red material.	Silty, hematitic limestone. Calcite (showing as white spots) fills the vugs.[b, c]
27	B14-188	–	–	–	1	57	57.78	10R 4/6	Lump of very hard dark red material with one smoothed (abrasion?) surface.	Silty hematitic sandstone.
28	C13-78	–	–	–	1	–	5.70	7.5YR 5/8	Very small fragments.	Goethitic and hematitic (carbonatic) sandstone. Abundant ferruginous oolites < 0.05 mm.
29 (Q75)	C12-62	–	–	549	1	41	23.82	–	Lump of hard dark red material.	Hematitic siltstone containing ferruginous oolites < 0.5 mm.
32 (Q79)	C10-386	–	–	598	1	17	2.08	5.0R 4/10	Soft red piece.	Hematitic limestone and dolomite with few ferruginous oolites. Contains maghemite.[b, c]
38 (Q79)	C10-394	–	–	–	1	28	7.21	5.0R 3/10	Fragment.	Hematitic siltstone.
39 (Q79)	C10-406	–	–	–	3	19	3.78	5.0R 3/8	Fragment.	Hematitic sandstone with abundant ferruginous oolites < 0.1 mm.
40 (Q79)	C11-531	40	94	568	1	–	0.18	5.0R 5/8	Very small fragment.	Hematitic siltstone with few ferruginous oolites.
41 (Q79)	C11-537	58	83	572	1	31	9.27	5.0R 5/10	Very hard lump of dark red material.	Hematitic limestone and dolomite with few ferruginous oolites.[b, c]
42 (Q79)	C11-536	88	90	571	2	22	3.89	5.0R 5/8	Fragment.	Hematitic siltstone containing few ferruginous oolites.[b, c]
47 (Q79)	C11-790	66	9	613	1	22	8.07	7.5R 3/6	Small lump of red material, coated with white ash (?).	Hematitic sandstone containing some ferruginous oolites < 0.05 mm. Calcite in vugs.
49 (Q79)	C11-548	–	–	580	1	19	2.18	7.5R 3/8	Fragment, dark red.	Hematitic siltstone in physical contact with dolomite (?).
50 (Q79)	C11	–	–	–	1	21	4.55	5.0R 5/8	Fragment.	Hematitic siltstone.
52 (Q79)	C11-543	–	–	–	1	53	37.40	5.0R 5/8	Fragment.	Fine-grained hematitic sandstone.
XXI/XXII										
22 (Q75)	C13-93	65	80	533	1	32	16.09	7.5R 3/4	Lump of dark red material covered with remains of ashes.	Hematitic limestone containing few ferruginous oolites. Manganese coating.[b, c]
XXII										
2 (Q73)	A12-588	–	–	–	1	33	10.15	7.5R 3/6	A "flake" of very hard dark red material.	Hematitic sandstone containing ferruginous oolites < 0.2 mm.[b, c]
14 (Q73)	B12	–	–	–	1	31	6.6	7.5R 3/6	A small lump of hard red material.	Hematitic limestone. Contains dolomite, manganese, and maghemite.[b, c]

TABLE 1
(*Continued*)

Layer and Sample	Square and Number	X (cm)	Y (cm)	Depth below Datum (cm)	*N*	Maximal Size (mm)	Weight (g)	Color (Munsell)	Description	Petrographic and Lithologic Description
20 (Q75)	C12-103	24	48	574	1	42	23.45	7.5R 3/5	A lump of hard dark red material.	Hematitic carbonatic sandstone; no ferruginous oolites.
24	B12-663	–	–	–	1	33	9.93	7.5R 3/8	Lump of very hard dark red material.	Hematitic limestone; no ferruginous oolites. Contains maghemite.[b, c]
55 (Q69)	A13	–	–	–	1	12	5.20	5.0R 4/10	Very hard pink-red lump.	–
XXIII										
11 (Q79)	C10-410	84	44	644	1	39	14.81	7.5R 3/8	Yellow and red fragment.	Hematitic siltstone containing some ferruginous oolites.
44 (Q79)	C11-792	–	–	624	1	12	0.78	7.5R 4/8	Fragment.	Hematitic siltstone with few ferruginous oolites.
48 (Q79)	C10-408	–	–	630	1	24	5.19	7.5R 3/6	Pebble-like lump of dark red material.	Hematitic siltstone containing abundant ferruginous oolites < 0.05 mm. Calcite in vugs.
XXIV										
21 (Q75)	C12-113	–	–	611	1	35	31.77	7.5R 4/8	Lump of very hard dark red material.	Hematitic siltstone.
31 (Q79)	C11-798	65	30	653	1	27	11.19	5.0R 4/10	Very hard pink-red lump, possibly a burnt stone(?).	Hematitic dolomite.[b, c]
45 (Q79)	C10-420	–	–	664	1	39	49.43	7.5R 3/4	Pebble-like, broken lump of very hard dark red material, one tip and edge rounded, one surface concave.	Hematitic sandstone containing abundant ferruginous oolites < 0.05 mm.
53	C12-114	–	–	613	1	65	69.58	–	Fragment of very hard (stonelike) red-pink material with grey incrustations and adhered ashes.	Hematitic limestone and dolomite. Metal particles in hematitic part probably derived from tools used in the excavation during the early 1970s.[b, c]
Total					71		1,142.48			

[a]When a sample consists of more than a single piece, measurements are given for the largest of the two.
[b]Examined chemically.
[c]Examined by X-ray diffraction.

scope, as this second analysis was intended to describe the *range* of chemical variation rather than the norm.

The mineralogical compositions of 21 samples (30% of the assemblage) were determined by X-ray diffraction, using a Philips PW1730 X-ray generator and PW1710 diffractometer control, with Cu K α irradiation and Ni filter.

In order to identify the geological sources of the ochre, we compiled data from geological maps and survey and drilling reports in the region and conducted a limited field survey. Seven rock samples collected from a locality considered (on the basis of the petrographic analyses) to have been a potential source of the archaeological ochres were submitted to ICP-AES and X-ray diffraction. Similar data for other, more remote potential sources near Qiryat Shemona, in the north of Israel, were obtained by sampling and from the available literature and unpublished data.

Results

CHARACTERISTICS OF THE OCHRE ASSEMBLAGE

The relative frequencies of pieces of ochre within the total lithic assemblage (knapped lithics and ochre lumps

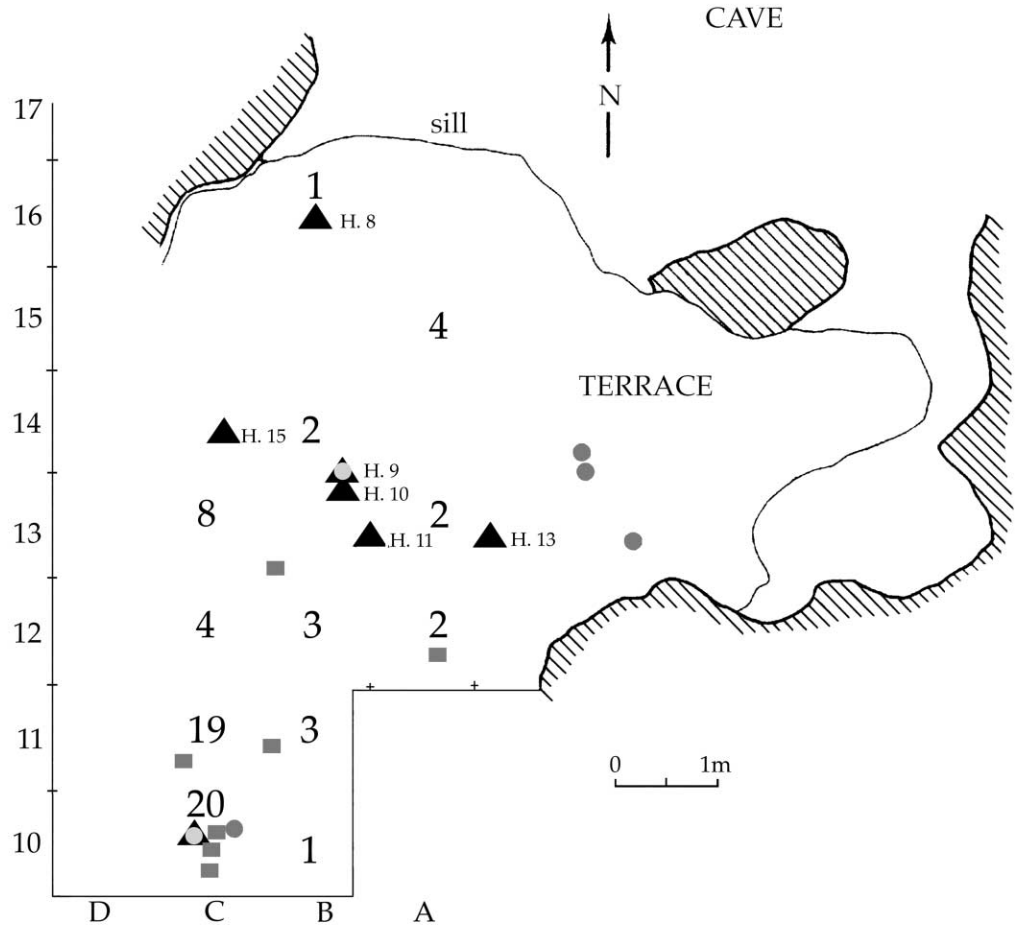

FIG. 1. *Map of excavation in Qafzeh Cave, showing lateral distribution of ochre lumps and of hominid remains (regardless of stratigraphic distribution).* Triangles, *burials;* rectangles, *skeletal remains of adults;* circles, *remains of infants (after Tillier 1999 and Vandermeersch 1981). Numbers indicate number of pieces in square.*

but not lithic chips and chunks) do not show a clear directional change through time (fig. 2). The observed color range is between red and pink, usually 5.0R 5/8 to 10.0R 4/6, with few (ca. 5%) yellows and browns. The largest numbers of ochre pieces were found in layers XIX and XXI (table 2). Combined, they constituted 60% of the total number of ochre pieces in the sequence and were followed by the assemblage from layer XVII. The same pattern held when the missing ochre pieces were added to the calculation (layer XIX, $N = 28$; layer XXI, $N = 23$; layer XVII, $N = 18$). The absolute frequencies of ochre lumps vary with the excavated volume of the stratigraphic layers (see Hovers 1997:table II.2 for primary data). Ochre mass had a different distribution. The highest cumulative weight per layer occurred in layer XXI, followed by layers XVII (in which over 50% of the total weight of ochre occurred [table 3, fig. 2]) and XIX.

Because the sample sizes are small, statistical comparisons are not meaningful, but some general tendencies can be observed. Each of the ochre assemblages consisted of both relatively large and small pieces. Of the three assemblages with ten or more pieces (layers XVII, XIX, and XXI), that of layer XVII stood out for its tendency toward the occurrence of larger and heavier pieces (figs. 3 and 4, table 4). Absolute frequencies of ochre in layers XIX and XXI were indeed higher than in layer XVII, but the descriptive statistics demonstrated that, in contrast to the situation in layer XVII, these were often very small crumbs, as was also the case for layer XXIII.

PETROGRAPHIC, CHEMICAL, AND MINERALOGICAL PROPERTIES

While the sizes and shapes of the 71 ochre pieces were highly variable, their lithological properties were relatively homogeneous. Ochre is an iron oxide that is usually impure—that contains a matrix. Petrographic and mineralogical examinations revealed that the sedimentary types of iron oxides in Qafzeh, in order of decreasing frequency, were siltstone, quartzic sandstone, limestone, dolomitic limestone, and dolomite. The chemical analyses showed that the archaeological ochres were char-

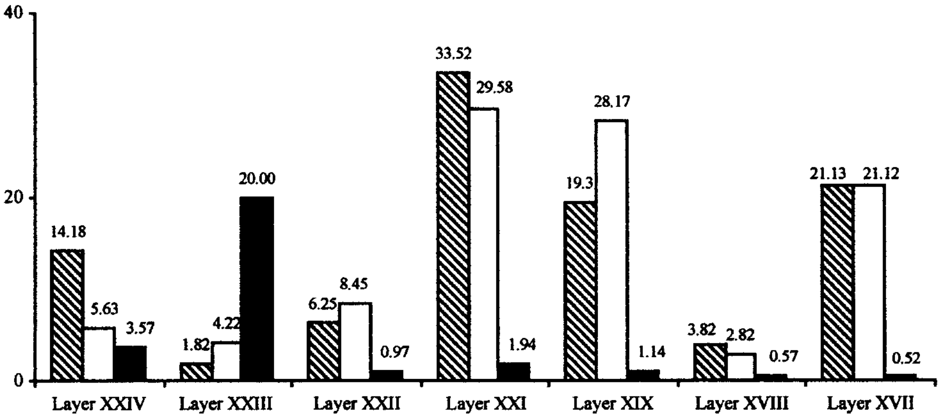

FIG. 2. *Distribution of ochre by layer.* Diagonal striping, *percentage of total weight;* white, *percentage of total number of pieces;* black, *percentage of total lithic number of lithics and ochre.*

acterized by their relatively high iron content (20–50%), with a few exceptions (notably, #5, #16, #42, #31, and #53, which contained 0.7–9% Fe_2O_3). The common iron mineral was hematite ($\alpha-Fe_2O_3$), as was suggested by the red-to-pink color that characterized most of the samples. Only a few pieces contained goethite (α-FeOOH) (e.g., #54 and #26) or maghemite ($\gamma-Fe_2O_3$) (#13, #15, #32, #14, and #24). Small (< 0.2 mm) ferruginous oolites were observed in the vast majority of the pieces, regardless of the specific iron mineral.

ARCHAEOLOGICAL EVIDENCE FOR OCHRE PROCESSING

Evidence for the utilization of ochre came from two types of finds: ochre lumps bearing signs of utilization and ochre-stained artifacts. The most obvious signs of usage were found on a lump from layer XVII (#6) which was scraped on both faces (Vandermeersch 1969). One surface (fig. 5) bore a deep, wide groove accompanied by shallower striations subparallel to one another. A second face of the same piece (fig. 6), perpendicular to the first, appeared to have been heavily scraped and exhibited a concave surface. This face bore several distinct types of marks. On the elevated part of the surface there were deep grooves that intersected one another and created a pattern reminiscent of the ones reported from Blombos Cave (Henshilwood et al. 2002), albeit on a smaller scale. On the concave lower area of the same surface there were shallow striations subparallel to one another.

A single piece (#10) also bore remnants of shallow striations on one of its edges.

One facet of piece #27 was very smooth and shiny red, with very fine striations that could be seen under magnification; all the other facets of this piece were rough, with only patches of dull red color. Another piece (#45) exhibited two perpendicular smoothed facets, one convex and the other concave. The geometry of this piece resulted from manipulation of the ore. On the rounded contact zone formed artificially between the two facets there were very fine striations.

Two additional pieces were "flakes" of ochre. Piece #2 exhibited a bulb of percussion and convex-concave profile identical to those of flint flakes. Piece #46 was broken at its "proximal" end; its profile was also similar to that of a flake. The shapes of these two pieces were inconsistent with natural breakage patterns. It is thus possible that the Qafzeh hominids practiced flaking ochre lumps as a technique for splitting the original chunks and obtaining pieces of the desired size.

Several lithic artifacts bearing ochre stains were recovered from layers XXII–XVII, the majority originating from layer XVII (table 5). This group of artifacts consisted mainly of unretouched flakes and a few retouched tools. On some of these ochre appeared along the edges, whereas in other cases the tips were stained with ochre (e.g., the notch on a broken flake from layer XXII; a core-trimming element from layer XVII [fig. 7, *1*]). Microscopic analysis revealed the presence of traces of ochre on the engraved face of a Levallois core from layer XVII (Hovers, Vandermeersch, and Bar-Yosef 1997, Nowell, d'Errico, and Hovers 2001).

An exceptional artifact was a large Levallois core from layer XIX, flaked by the centripetal recurrent mode of Levallois flaking (Boëda, Geneste, and Meignen 1990), that bore extensive ochre stains on its flaking surface (fig. 8). The residues of red pigment were thickest and densest in the deepest part of the large negative scar of the last Levallois flake removed from the core. Outside the contours of this scar, ochre was rare and, when present, occurred as small, thin, discontinuous stains.

SELECTION AND ACQUISITION OF OCHRE

Qafzeh Cave is situated on the slope of Har Qedumim (Jebel Qafzeh) at an elevation of 250 m above sea level on the eastern bank of a narrow creek (Arabic Wadi el-Haj, Hebrew Nahal Mizra) that cuts through the steep

TABLE 2
Stratigraphic Distribution of Lithics, Ochre Pieces, and Hominid Remains

Layer	Excavated Volume	*N* Lithics (w/Debris)	*N* Lithics (w/o Debris)	*N* Ochre Pieces	Relative Frequency	Density (per m^3)	*N* Hominid Remains
XVII	3.35	2,870	912	15	.005	4.48	13
XVIII	0.80	346	103	2	–	2.50	–
XIX	3.10	1,738	543	20	.012	6.45	1
XXI	2.25	1,059	329	21	.020	9.33	–
XXII	1.08	616	287	6	.008	4.63	1
XXIII	1.20	12	12	3	.250	2.50	–
XXIV	0.67	108	69	4	.037	5.97	–

escarpment facing the Yizrael (Esdraelon) Valley (Israel grid 178.05/231.75). At present it is about 110 m above the valley floor. The exposed geological section in the vicinity of the cave consists mainly of sedimentary rocks from Albian (Lower Cretaceous) to Eocene age, which form a ca.-1,000-m-thick column (Weiler 1968). The major part of the lithological column in the immediate vicinity of the site consists of dolomite and limestone without any siltstone, sandstone, or ochre occurrences. Specifically, the terrace sediments contain angular rubble derived from the dolomite bedrock (Farrand 1979: 377). The predominance of siltstone and sandstone in the ochre matrices strongly undermines the possibility that ochre accumulated on site as natural debris. Additionally, since excavation volumes do not differ significantly between the lower and upper parts of the sequence (Hovers 1997:table II.2), the absence of ochre and of ochre-stained artifacts from the upper part of the sequence cannot be explained as stemming from differences in excavation volumes. The available geological and archaeological data thus suggest that the ochre was actively collected by the site's occupants, who transported it to the cave when layers XXIV–XVII were deposited some 100,000–90,000 years ago.

Possible sources of hematitic ochre occur in three forms within 8 km of the cave. Veins of iron oxide, composed mainly of goethite and some hematite, are one potential source located 2.5 km west of the cave. These are found as joint fillings in the dolomitic rocks of Cemomanian age. Another possible source of available ochre is ferruginous concretions 1 to 10 cm in size, composed mainly of goethite, with some occurrences of hematite. These are present in limestone, chalk, and marl of the Lower Cretaceous at Mt. Devora, 4 km east of Qafzeh Cave, and in Paleocene and Eocene sediments 3 to 4 km northeast of the cave. Finally, blocks of yellow-brown-red quartzic sandy limestone containing ferruginous oolites, of Lower Cretaceous age (Weiler 1968), are found on the lower southern slopes of Mt. Devora as well as in the Mt. Tavor area some 8 km east of the cave.

The petrographic and mineralogical analyses show the total absence of ferruginous concretions and of fragments of iron veins in the archaeological sample, indicating that the majority of the potential geological sources were not tapped for ochre. At the same time, the abundance in the archaeological ochre sample of clastic siltstone and of sandstone enriched with ferruginous oolites suggests that the ochre source is in quartzitic sandstone strata intercalated with beds containing ferruginous oolites. Rocks of such lithology are typical of the Lower Cretaceous sequence and are exposed in the Mt. Devora locality and on the western slopes of Mt. Tavor. It thus appears that Qafzeh Cave's inhabitants selected ochre exclusively from these localities.

Alongside some broad similarities in the color and general petrographic characteristics of the archaeological material and the geological samples and their mineralogical properties there were a number of significant dissimilarities. First, the ochre from the cave came mainly from siltier sediments than the ochre from Mt. Devora and Mt. Tavor. Second, as we have seen, the ochre lumps from the cave were relatively rich in iron, compared with only 0.7–14% in the geological samples, and as a result there were also anomalously high values of some trace elements (Chao and Theobald 1976). Third, the archaeological material was characterized by the presence of hematite, whereas in the geological samples goethite was relatively abundant. Finally, in more than 50% of the cave samples, the abundance of ferruginous oolites was far greater than in the sandstone exposures of Mt. Devora and Mt. Tavor.

Comparative fieldwork and mineralogical and petrographic studies made it possible to correlate the Mt. Devora stratigraphic section with the well-known exposure of the Lower Createaceous Hidra Formation of Ramim Ridge, near Qiryat Shemona. This correlation indicated that the part of the Hidra Formation in the Mt. Devora area that contained the siltstones rich in ferruginous oolites was covered by subrecent (post–Middle Paleolithic) talus debris up to 12 m thick in the nearby drillhole Devora-1. The implication of this geomorphic feature is that while the particular lithological bed from which the Qafzeh hominids obtained their ochre likely existed in the Mt. Devora area, our geological samples did not derive from it. This situation thus explains the incompatibility between the geological and the archaeological materials.

Apart from the two sites at Mt. Devora and Mt. Tavor, there are three exposures of Lower Cretaceous ferruginous oolite quartzic beds in northern Israel (fig. 9). In order of increasing distance from the site, these are 'Ein el Assad, about 30 km northeast (D. Levite, Internal Re-

TABLE 3
Descriptive Statistics for Weight of Ochre Pieces (g)

Layer	Count	Total Weight	Mean	S.D.	Minimum	Maximum	Median
XVII	10	241.39	24.14	16.04	5.42	56.12	19.20
XVIII	2	43.48	21.74	19.69	7.82	35.66	21.74
XIX	13	220.51	16.96	26.84	0.69	86.22	5.03
XXI	18	382.93	21.27	22.64	0.18	67.71	8.67
XXII	6	66.22	11.90	6.80	5.20	23.45	10.15
XXIII	3	20.91	6.92	4.14	0.78	14.81	5.19
XXIV	4	161.96	40.49	24.90	11.19	69.58	40.60

port to the Geological Survey of Israel), Wadi Malikh, about 40 km southeast (Mimran 1972), and the Lower Cretaceous Hatira and Hidra Formations exposed at Ramim Ridge near Qiryat Shemona, about 60 km northeast (Kafri 1991). The mineralogical and chemical compositions of the first and last of these exposures (Zackheim 1997) differ from those of the archaeological material found in Qafzeh Cave mainly in the concentrations of trace elements and in some cases also in the common form of iron oxide (goethite rather than hematite [Zackheim 1997: tables 12, 14]).

Discussion

THE OPERATIONAL SEQUENCE OF OCHRE USE

Selection criteria. The ochre lumps from Qafzeh Cave were mostly silty and clayey, with their hues significantly skewed toward the red. Red ochre can either be collected from natural sources or produced, primarily by heating, from other iron minerals (see Weinstein-Evron and Ilani 1994, Wreschner 1980, Zackheim 1997). The evidence for the existence of hearths in the layers of Qafzeh Cave which contained the ochre (Hovers 1997, Vandermeersch 1981) raises the possibility that yellow goethite was transformed by heating, sometimes accidentally, into red hematite (e.g., Weinstein-Evron and Ilani 1994). We were unable to use Pomiès, Menu, and Vignaud's (1999) mathematical manipulation of X-ray diffraction data to distinguish between natural hematitic ochre and red ochre which originated from the heating of goethite. On the basis of two lines of reasoning, however, we assume that the ochre assemblage from Qafzeh represents the color preferences of the hominids independent of the use of heating.

First, if goethite had been transformed into red hematitic ochre by accidental, random heating, lumps of yellow iron oxide should have occurred in the archaeological ochre assemblages. These, however, are extremely rare (table 1). The chemical properties of goethite do not change when the mineral is heated. Therefore, an alternative hypothesis—that fire was used intentionally to change the yellow color of goethite to red—would imply that the characteristic red hues were the specific goal of the heating. This hypothesis is weakened by the fact that during the Middle Paleolithic goethite with the sandy matrix characteristic of the ochre found at Qafzeh Cave would have been mined from the same geological units of the Lower Cretaceous sequence that contained red hematitic ochre. Hominids with access to the former could have acquired the latter with the same amount of effort and would not have needed an additional process to obtain the very same end product.

Lithological units containing ores similar to the archaeological ochres are not ubiquitous among the identified probable sources of ochre or in the more distant Lower Cretaceous deposits. Still, Qafzeh's occupants did not tap the more readily available ferruginous concretions and veins of iron oxides. The combined geological and archaeological data therefore point to active search and sampling in order to meet well-defined selection criteria in the course of ochre acquisition.

Identifying these criteria is not an easy task, since the archaeological ochres shared a number of chemical and visual properties any one of which could have been such a criterion. One possibility is that it was a *combination* of characteristics rather than any single one that satisfied the selection criteria. Alternatively, Middle Paleolithic hominids might have selected for a single desired property that was accompanied by other characteristics as by-products or side effects. The red hues (and, sometimes, the visible ferruginous oolites) likely advertised to the Qafzeh hominids the presence of ochre of the desired properties—but was the red color the main criterion for selection?

The utilization of ochre through grinding and scraping might explain the selection for iron oxides derived from relatively soft materials (e.g., clays and silts) which could be pulverized easily. It does *not* explain the overrepresentation of red hues in the archaeological assemblages. Yellow goethite is ubiquitous in all the Lower Cretaceous exposures considered above as sources and occurs in matrices of similar hardness and chemical properties. Accepting that the archaeological ochres had not undergone heat-induced chemical changes, the absence of goethite from the Qafzeh sample suggests that the red hue of the hematitic ochre was a crucial selection criterion. Given the limited geographic distribution of exposures containing the particular type of ochre and the paucity of hematitic ochre *within* the relevant beds of the Lower Cretaceous strata, it seems that considerations of cost-effectiveness did not play a central role in decision mak-

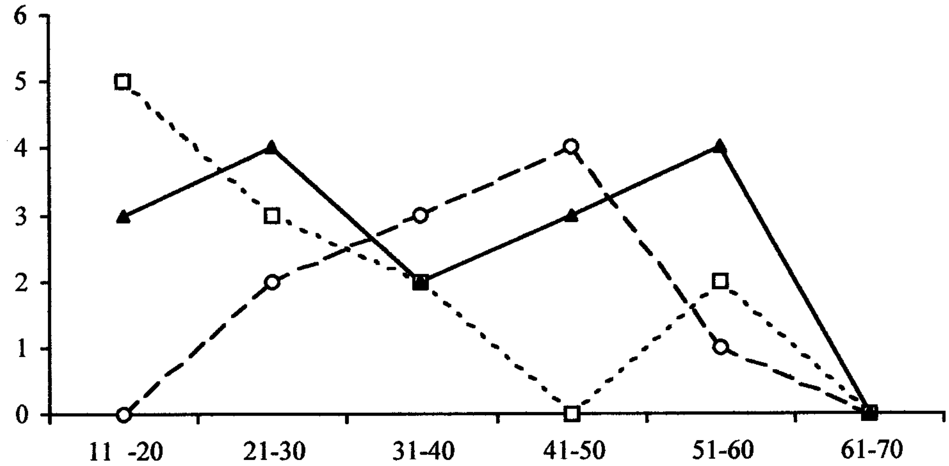

FIG. 3. *Frequency distribution (counts) of maximal dimensions (mm) of ochre fragments.* Circles, *layer XVII;* squares, *layer XIX;* triangles, *layer XXI.*

ing related to ochre acquisition. Moreover, the data suggest that the same selection criterion and similar processes of decision making were employed repeatedly throughout the time span of the deposition of the lower layers.

Techniques of ochre processing. The modifications seen on the pieces of ochre in Qafzeh fall within the restricted range of utilization techniques typical of ochre exploitation in a variety of temporal and geographical contexts (d'Errico and Nowell 2000). The appearance of deep intersecting grooves on lumps of ochre (e.g., #6) is characteristic of the use of the pointed tips of lithic tools in the process of scraping. Subparallel shallow striations are normally associated with the use of the lateral edge of a blank or of a retouched tool (d'Errico and Nowell 2000:160). The apparent marks on three of the ochre lumps thus suggest that both modes of scraping were known to the Qafzeh hominids. In the case of lump #6, the shallow marks appear to postdate the deep grooves. This implies either that the utilization of the piece took place during two or more sequential events of scraping or that tools were switched and the manner of ochre exploitation changed in the course of its utilization.

Another technique of extracting powder from the imported natural lumps was grinding (pieces #27 and #45). In contrast to the evidence from the African Middle Stone Age, in which ochre-stained groundstone tools are reported from a number of sites (McBrearty and Brooks 2000:528 and references therein), and to some European examples (e.g., Bordes 1952), the lower layers of Qafzeh Cave produced no well-executed groundstone artifacts. However, the placement and concentration of ochre on the Levallois core from layer XIX fit the definition of Upper Paleolithic ochre receptacles as exhibiting "traces of pigments in their concavity [which] imply that they served in storage and preparation of pigment" (de Beaune 1993:177). It is possible that this core was recycled into an ochre receptacle (fig. 8). The shape and the topography of the large negative scar of the core on which the ochre is found resemble those of a small cup-hole (see Kraybill 1977:495 for examples of pre–Upper Paleolithic grinding stones with ochre).

None of the scraped pieces was reduced to the form of a thin tablet (see Henshilwood et al. 2001:fig. 8; Watts 1999). Similarly, grinding never proceeded to the point that it resulted in the distinct morphology of a "crayon," in which the ground facets converge into a point (e.g., Henshilwood et al. 2001:433; Watts 1999:figs. 7.2–7.4). It is also noteworthy that, while relatively few lumps (only 8.5% of the total number) were modified in any way, these tended to be among the largest and heaviest pieces (43% of pieces weighing over 50 g showed evidence of modification; in two cases, #6 and #27, they were the heaviest pieces in their respective layers). No signs of grinding and/or scraping were observed on any of the light pieces (< 10 g). Since there was no correlation between the size and the hardness of the ochre pieces, it is reasonable that the larger and heavier pieces were the sources from which pigment was extracted and the small pieces constituted processing debris. The distributions of size and mass of the ochres are consistent with this interpretation (figs. 3 and 4) in that each occupation layer contained a few large and many small pieces. These data also suggest that ochre lumps were not exhausted before discard. Combined, these sets of data are compatible with short transport distances, which did not impose heavy costs on the use of the natural ores.

Ochre pieces throughout the sequence of the lower layers showed a distinct spatial clustering, but this was not the case with the few ochre-stained artifacts. The weak spatial association between the stained lithics and the ochre lumps undermines suggestions that the presence of the former resulted from unintentional, random staining due to physical proximity to the pieces of ochre.

By the same token, the locations of the ochre on some artifacts (table 5) in fact conform with predictions derived from the two methods of scraping observed on the ochre pieces—using the tip of a tool or its lateral edges.

EXPLAINING THE SPATIO-TEMPORAL PATTERNING OF OCHRE FINDS

The ochre record of Qafzeh Cave is extraordinary in its temporal disjunction. Frequencies of ochre pieces and ochre-stained lithics did not simply change gradually or stochastically throughout the sequence; instead, the modification and use of ochre seem to have stopped after the deposition of layer XVII. Where present, however, the archaeological ochres were remarkably homogeneous in their chemical and mineralogical properties and mode of extraction. Plausible explanations for the presence and significance of ochre must account for these two seemingly unrelated phenomena.

Although the authenticity of ochre finds in Middle Paleolithic contexts has been questioned in the past, the occurrence of ochre in these contexts and its use by hominids of this period are now uncontested (Chase and Dibble 1987, McBrearty and Brooks 2000, Mellars 1996 and references therein). What is still controversial is the behaviors that these remains represent. Two types of explanations that have been offered agree that ochre and/or the products of its processing played a role in the adaptive strategies of a site's occupants but differ in the functions they assign to it. One type emphasizes the *practical* applications of ochre and/or of its processing products. If such explanations were substantiated by archaeological data and accepted, it would be impossible to argue for the symbolic use of ochre on the basis of the material evidence alone. The second type of explanation is that the use of ochre and ochre products evolved and later occurred repeatedly in symbolic contexts. To support this argument, one would need to demonstrate that ochre was positioned within an organized system of other symbols and thus had referential powers and the capacity to generate symbolic predictions among the participants in the symbolic network. This proposition cannot be tested in most of the pre–Upper Paleolithic sites containing ochre. Fortunately, the context of the ochre in Qafzeh Cave provides such an opportunity.

Practical uses. Unless shown otherwise, practical uses

TABLE 4
Descriptive Statistics for Maximal Dimension of Ochre Pieces (mm)

Layer	Count	Mean	S.D.	Minimum	Maximum	Median
XVII	10	39.70	11.09	20.00	56.00	41.00
XVIII	2	35.00	5.66	31.00	39.00	35.00
XIX	12	27.50	14.98	13.00	58.00	25.00
XXI	16	35.13	14.74	17.00	57.00	32.50
XXII	6	30.50	9.89	12.00	42.00	32.50
XXIII	3	25.00	13.53	12.00	39.00	24.00
XXIV	4	41.50	16.44	27.00	65.00	37.00

FIG. 4. *Frequency distribution (counts) of ochre by weight (g).* Circles, *layer XVII;* squares, *layer XIX;* triangles, *layer XXI.*

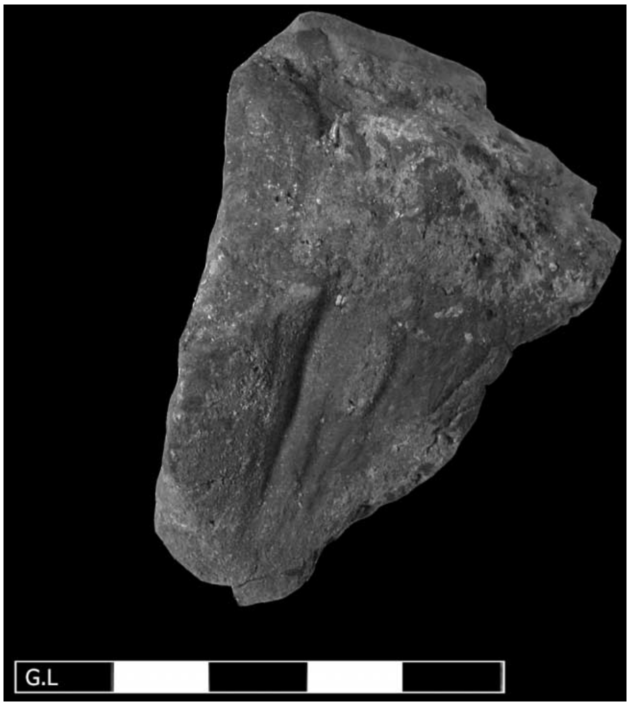

FIG. 5. *Lump of ochre (#6) showing a deep, wide groove and shallower striations subparallel to one another.*

provide the more parsimonious of the two types of explanation for the presence of ochre in early sites. Various writers have suggested the use of ochre as a technological aid in hide tanning (e.g., Bueller 1988), in hafting (Couraud 1988:28; Inizian 1976), as a painting and sealing substance in domestic contexts (Mellars 1996:370), and for medicinal purposes (see Erlandson, Robertson, and Descantes 1999, Sagona 1994 for review and ethnographic examples, Velo 1984).

Hafting as an explanation for the ochre record of Qafzeh Cave runs into difficulties. First, the locations of ochre residues on the surfaces of the artifacts are not congruent with the use of ochre in the process of tool hafting. Even where the colored areas occur on the proximal ends and lateral edges of the flakes, their borders on the dorsal and ventral faces do not mirror one another as would be the case where lithic artifacts were hafted (Beyries 1983, Inizian 1976). Also, for the hypothesis of hafting to survive scrutiny, it would have to explain the absence of ochre in the upper layers. One possible such explanation is that the observed interassemblage typological variability reflects differences in frequencies and processes of hafting. This explanation, however, is not easily reconciled with the record of the site. Although the lower layers are relatively rich in notches/denticulates, the frequencies of these tools among the pieces with visible signs of ochre are low (table 5). Additional typological differences between the lithic assemblages of the lower and the upper layers are much subtler. These minor differences, combined with technological homogeneity (Hovers 1997), do not furnish a satisfactory explanation for the alleged presence of hafting in one but not the other cluster of lithic assemblages. Finally, it is now evident that hafting in the Middle Paleolithic was not restricted to specific types of lithic artifacts or, indeed, even to retouched pieces (Boëda, Connan, and Muhesen 1998; Friedman et al. 1994–95; Shea 1989, 1997). Given that, the existence of typological differences per se is hardly a sufficient explanation of the dichotomous distribution of ochre seen in Qafzeh Cave.

Hide tanning, using ochre as a preservative, is often mentioned as a possible utilitarian use of ochre. Several characteristics of the ochre record in Qafzeh Cave are inconsistent with this hypothesis. First, the preservative properties of ochre are not color-dependent (Watts 1999: 121), and therefore the tanning hypothesis does not offer any explanation for the observed repeated, focused selection for red hues of ochre.

Another difficulty with the tanning hypothesis is its inherent emphasis on the exploitation of faunal resources. Studies of lithic use-wear and typo-technology suggest that exploitation of faunal resources may not have been a prominent activity throughout the duration of human occupation of Qafzeh Cave (Hovers 1997, Shea 1991). Taking the frequencies of mammal bones as a proxy for the relative extent of animal exploitation within the sequence, the upper layers, which show higher *absolute* frequencies of large mammal bones (Rabinovich and Tchernov 1995), would be expected to have

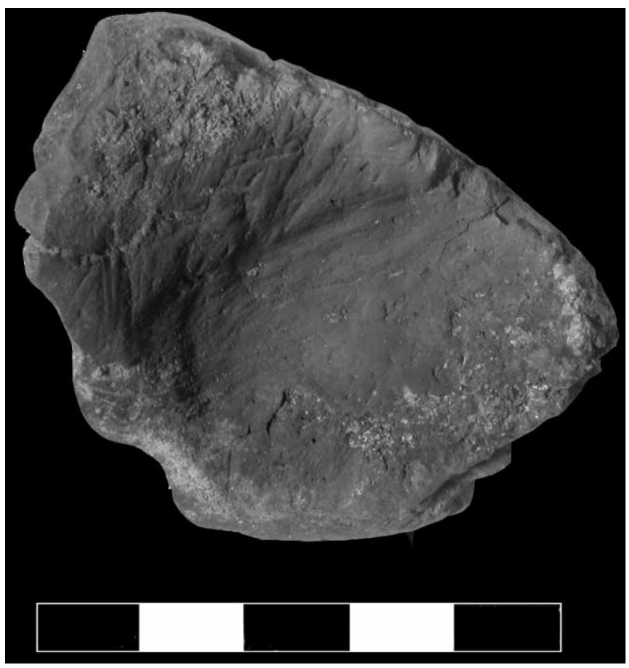

FIG. 6. *Another face of the same piece, perpendicular to the first, showing concave surface apparently produced by heavy scraping.*

TABLE 5
Ochre-Stained Artifacts in Qafzeh Cave Terrace

Layer and Number	Description	Location of Ochre Stain
XXII, B15-77	Kombewa flake	On one of two bulbs of percussion
XXII, C14-60	Notch on a broken Levallois flake	On dorsal face, distal
XX, C12-658	*Eclat debordant*	On ventral face, proximal right edge
XIX	Levallois core	On flaking surface, especially in the negative of a large flake
XVII		
B12-575	A double tool—side scraper and massive denticulate	On dorsal face
C15-58	End scraper	On dorsal face
C11-672	Core-trimming element	On distal tip of the flake, previously the core's striking platform
A11-336	Flake	On dorsal face
B12-545	Levallois flake	On butt and along one edge
56	Flake	On ventral face
C10-280	Primary flake	Whole flake smeared with ochre

more ochre in them if ochre were associated with hide tanning and/or other hide-working-related activities (e.g., Philibert 1994). The record from Qafzeh is in agreement with other studies that have questioned the use of ochre in tanning activities on grounds of social theory and ethnographic and biological evidence (Watts 1999: 121 and references therein).

Symbolic use? From the formal positivist standpoint, hypotheses focusing on symbolic behaviors are notoriously difficult to test and refute. Symbols are abstract, society-specific constructs. It is only within the social networks that constructed them in the first place that symbols can be deconstructed into communicated information (e.g., Chase 1991, Conkey 1978, Deacon 1997, Gage 1999, Wobst 1977). As a result, ethnographers and ethnologists, working with extant societies, rely on the help of informants to understand discrete symbolic behaviors (and their material expressions) and their place as components within whole symbolic systems (e.g., Balikci 1970, Barley 1983, Spencer and Gillen 1968 [1898]). Archaeologists are obviously at a disadvantage given the limitations of their subject materials. In the particular case of ochre there is also the possibility that its symbolic use may have entailed activities that are not observable in the archaeological record, such as mimicry and body painting (e.g., Bordes 1952, Clark 1988, Knight, Power, and Watts 1995, Power and Aiello 1997, Watts 1999).

The combined outcome of such constraints is that the notion of ochre as part of a symbolic system is fraught with analytical difficulties and involves evaluation rather than direct testing of specific hypotheses. The complex, hierarchical nature of symbol systems renders such an evaluation a matter of analyzing patterns of associations and dissociations (Foster 1990). An important caveat is that such an endeavor is acceptable only after other, testable explanations have failed to fit the ar-

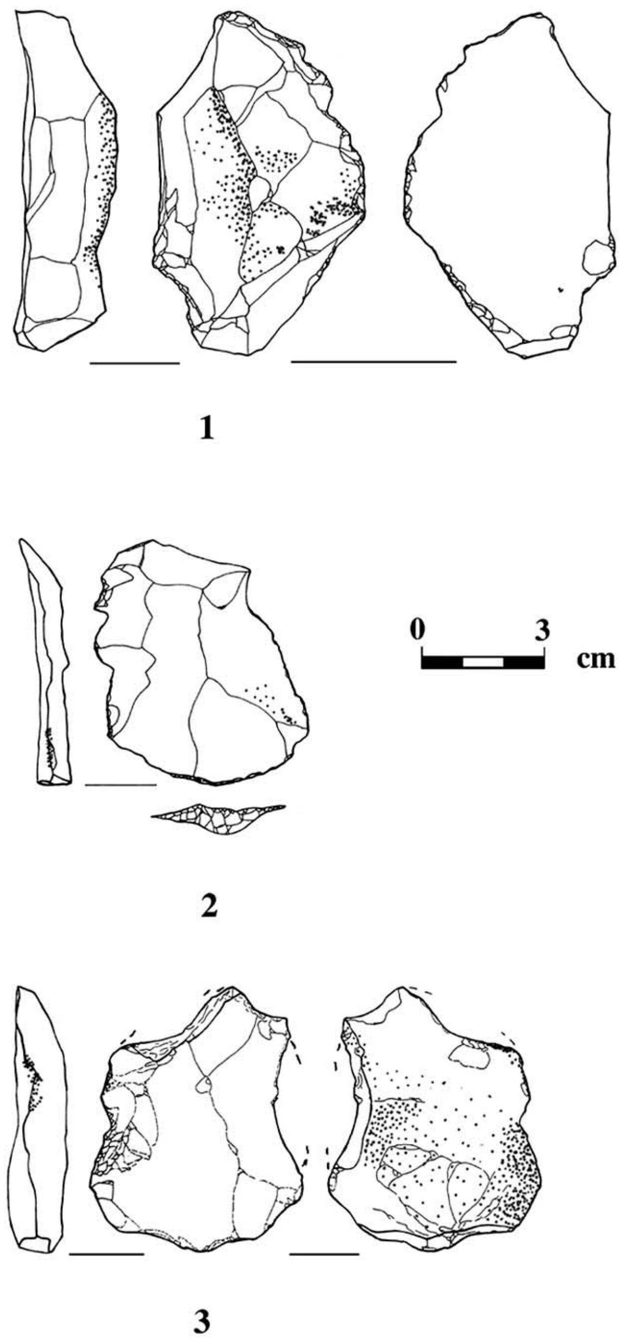

FIG. 7. *Ochre-stained lithic artifacts (stained areas shown as dotted). 1 and 2, from layer XVII; 3, from layer XXI.*

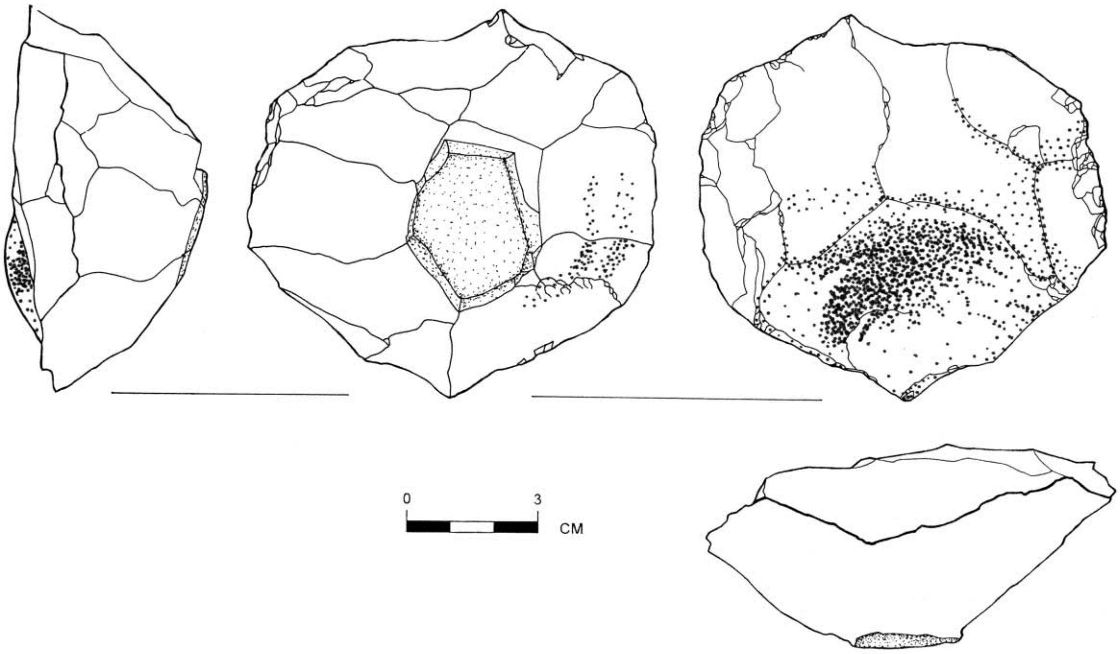

FIG. 8. *Levallois core heavily stained with ochre.*

chaeological evidence. Having shown that practical hypotheses fail to account for the spatio-temporal patterns of the ochre record at Qafzeh Cave, we now explore the hypothesis that the ochre occurred in the context of a symbolic color system.

The data at hand indicate that at Qafzeh Cave a single operational sequence of ochre selection and acquisition persisted through time. The analysis documents repetitive targeting of particular geological localities on the landscape as a matter of informed choice based on unwavering selection criteria. Specific hues of red appear to have been the sought-after property of the ochre obtained in the particular localities. Lumps of ochre were brought into the cave and processed there. The acquisition and transport behaviors are inconsistent with straightforward least-cost economic principles.

The available radiometric dates for the ochre-bearing layers XXIV–XVII suggest a time span of ca. 10,000 years for their accumulation (Valladas et al. 1988). This may be an overestimate, as sedimentological evidence suggests rapid sediment accumulation (Farrand 1979). Still, the stretch of time encapsulated by the sequence of ochre-bearing layers likely encompasses some thousands of years (e.g., Bar-Yosef 1998). The overall pattern seen at Qafzeh Cave is that of a robust and redundant system of decision making guided by nonpractical criteria and directed toward nonpractical goals. The redundancy of the selection parameters, combined with the absence of indications of the practical use of ochre at the site, suggests that the phenomenon of ochre is to be interpreted as a persistent tradition handed down through the generations of the use of the color red as an index for objects, ideas, or events.

Ochre and burials. Ochre and human burials (as well as other human remains that are not burials) occur only in the lower layers of Qafzeh Cave, sometimes associated with marine mollusks. The majority of ochre lumps tend to be clustered in a particular part of the excavated area of the terrace (fig. 1). The occurrence of large lumps and small debris of ochre (figs. 2–4), a pattern present in all the ochre-bearing layers, hints that this may have been a work area where ochre was processed, perhaps to be employed in activities related to burials. Interestingly, in layer XVII, which yielded the largest number of intentional burials,[3] the frequencies of large, heavy pieces of ochre are higher than in any of the other layers. Also in this layer there is an intriguing spatial association among the burial of hominid 8, an intensively scraped piece of ochre (#6; Vandermeersch 1969), and an engraved lithic artifact (Hovers, Vandermeersch, and Bar-Yosef 1997), all found less than a meter from one another in square B16.

In addition to the presence of ochre and human remains, the lower layers of Qafzeh Cave are distinguished from the upper ones by the occurrence of hearths (Vandermeersch 1981, Bar-Yosef and Vandermeersch 1993, Hovers 1997). Human occupations in the upper layers were as intensive as the occupations in the lower layers

3. Five burials were identified in this layer. One of these, Qafzeh 13, was initially reported as originating in layer XVa, but reexamination of stratigraphic sections and elevations in 1997 indicated that its more probable source was layer XVII.

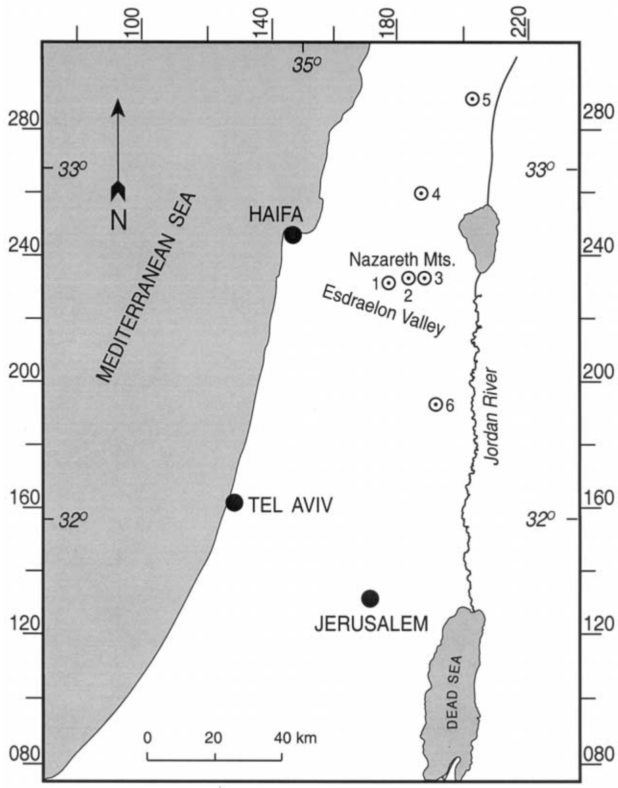

FIG. 9. *Location of ochre sources mentioned in text. 1, Qafzeh Cave; 2, Mt. Devora; 3, Mt. Tavor; 4, 'Ein el Assad; 5, Qiryat Shemona; 6, Wadi Malikh.*

and often more so (Hovers 1997). Still, evidence for the use of fire is considerably weaker than in the lower ones; visibly burnt sediments and burnt flints (either intentional or by-products of the use of fire) are rare. It may be that at the time of the upper layers (VIII–III) the terrace was only peripheral to the main occupation inside the cave, but it should be noted that the sediments have undergone *in situ* erosion. Because lithics are less vulnerable to the vagaries of diagenetic processes than ashy sediments or bones, the difference in their relative frequencies between the two stratigraphic blocks cannot be attributed solely to the effects of differential taphonomic processes. Whatever the reason, in the excavated areas of the cave's entrance the dichotomy between the upper and lower layers reflects a real behavioral difference.

The co-occurrence of burials (and hominid remains in general), intensive use of fire, ochre, and some inedible marine mollusks and their temporal clustering are striking. None of these types of finds were documented in the upper layers. Ochre processing did not fully overlap with the stratigraphic and spatial occurrence of the burials (the distribution of ochre was more clustered than that of the human remains in the excavated areas, and some ochre was found in layers that did not bear hominid remains [e.g., layers XXIV, XX]). Still, ochre utilization appears to have been part of a structured ensemble of behaviors. But what types of behaviors were they?

The answer to this question is more ambiguous in the cases of the mollusks and the hearths. For the former, in the absence of a detailed publication little discussion is possible. It is clear, however, that their occurrence was not associated with dietary habits, as they are of inedible species and occur in small numbers (Bar-Yosef and Vandermeersch 1993). By the same token, the possibility that the hearths found in lower layers were used in everyday practical contexts cannot be ruled out. In this case, the difference in the magnitude of the phenomenon between the two stratigraphic blocks of the Qafzeh sequence is circumstantially suggestive of fire use in contexts that were not strictly mundane during the time of deposition of the lower layers. For these two types of finds, there are no compelling indications that the phenomena as such were symbolic in nature.

The presence of human burials exclusively in the same stratigraphic block as the ochre is more telling. Despite arguments to the contrary (Gargett 1999 and references therein), a growing number of researchers now subscribe to the view that intentional burial existed in the Middle Paleolithic (Belfer-Cohen and Hovers 1992, Hovers, Kimbel, and Rak 2000, Hovers et al. 1995, Mellars 1996, Riel-Salvatore and Clark 2001, Tillier 1990). If so, such burials are, because of their intentionality, symbolic. Mellars (1996:381, emphasis added) has suggested that "at the *very least* we must assume that the act of deliberate burial implies the existence of some kind of strong social or emotional bonds [within Neandertal societies], which dictated that the remains of relatives or other close kin should be carefully protected and perhaps preserved in some way after death." Even in this cautious, minimalist view a symbolic component is implied, for the bones of dead kin are *at least* iconic of the living person in that they point to their referent by physical resemblance. In the particular case of Qafzeh Cave, the presence of a burial gift in one instance (the deer antlers with *Homo* 11 [Vandermeersch 1970]) and a double burial of an adult female and an infant (*Homo* 9 and 10 [Vandermeersch 1981]) suggest the existence of referential associations of a higher order. We interpret the occurrence of ochre with burials as a symbolic system in that we observe indexical relations between two sets of indices, with perceptually based representations being juxtaposed to create new abstract concepts (Goldstone and Barsalou 1998:167).

The process of learning to use a complex abstract system (symbols) instead of concrete, iconic associations as a normative referential framework is cognitively a difficult one. Deacon (1997) has hypothesized that mastering the ability to use symbols as a communications system required a two-stage process: hominids "were forced to learn [construct] a set of associations between signs and objects, repeat them over and over, and eventually unlearn [deconstruct] the concrete association in favor of a more abstract one" (p. 402). Ritual played a major role in this process because by definition it entails repetitive associations between particular sets of actions and particular sets of objects and thus aids the transition from concrete to abstract associations (Deacon 1997: 401–10). The redundant co-occurrence through time of ochre and burials in Qafzeh Cave is consistent with the patterns predicted where symbolic referential relations are being shaped.[4]

Possibly, the intensive use of hearths in the lower layers of Qafzeh Cave is to be understood in this context. While there is no evidence that fire per se had symbolic meaning, the redundant presence of intensive heating with the ochre-burial association may be understood in this broader context of symbolic behavior. The dichotomous occurrence of this "package" of behaviors in the stratigraphic sequence may reflect changes through time in site function (Bar-Yosef and Vandermeersch 1993, Hovers 1997). In this sense, the record of Qafzeh Cave depicts the shift from a structured symbolic system in the making to one that is established and requires less intentional investment (Hovers 1997).

IMPLICATIONS FOR THE EVOLUTION OF SYMBOLIC SYSTEMS

The human cognitive capacity for creating symbols may go back a long time. In his discussion of the most complex and variable symbolic behavior, Deacon (1997) argues that the processes that have shaped modern language have a long history and involve multiple levels of causality and constraints—genetic, neurological, oral-vocal, social, and semiotic. According to this view, changes in brain architecture (specifically, the expansion of the prefrontal cortex) at the transition from *Australopithecus* to *Homo* forms the core adaptation for language. The co-occurrence of large brains, stone tools, reduction in dentition, and changes in hand morphology already marks a socio-ecological environment that required symbolic solutions (Deacon 1997:348). Over time, the human brain and the capacity for symbolism evolved in tandem.

In accordance with the claim for early beginnings of the gradual coevolution of the brain and symbolism, the archaeological record of the Lower and Middle Paleolithic contains potential manifestations, albeit meager, of symbolic capacities. Red and black pigments are relatively abundant among these rare manifestations, and their presence is often mentioned in support of the view that symbolism is expressed in the early Paleolithic record (Bednarik 1992*b*; Bordes 1952; d'Errico and Soressi 2002; Marshack 1981, 1989; McBrearty and Brooks 2000; Wreschner 1983). Given the neuropsychological principles underlying human color perception and categorization and their postulated antiquity, evidence for the use of red and black pigments, let alone their mere occurrence in early prehistoric sites, may indicate the presence of cognitive capacities for categorization and symbolic thought. However, it does not in itself constitute evidence of symbol use in the context of a *cultural network*. The question of interest for this study has therefore been not whether the Middle Paleolithic occupants of Qafzeh Cave were capable of symbolic behavior but whether the ochre finds from the site indicate that such capacities had become a system of symbolic culture—that is, normative social constructs. Having established that such was the case, we now explore briefly the implications of this finding for the explanation of the emergence of such systems. The issue is of particular interest because it has recently been suggested that red ochre was at the core of the emergence of the earliest appearance of symbolic culture as defined here (Knight, Power, and Watts 1995, Power and Aiello 1997, Watts 1999).

On the basis of the abundant ochre record from Africa, whose beginnings can be traced to the late Middle Pleistocene, Knight, Power, and Watts (1995) and Watts (1999) have postulated that symbolic culture as a systematic behavior emerged within an African Middle Stone Age population of modern humans. Their line of reasoning is characteristic of the "symbols as tokens" approach in that it views symbols as information carriers and places their origins in rational behavior designed to satisfy material needs (Robb 1998). According to the suggested model, the use of ochre as the first cultural symbolic construct emerged as a sociobiological response to the reproductive stress experienced by females during the phase of encephalization associated with archaic *H. sapiens*. Menstruation was taken to indicate fertility, and ochre was used to fake menstruation in nonmenstruating females ("sham menstruation"), thus ensuring males' attraction to and support for a large number of females. For the fraud to be effective, the use of ochre had to be anchored in elaborate social dynamics (Knight, Power, and Watts 1995, Power and Aiello 1997). Put succinctly, Knight, Power and Watts (1995) see the first symbolic culture as the set of all such deceptive signals. Ochre was recognized as the signal for menstruation and thus came to stand for a biological phenomenon to which it had no relation in real life. They argue that the signal of menstruation, *appropriated from an individual by a collective*, communicated for the first time a "symbolic" construct, and because the symbol as such came into being only within a social context they view the use of ochre as the beginning of symbolic culture. Knight, Power, and Watts (1995) and Watts (1999) see clear indications in the African archaeological record that the beginnings of the postulated symbolic culture long antedate the production of representational imagery on inanimate surfaces (i.e., Upper Paleolithic rock painting). Watts (1999) accepts that the Middle Stone Age does not share the elaborate symbolic culture evident in the Late Stone Age (and the Upper Paleolithic in Europe) but maintains that all the essential elements appear to have been in place by, or shortly before, the Last Interglacial—within the Middle Stone Age 2 and approximately coincident with the emergence of anatomically modern humans. Significantly, he notes that the frequency and

4. Deacon discusses early hominids, presumably earlier than those of Qafzeh Cave. This seems to be irrelevant to the point that we are making here. The process of unlearning associations between signs and discrete objects in favor of abstract ones would have had to be repeated whenever a new symbolic framework was being structured.

intensity of the use of ochre increase gradually over time from the Middle Stone Age onwards.

A recent review (McBrearty and Brooks 2000) provides ample evidence to support the argument for early beginnings of ochre use, and new finds (e.g., Henshilwood et al. 2002) furnish evidence that it was used symbolically. However, the archaeological record as reviewed by McBrearty and Brooks poorly supports the explanatory model. Corroboration for the model is recruited from Khoisan ethnography, where menarchal rituals were documented as the context in which red pigments were almost invariably used (Knight, Power and Watts 1995; Watts 1999:134). This is problematic on several levels. Apart from the circular reasoning involved in such claims (and, in fact, unavoidable in ethnographic analogies), the worldwide survey of color symbolism summarized above indicates that the association of red with menstruation is not necessarily shared among all extant societies and is not the only referential association of red.

At Qafzeh Cave, an inductive approach to the ochre record shows that a symbolic explanation is the most parsimonious one for a number of phenomena observed in the archaeological record. The patterns of ochre utilization and the associations of ochre with other types of finds present hitherto unprecedented *archaeological contextual* support for the existence of symbolic culture and offer support for the identification of ochre as an ancient social symbolic construct. The same evidence suggests that the ochre at Qafzeh was used in symbolic contexts that differ from the scenario envisioned by Knight, Power, and Watts (1995) and Watts (1999). Given the specificity of the social construct, we cannot offer any insights into the meanings of the symbol per se, but we can venture a suggestion as to the general context of symbolic use of ochre. After the Middle Paleolithic, ochre was clearly associated with burials (Chase and Dibble 1987:280), and its use has been accepted by archaeologists as part of symbolic mortuary behaviors. The strength of the contextual evidence in Qafzeh is such that it permits the suggestion that it is an early (possibly the earliest) "prototype" of such behavior.

Unfortunately, Qafzeh Cave contains the only record of the Levantine Middle Paleolithic from which hematitic ochre has been reported. This record does not offer ready explanations of the processes by which ochre became part of symbolic culture, nor are such evolutionary insights likely to be gained from the relatively short record of a unique locality. But accepting as we do the claim for ochre's being a social symbolic construct from the time of the Middle Paleolithic, the comparison of the record from Qafzeh Cave with the patterns seen in the African record reveals interesting trends.

Symbolic culture seems to have existed by ca. 100,000 years ago in both regions, but the referential framework of ochre may not have been identical in Africa and the Levant at this early time. Color symbolism further diverged during the Upper Pleistocene. In Africa, the use of pigments has been continuous and overall has increased over time (McBrearty and Brooks 2000, Watts 1999 and references therein). Analysis of selection criteria indicates that the brightness and hue of color were the sought-after properties and has led to the suggestion that ochre was utilized mainly for body painting and/or for the decoration of perishable organic artifacts (Watts in Henshilwood et al. 2001, Watts 1999). A general conclusion about the use of ochre in symbolic contexts and/or to enhance stylistic traits is warranted here, although the contexts of symbolic use remain obscure.

An opposite trend can be observed in the Levant. Not only is Qafzeh Cave the only Middle Paleolithic site known to date that contains ochre but there are no indications for systematic use of ochre and/or other pigments during the Late Levantine Mousterian (80,000–45,000 years ago) and only a few occurrences during the Upper and early Epi-Paleolithic periods (45,000–12,500 years ago). When ochre is present in the latter contexts it occurs sporadically, usually in what appear to be utilitarian context (e.g., hafting of microliths and blades [Korn 2000]). Quantities of ochre increase only in the late Epi-Paleolithic period, in the Natufian and the Harifian entities, dating to 12,700–10,500 years ago and 10,500–9,500 years ago (uncalibrated dates), respectively (Korn 2000, Weinstein-Evron 1998, Zackheim 1997 and references therein). For the Natufian, ochre has been found in sites that contained burials. A relevant observation is that from the Middle Paleolithic on the pre-Natufian record of the Levant was depauperate of symbolic manifestations of any type. It has been suggested that the stability and availability of resources in the Levant necessitated smaller territories and caused social gatherings to be briefer and perhaps smaller in scale than, for example, in Europe. This in turn reduced the need for elaborate symbolic expressions (Bar-Yosef 1997 and references therein, Hovers 1990). If the use of ochre indeed started out as a symbolic construct in the Middle Paleolithic, its near absence from the record is congruent with this interpretation, suggesting that the social contexts in which it was used were rare in the Levant for most of the Upper Pleistocene. By that time, symbolic frameworks in the Levant may have diversified and focused on other, possibly nonmaterial signs (in contrast to the Middle Paleolithic, for which language is debatable, its use cannot be easily rejected for the majority of the Upper Pleistocene). The social and demographic impact of the shift toward reduced mobility could have been a driving force in the return to color symbolism in the late Epi-Palaeolithic.

The symbolic contexts of ochre use in the Levant and Africa seem to have differed already during the Middle Paleolithic/Middle Stone Age. Such diversification of the symbolic color system supports the argument for its antiquity although not necessarily the sociobiological explanation suggested for it. It is the trajectories of the ochre record in the two regions during post–Middle Paleolithic/Middle Stone Age time which speak of a rapid diversification of the content of the symbols employed in cultural systems, breaking the evolutionary constraints which may have driven its initial appearance. This later, independent development supports the identification of ochre utilization as an already deeply rooted symbolic construct attaining different meanings and different significance for the human groups that have used it in varied circumstances, as is the case with symbolic color systems in extant societies.

Comments

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The search for life on Mars and the search for evidence of symbol use before the Upper Palaeolithic have much in common. Both arouse passionate debate, and both phenomena would have profound evolutionary implications should they exist. Where astronomers and archaeologists differ is that astronomers know what to look for and can devise unambiguous criteria for testing their theories. Archaeologists have a body of data—artefact styles, subsistence and burial practices, long-distance exchange, modified objects, and pigment use, among others—that constitutes a common vocabulary for discussing early symbol use, but they do not agree on how or in what contexts symbol use might have occurred before the Aurignacian of western Europe. The result is extreme variation in the interpretation of the archaeological record, with Klein (2000) arguing for development of symbol use 50,000 years ago and Bednarik (1992*a*, *b*) recognizing symbol-based behaviours in the Lower Pleistocene.

Hovers et al. make an important contribution towards the development of a robust methodology for recognizing symbol use in the absence of "art." Associating themselves with Deacon's (1997) synthesis of the neurological and behavioural foundations of symbol use takes them to the heart of the problem—how to detect the material signatures of symbols when by definition symbols are social constructs that work in reference to other symbols. Fortunately for archaeologists, symbolic behaviour is embedded in the routines of daily life or habitual time (Gosden 1994), and through the repetitious structure of rituals it may leave material traces. Chase and Dibble (1987) regard the redundancy built into symbol-based systems as an essential criterion for recognizing their presence in the past. The occasional engraved or otherwise modified object found isolated in time and space (Bednarik 1992*a*) would not constitute sufficient evidence for symbol use by their standard or that of Hovers et al., so perhaps we are moving towards agreement. In the case of pigment use, we should look for systematic collection and processing of specific minerals, examine their properties as colorants, and consider the spatial, social, and potential functional contexts of their use before deducing a symbolic role. This contextual approach has been applied to the records of pigment use in Middle Stone Age southern (Watts 2002) and south-central (Barham 2002) Africa and is used to good effect in the case of Qafzeh.

Watts (2002) links ethnographic accounts of pigment use in southern Africa with his interpretation of archaeological pigments by referring to universal human categories of colour perception deriving from our primate heritage. Hovers et al. use this same neuro-optical link when analysing the selection of iron oxides by Qafzeh's occupants. Acknowledging the various functional interpretations of the use of iron minerals in general and dismissing each individually in this context, they make a persuasive case. Stripping out utilitarian options leads to the interpretation that a colour-based symbolic system was operating 90,000 years ago at this site. There is convincing geological evidence that red iron oxides were selected in preference to yellow hydroxides from the same source. Consideration of the broader context of pigment use supports their conclusion that these early modern humans engaged in various complex behaviours based on networks of symbols.

Research into pigment use has moved beyond cursory descriptions of the presence of ochres to detailed geochemical, quantitative, and experiment-based analyses of source materials and their modification. This analytical approach should become standard practice. There are collections that would merit reexamination under modern analytical techniques as in the cases of Qafzeh and Pech de l'Azé (d'Errico and Soressi 2002). The detailed presentation of the Qafzeh material is a valuable contribution to Palaeolithic archaeology. It may lead eventually to methodological consensus, but I suspect that life will be found on Mars first.

Whilst supportive of the methodology and conclusions, I feel that an opportunity was missed to place Qafzeh in the context of wider debate about an African origin for behavioural modernity. Reference is made to the African Middle Stone Age in the context of continuity of pigment use, but otherwise the European and African records are treated as a generalized pool of Middle Palaeolithic behaviours, overlooking potentially significant differences. While red and black are commonly used colours, black is predominantly a feature of the European record (Mellars 1996), and pigment use is sporadic among Neanderthals. In contrast, systematic pigment use associated with processing tools (grinding stones) appears about 300,000 years ago in south-central (Barham 2002) and eastern (McBrearty 2001) Africa. It occurs with the earliest Middle Stone Age industries in each region and may reflect new behaviours associated with the Acheulean/Middle Stone Age transition. In south-central Africa, hunter-gatherer pigment use continued to the historic present (Barham 2002). Such continuity is a real difference between the African and European records which deserves greater recognition. Qafzeh, as a lone example in the Near East, could be considered an extension of the African pattern of pigment use that is linked to anatomically and behaviourally modern humans.

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At the risk of being accused of nepotism, I would venture to say that this is one of the best-written, most coherent and balanced papers I have read on the issue of pigment use by prehistoric humans. It has it all: impeccably presented archaeological data, a solid background of facts and figures from other scientific domains (e.g., neurology, linguistics, ethnography), and theories concerning "symbolism." All of these are cross-referenced and discussed at length to explain the spatio-temporal patterning of ochre finds in Qafzeh Cave and to explore its implications for the evolution of symbolic systems.

I have but one comment or, better, cautionary note: In this paper as well as in others cited therein, one observes a search for a mental "achievement," mostly to do with the "claim for early beginnings of the gradual coevolution of the brain and symbolism." I may be wrong, but this emphasis seems somehow tied in with the search for evidence of becoming "clever," as in the particular scenario offered by Knight, Power, and Watts (1995) and Watts (1999). Eloquently presented in both the original publications and the paper at hand, it can be summed up as females' *discovering* the art of male deception to promote their own biological interests, that is, cheating on the enemy.

Self-evident as it may be, I think that in dealing with scenarios of a coevolution of the brain and symbolism one should make a point of referring to the realms of the human "soul," given that not only the human cortex but the human limbic system is unique (Belfer-Cohen and Hovers 2002). The authors describe an exceptional artifact, a large Levallois core, with thick, dense ochre residues in the deepest part of the large negative scar of the last removal (fig. 6). They consider it "possible that this core was recycled into an ochre receptacle" and cite references to that effect. This may be true, but there is an alternative explanation for the presence of the pigment in the core's deepest scar. In his overview of adze production among the inhabitants of the Langda plateau, New Guinea, Dietrich Stout writes: "Some of the deeper flake scars are usually left intact and may be painted with red and white pigments. These markings are both decorative and symbolically meaningful; Petrequin and Petrequin (1993) report on informants' 'giving life' to the adze by putting 'blood' in its wounds, while my own interviews suggest that pigmented adzes are reserved for use by men only" (Stout 2002:700). A Middle Paleolithic Levallois core is not a present-day Langda adze, but one should remember the complex relationship humans have with their *culture* (spiritual as well as material), production processes, and final products (e.g., Jones and White 1988). This is a cautionary note against taking the self-evident for granted or ignoring it, lest we find ourselves missing out on the "soul" while gaining on the "brain."

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Hovers et al. show that the people who occupied Qafzeh Cave 90,000–100,000 years ago collected naturally occurring pigment. From the reconstructed pattern of pigment utilization and the association of pigment with other kinds of finds, they argue that the people employed pigment mainly for a nonutilitarian purpose such as body (possibly dead-body) painting as opposed to a more mundane purpose such as hide tanning. Others have suggested broadly similar nonutilitarian pigment manipulation by contemporaneous or somewhat more recent Middle Stone Age people in southern Africa (Henshilwood et al. 2002) and by Mousterian people in France (Bordes 1952, d'Errico 2003). Pigment manipulation may thus be added to other advanced behaviors, such as a sophisticated ability to flake stone, control over fire, burial of the dead, and the recurrent hunting of large mammals, that Mousterian and Middle Stone Age populations shared with each other and with succeeding Upper Paleolithic and Later Stone Age people after 50,000 years ago. Arguably Mousterian and Middle Stone Age people inherited most of these behaviors, including pigment use, from a shared Late Acheulean ancestor.

These researchers and others believe that nonutilitarian pigment manipulation implies "symbolic culture," and this raises the question why Mousterian and Middle Stone Age people left little or no unambiguous evidence for representational art, jewelry, burial rituals, or other symbolic indicators that mark the Upper Paleolithic and the Later Stone Age. One possibility is that only Upper Paleolithic and Later Stone Age people possessed the biological (neural) capacity for full symbolic culture. Another is that Mousterian and Middle Stone Age people had the capacity but routinely expressed it only after they had crossed some as yet undetected technological, social, or demographic threshold about 50,000 years ago.

Archeology alone cannot eliminate either alternative, but human fossils help. These show that European Mousterians were Neanderthals, Middle Stone Age Africans were anatomically modern or near modern, and Upper Paleolithic/Later Stone Age people were the descendants of Middle Stone Age people who expanded from Africa to Eurasia beginning about 50,000 years ago. Their expansion appears to have been grounded in the development of fully modern ("symbolic") culture, and its appearance only about 50,000 years ago would explain why anatomically modern or near-modern Africans failed to spread to Eurasia before then. Archeology, human fossils, and the genes of living people suggest that the spread occurred without significant cultural and genetic exchange between modern human invaders and Neanderthals or other nonmodern Eurasians. In this respect, it differed significantly from subsequent well-documented prehistoric and historic population expansions, in which invaders and indigenes usually engaged in substantial cultural and genetic exchange. A plausible explanation for the difference is that the Neanderthals and their nonmodern Eurasian contemporaries were biologically (neurologically) incapable of adopting the more sophisticated culture of the invaders, while the invaders saw no advantage in the more limited culture of nonmodern people.

Recent research suggests that it may be possible to isolate genes that bear on modern cognition or communication (Enard et al. 2002), and future research may show that a particularly crucial gene achieved its present form about the time that modern humans spread from Africa. In this event, it would be reasonable to infer that genetic change underlay the development of full symbolic culture. Nonutilitarian pigment manipulation by earlier people would then mean only that they were cognitively advanced in the direction of modern humans, not that they were cognitively the same.

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Hovers et al. convincingly argue that the Qafzeh ochre record belongs to an organized system of symbols. This corroborates a growing body of research results (most recently Barham 2002, Watts 2002) implicating habitual red ochre use in the emergence of symbolic culture identified with African modern humans between 100,000 and 200,000 years ago rather than with the Eurasian Middle/Upper Palaeolithic transition. Their broad theoretical approach is refreshing. We welcome their engagement with our explanation for the ochre record (Knight, Power, and Watts 1995) but query the reductionism apparent in much of their approach. Can the "basic colour triad" described by Turner among the Ndembu plausibly be mapped to ancestral primate trichromacy? The Ndembu triad includes black and white, which do not involve mechanisms of colour perception at all (De Valois and De Valois 1993, Abramov 1997), and certain cultures have only two terms—not "black" versus "white," as Berlin and Kay (1969) originally proposed, but composite "light/warm" versus "dark/cool" (D'Andrade 1995, Kay et al. 1997, Heider 1972). Had Berlin and Kay's original formulation been correct, we might have expected black (and white) pigments to predate red ones. Colour reference, however, has evolved in adaptation to both the human nervous system (with its biases) and the pragmatic constraints of habitual use (Deacon 1997, Watts 2002).

Hovers et al. acknowledge ritual's role in installing symbolic representations in human minds. Key to hunter-gatherer symbolic inheritance is *initiation*. This is always in some sense a "death" followed by "rebirth" (Van Gennep 1960 [1908]), making it misleading to assign mortuary symbolism to a separate and unrelated category. For females, initiation coincides roughly with first menstruation, but regardless of sex, artificially amplified "blood" signals (e.g., circumcision, subincision, cicatrization, nose-bleeding) recurrently connote concepts variously translated as "temporary death," "resurrection," "fertility," "ritual inviolability," etc. (Knight 1991).

Hovers et al. proceed as if language as an abstract entity could be detached from the study of materially embodied symbols. But Darwinian theory tells us that for signals to be effective they must be reliable and to be reliable they must be *costly* (Zahavi and Zahavi 1997). Words are cheap, hence ineffective in signalling commitment. An additional framework is required to establish the reliability of verbal signals, and we argue that ritual—in proving commitment to in-group honest communication—serves this purpose (Knight 1998, 1999, 2000, 2002; Power 1998, 2000). Hovers et al. demonstrate that the procurement of the Qafzeh pigments entailed greater investment in time and energy than would be predicted on strict grounds of cost-efficiency. Blood is costly, and so is high-quality ochre. It is precisely this costliness that proves that ritual participants "mean it."

Archaeology necessarily draws on ethnographic analogy. The critical point is how tightly constrained this is. Our point of departure was not ethnographic observation of pigment use. We developed a purely theoretical model that led us to specific predictions testable against the fossil, archaeological, and ethnographic records. Our model predicted certain cross-culturally invariant—"time-resistant"—*syntactical* features of magico-religious tradition. We chose to test it against Khoisan cosmology because of the geographical focus of our research, the time depth of Khoisan genetic lineages, and the cultural continuities between recent Khoisan and Later Stone Age traditions. It was on Darwinian grounds that we focused on menstruation, but ethnography provides cross-cultural evidence of ritually constructed taboos on symbolically "menstruating" initiates. We argued that the symbolic domain was born as such prohibitions and rituals became regularly established. Hovers et al. observe that menstruation "is not the only referential association of red." Obviously not. But we never suggested that ochre must necessarily "refer" to "menstrual blood." Ritual is not referential but performative—it constitutes its own "truth" (Rappaport 1999). In our model, ritually displayed red cosmetics invoke and sustain collective representations translatable not narrowly as "menstruation" but more broadly as "fertility," "supernatural potency," etc. We made predictions about the form of such metarepresentations (see esp. Power and Watts 1999) and about when in the archaeological record we should first expect pigment use, when we might see a shift from irregular usage, and which colours should be selected.

A manganese/burial co-association at Qafzeh would have falsified our model. Again, with the hypothesized "sham menstruation" strategy being driven by the reproductive costs of encephalization between 500,000 and 150,000 years B.P., the model would be falsified if *Homo erectus/ergaster* used pigment or, alternatively, if such a ritual tradition arose only after brain volumes in modern humans had already stabilized. There is no compelling evidence for pigment use predating the middle of the Middle Pleistocene (Watts 1999, Barham 2002), and there are no reports of black pigment predating the Late Pleistocene. Watts (1999) reported a *dramatic* increase in red ochre use in the southern African Middle Stone Age rather than a "gradual" increase "from the Middle Stone Age onwards." This increase was tentatively placed in the early Late Pleistocene; revised dates for the Border Cave sequence (Grün and Beaumont 2001) may push this back to the terminal Middle Pleistocene, while Barham's (2002) and McBrearty's (1999) research suggests that regular use may be earlier still in the African Tropics. Claims of ubiquity, particularly those made by Bednarik (1992*a*), need to be carefully evaluated.

The temporal contrasts that Hovers et al. draw between the Levantine and African ochre records are interesting, but we don't know how significant a presence modern humans had in the Levant during the Late Mousterian. Furthermore, an absence of ochre need not imply a lack of interest in red pigments—in the Kalahari, scarcity obliged Khoisan to employ plant substitutes (Watts 1999:133), and henna is widely used in the Near East. Hovers et al. argue that the symbolic contexts of ochre use in the Levant and Africa differed as early as the Middle Palaeolithic/Middle Stone Age, but all that we can be sure about is that, in contrast to their Levantine counterparts, Middle Stone Age people did not bury their dead in caves.

Finally, where symbolic culture exists, local symbolic meanings will vary. What strikes us is that, regardless of variability on this level, structural features of ritual show extreme conservatism, red pigments being used to generate multiple meanings. It is on this syntactical level that our model can account for such recurrent features as red-ochre burials in the global archaeological record of modern humans in the Late Pleistocene.

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Much of the debate concerning the origin of modern human behavior stems from disagreements about what constitutes symbolic behavior and what standards of proof are required to establish it. I am pleased to see a paper that situates this discussion firmly in the material world, independent of unverifiable speculation about language or the nature of the symbolic content itself. The method employed here, treating archaeological remains as tokens, may ultimately prove to be as important to understanding Paleolithic symbolic behavior as it has been to clarifying the origins of writing (Schmandt-Besserat 1996).

Hovers and her coauthors provide solid empirical evidence for the collection and manipulation of ochre in the Levantine Middle Paleolithic. The archaeological, lithological, chemical, and mineralogical evidence provided here supports the conclusion that the ochre was selected for its color properties, that it was transported to the site, that coloring matter was obtained by scraping it with stone tools, and, intriguingly, that it was perhaps further processed in the concavity of a Levallois core. I think that the case for ochre, fire, and burials functioning together as a symbolic system is less firmly established. The materials do not seem to be in direct archaeological association, and the debris in which they are found is estimated to have accumulated over a period of perhaps 10,000 years.

It would be very interesting to compare the behavior reflected in the lower, ochre-bearing levels at Qafzeh, presumably the product of anatomically modern *Homo sapiens*, with that in the upper layers, apparently accumulated by Neanderthals. Lieberman and Shea (1994) have outlined a model for the Middle Paleolithic of the Levant which contrasts the foraging behavior and ranging strategies of modern humans with those of Neanderthals. Does the Qafzeh evidence support or refute their ideas?

The linguistic evidence for the universality of red in human color classifications (Berlin and Kay 1969) is strong circumstantial evidence for the very great antiquity of the color red as a symbolic category. While I happen to believe that the use of ochre is in itself evidence for symbolic behavior, I doubt that this paper will convince those who do not share my view, and no doubt utilitarian uses for the ochre will be invoked.

One of the most difficult tasks for the prehistorian is to identify the emergence of novel behaviors. The challenge is similar to that encountered in recognizing the origin of biological species. The earliest members of a new species will be few and will probably resemble not only their ancestral but also their sibling species. Traits in a new species may be hypervariable until they are canalized by adaptation, sexual selection, or other weeding-out processes. Similarly, it may be problematic to recognize innovations in the archaeological record prior to their becoming stereotypical or "normal" behavior for the society.

Populations of both Neanderthals and early *H. sapiens* were geographically widespread, and one would not expect the behavior of either of them to have been uniform throughout their range. Specific case studies such as the one provided here allow a richer view of the behavior of *H. sapiens* in the Levant of 90,000 years ago, and it will be interesting to compare it with cases of pigment use elsewhere at a similar time depth.

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Hovers et al. provide important archaeological and geological evidence for the use of ochre during the late Middle Paleolithic at Qafzeh Cave. Their paper is a significant addition to the recent discussion of the Middle Paleolithic use of ochre at Blombos Cave (Henshilwood et al. 2001, 2002). The far earlier Middle Paleolithic cave of Beçov in Middle Europe, ca. 250,000 B.P., produced a piece of intentionally striated ochre, an abraded quartzite rubbing stone, and a huge quantity of ochre powder dispersed in a circle around the stone on which the abrader had sat (Marshack 1981). The feet of the abrader were outlined on the ground as ochre-free, negative footprints. Particularly important was the fact that a piece of ochre, a rubbing stone, and apparently a container had been brought from different places to this particular cave at a particular time for a particular purpose—processes similar to those inferrable for the use of ochre at Qafzeh and Blombos. The production of ochre at Beçov, while archeologically and quantitatively unique for the period (see Chase and Dibble 1987, Chase 1991), was clearly a learned, *cultural and social* behavior under frontal-lobe mediation and probably therefore, at some level, "symbolic."

There was no evidence that ochre had been produced elsewhere in Beçov or anywhere else in Middle Europe during this period, and Chase and Dibble would consider this quantitative singularity a statistical argument against Middle Paleolithic "culture" or the cultural use of ochre. There may, however, be a need for caution in drawing such an inference. The Middle Paleolithic hunter-gatherers at Beçov were seasonally mobile. Social, cultural, and ritual events would therefore have been *periodic* and place-and-time-specific, as in a regional aggregation, or *aperiodic*, as in the death of an elder, a birth, the failure of a resource, or a sudden epidemic. The lower levels at Qafzeh represented ephemeral seasonal camps (Bar-Yosef 1994:43). The production of ochre in these early cultures may thus always have been time-, context-, and place-specific and so not always available archeologically. Besides, the major rituals or burials of mobile hunter-gatherers are often conducted not within the habitation cave or on its terrace but in a culturally specified ritual place (Marshack 2001). It is likely that early ochre was often prepared and used elsewhere and that its absence from a particular cave would not denote its absence from the culture.

There is another problem. Hovers et al. note that one of the trichromatic colors is white. White is an important color in body painting and other modes of surface decoration. In the Franco-Cantabrian caves, white was effectively used within images by leaving areas of limestone wall blank or by scraping a coating of surface clay or dust to create an area of white. The bichrome "Chinese horse" in Lascaux has an unpainted white underbelly that is indexical of the dark creamy tan of its summer coat. Could white have also been used as an applied color, say, in body painting, during the Levantine Paleolithic or the European Upper Paleolithic and not be evident archeologically?

In the Middle Magdalenian decorated cave of Bedeilhac (Ariège) a large number of flat, irregularly shaped clay plaquettes had been peeled and lifted from the ground and incised with images. One hand-sized pure-white clay or "chalk" plaquette (11.5 × 8 cm (Field Museum # 212709) differed from the others in that while the rear retained its original sharp edge of breakage the front half had been lightly abraded and thinned to produce a white powder, shaped to a point, and, as the edge polish revealed, used as a pencil or crayon to mark a smooth surface—probably a skin garment or a human body in a ritual (fig. 1). After use for its color it had been symbolically incised (see Henshilwood et al. 2002 for the overmarking of ochre at Blombos Cave).

These rare data pose a number of interpretive problems. Red and red ochre have profound affective and symbolic resonance, but white, through less common archeologically, has its own powerful semantic: in bones, skulls, and skeletons. White is common as body paint in shamanic and popular ritual and, like black, is symbolic in many cultures. However, white paints, when derived from a mixture of water and clay or chalk, would probably not have survived archeologically as well as ochre, manganese, or charcoal. White would surely have been effective in human perception and the functional color palette. Have archeologists investigated the sources and possible uses of Middle and Late Paleolithic clays and chalk as a possible pigment?

Hovers et al.'s paper has made it possible to address a number of issues. Reference to human neurology in an attempt to understand the human productive, cultural, and symboling capacity and its relation to the archeological record has taken many routes, but, as far as I know, this is the first paper to discuss trichromatic hu-

FIG. 1. *Pure white chalk plaquette (11.5 × 8 cm), abraded to produce a white powder and then used as a crayon, probably for ritual marking of a body or a hide. Magdalenian IV, Bedeilhac (Ariège).*

man perception as an aspect of early, pre-Upper Paleolithic symboling behavior.

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Hovers et al. are to be congratulated for advancing our understanding of prehistoric colour systems in a major way. Their detailed analysis of ochre procurement and usage by the Middle Palaeolithic occupants of Qafzeh Cave is as persuasive as it is thought-provoking. They argue that layers XXIV–XVII, the ochre-bearing deposits at Qafzeh, represent a unique episode in the history of the site, specific to the conditions of the time, in which the hominids found themselves constructing new social behaviours that in part revolved around colour symbolism. Moreover, for reasons presumably associated with different modes of symbolic expression, ochre usage all but disappeared in later layers at the site.

It seems that the Qafzeh hominids most likely had a number of desirable criteria in mind when they targeted the nearby ochre sources (ferruginous oolites embedded in sandy limestone) at Mt. Devora and Mt. Tavor. Hovers et al. quite correctly suggest that the hominids probably valued a range of characteristics in the ochre, which may have included texture as much as colour. Certain modern societies also value the lustre that can be obtained from ochre with specific impurities. While the silty quality of the archaeological samples found in the cave at Qafzeh may have been more desirable than matrix from the sources that were not exploited (veins of iron oxide in dolomitic rocks and ferruginous concretions), it would also be useful to know how they compared in terms of colour (i.e., content of iron oxide). If these unexploited sources are indeed redder, it could support the idea that although *redness* was the preeminent attraction, the intensity of red was not necessarily the sole criterion. There is good evidence that certain Australian Aboriginal communities, for instance, bypassed ochre sources that were very red and embedded in undesirable matrices in favour of less colour-saturated sources that had a more desirable plasticity.

While it seems, judging from the absence of random samples of yellow ochre, that goethite was not heated at Qafzeh, I am not sure I would agree that mining and subsequently heating goethite would have required a greater investment of time and energy. Goethite can be transformed into red haematite quite readily—it would have simply required "roasting" of the lumps of ochre in an open fire. If a source of ochre is interleaved or speckled from yellow through red, collecting ochre as it came, irrespective of colour, and then heating it might in fact have been less time-consuming than following haematite veins.

Hovers et al. distinguish between practical and symbolic uses of ochre. This distinction concurs with traditional views that often separate subsistence strategies and related activities from ritual and ceremony, which are conventionally viewed as epiphenomenal. Increasingly, however, the argument is that the boundaries between the cultural, natural, and economic worlds of the past were blurred and were rich in symbolic meaning (Bradley 1998, 2000; Gosden 1994). Therefore, while ochre may not have been used for tanning hides (a "practical" activity) at Qafzeh, for instance, we should not assume that such an activity was necessarily devoid of symbolism.

I find the idea that the hearths in the ochre-bearing layers at Qafzeh may have had symbolic meaning a tantalizing one even though the authors choose to err on the side of caution. For later prehistoric complex societies, especially the highland communities of Anatolia, for example, there is a growing body of contextual evidence that the hearth was not only the focus of the household but, through an association of deliberately placed objects, had a multiplicity of purposes ranging from utilitarian to ritual (Sagona 1998). Similarly, there may well have been a package of symbolic elements of the Middle Palaeolithic including the hearth as the authors suggest.

Finally, the Qafzeh data make one reflect on the extraordinary longevity of the symbolism of red, which has persisted into modern times. Although ubiquitous, ochre usage was nonetheless historically and culturally contingent. In terms of colour symbolism what is so intriguing is that certain societies—early Archaic states in the Near East, for instance—appear to have abandoned, wholly or in part, their attachment to red in favour of blue (Sagona 1996). This change in symbolism appears to have embraced a new set of values and social constructs. While we shall never know what the colours actually meant to the people who used them, it is worth making a suggestion. If at Qafzeh we see the beginnings of red as a symbolic colour for life, vigour, blood, fertility, and so on, the appearance of blue may represent the need for an apotropaic colour at a time when there was a conspicuous increase in personal wealth and prestige.

Reply

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We thank the editor of CURRENT ANTHROPOLOGY, Ben Orlove, for insisting on our turning a lengthy technical report on the ochre of Qafzeh Cave into a broader (and even lengthier) article. We thank the commentators for their thoughtful and illuminating responses. It pleases us that all of them see much merit in the presentation of the data and in the analytical methods we employed in our study and that, to varying degrees, they accept our conclusions. The commentaries are diverse and rarely focus on the same issues, and this dictates brevity in our response to each of the points raised.

Some of the comments address specific properties of the ochre assemblage of Qafzeh Cave. Sagona questions the robusticity of the selection criterion based on the color red. Analyses of ochre sources in the area of Qafzeh Cave (mentioned but not presented in the article) indicate that the color of ochre there is more often yellow (goethite) than red. However, ochre from these sources is sometimes harder than the common ochre at Qafzeh. We do not doubt that texture was a criterion that helped form decisions as to *the particular exposure* to exploit, since the softer silty material would have been easier to scratch and grind into powder. But if red was not the preferred color, more goethite from the same source would be expected.

Sagona also wonders whether the heating of goethite collected at the same source would have increased the cost of the utilization of ochre. The answer is yes. At the time of writing we had submitted several pieces of ochre from Qafzeh Cave to luminescence analysis but did not yet have the data to address the issue directly and relied on reasoning to make the argument that ochre was not heated. The recent publication of preliminary results of the analysis (Godfrey-Smith and Ilani 2003) shows that some goethite may have been heated. However, red becomes black if the temperature rises above 450°, far below the 1,000° reached in a hardwood hearth. The fact that a few lumps of goethite turned red but none turned black suggests that temperatures were closely controlled and the heating was not accidental. Apparently, turning yellow goethite to red ochre was not simply "roasting" it in the fire but a complex and time-consuming procedure. As is emphasized by Knight et al. in their comment, high-quality red ochre is costly. Combined with the overall paucity of yellow goethite in the assemblage, this is another indication that red was a desired quality.

Belfer-Cohen, McBrearty, and Sagona reflect on the meaning of ochre in this particular case study and in the archaeological record in general. While their specific points differ, their comments go beyond the immediate case to issues of hypothesis building, on the one hand, and epistemology, on the other. In recognition of the elusiveness of symbolic behavior and the difficulty of testing and refuting hypotheses about symbolism, we presented an inductive study that incorporated attempts to refute a number of working hypotheses about the nonsymbolic nature of the ochre assemblage. McBrearty, a self-professed believer in the symbolic use of ochre, points out that utilitarian uses for the Qafzeh ochre will doubtless be invoked. Probably so—we likely did not address all the potential utilitarian explanations for the presence of ochre—but we believe that we presented a strong enough case for the symbolic use of ochre that notions about additional utilitarian uses are no longer necessarily the most parsimonious explanation. Quite to the contrary, Belfer-Cohen cautions against a too materialistic, "brainy" as opposed to "soulful" reading of the evidence, while Sagona notes that "utilitarian" (for want of a better term) uses of ochre may in fact have been symbolic as well. Both points are well taken, and some archaeological cases (e.g., Inizian 1976) have indeed been interpreted in this way. We of course agree that the soul was involved in symbolic activity at any given time in the human past. In the specific case of Qafzeh, one should bear in mind that we were trying to evaluate the case for symbolism in a period for which its existence is not a trivial notion. Our policy was to formulate working hypotheses that went against the argument for symbolism, test them with the archaeological evidence, and make an interpretation based on parsimony. Here we concur with Speth (n.d.) that "parsimony—giving priority to the simplest explanation—is not a fact of the way nature works but a reflection of our inability to grasp and deal with the complexity of the real world" (see also Klein 2000:28). Beyond that, as observers of rather than participants in the postulated symbolic system of Qafzeh Cave we chose to err on the side of caution in our interpretations of the record and possible symbolic contents of artifacts. For this reason we discussed only in general terms the idea of the diversification of early color symbol systems. The clarification by Knight, Power, and Watts that they expect such variation in the symbolic contents of local systems broadens the scope of their original model significantly and is welcome in itself. This expected evolutionary pattern might not interfere with drawing high-relevance analogies from present societies to the prehistoric past. Still, they have not engaged in any treatment of dissimilarities between a wide range of sources and their subject—a criterion that is recommended for evaluating the strength of a relational analogy (Wylie 1985)—and it remains unclear how a highly relevant ethnographic analogy (Watts 2002) can be used both as a building block of a model and as a test of that model.

A number of comments are concerned with the meaning of the Qafzeh ochre record in the context of the origins of behavioral modernity. Qafzeh Cave is well known as an early occurrence of anatomically modern human remains that are far better preserved than those in African Middle Stone Age sites (Klein 2000:26; Klein and Blake 2002:224–27). There are no Neandertal remains anywhere in the sequence of the site and no compelling indication of a change in the lithic assemblages that might suggest a change in population (Hovers and Raveh 2000), to the degree that such a distinction is possible. The disjunction in the characteristics of the ochre cannot be related to the existence of two different populations. For the Levant in general, the behavioral differences suggested to have existed between Neandertals and moderns (Lieberman and Shea 1994) have not withstood testing in terms of methodology and biological and archaeological evidence (Hovers 1997; Lieberman 1998; Speth and Tchernov 2001, n.d.; Stutz 2002). From a broader geographical perspective, Barham, McBrearty, and Knight, Power, and Watts see a clear dichotomy between the African Middle Stone Age and the European Middle Paleolithic in behavioral modernity. Explicitly or implicitly, they view the ochre record from Qafzeh as vindicating the idea that the Levant should be perceived as a geographical extension of the African Middle Stone Age (see Klein 1995, 1999, 2000; Klein and Blake 2002) and is therefore expected to be different from the Middle Paleolithic record of pigment use in by Neandertals in Europe. How much of the observed difference is the result of research history and/or bias is to some extent an open question. Before the publication of this work, for example, Barham was likely to include Qafzeh Cave in the European "color-depauperate" realm on the basis of the single lump of ochre published from this sequence (Vandermeersch 1969). As he points out, there are old collections that merit reanalysis by modern techniques. We would suggest that this reexamination be expanded to include white and black ones, if any, to which (as Marshack points out) little attention has been paid in the past. This would certainly be in line with linguistic studies of color terms and of the neural, psychological, and physiological infrastructure of trichromatic vision in humans. We should also bear in mind that nonutilitarian artifacts found in Middle Paleolithic sites have sometimes been considered intrusions from Upper Paleolithic horizons, and their cultural and chronological affinities have not always been examined seriously (e.g., Bar-Yosef 1988, d'Errico et al. 1998, Zilhão and d'Errico 1999). The fact is that when pigments and/or other types of nonutilitarian objects occur in Eurasian Middle Paleolithic sites, there is often a co-occurrence of several types of such finds (Hovers, Vandermeersch, and Bar-Yosef 1997 and references therein) which may suggest more than just random coincidence and possibly merits in-depth contextual study. Finally, we draw attention to the fact that burial has so far been encountered in Middle Paleolithic Europe and the Near East but not in African Middle Stone Age sites. As Knight, Power, and Watts suggest, this may be due to the fact that mortuary behavior was different in the two regions—but then the same logic can be applied, on the basis of current evidence, to the use of pigments in general and ochre in particular in Neandertal Europe.

Klein emphasizes a temporal dichotomy, with hominids in both Africa and Europe having essentially the same nearly but not fully modern behaviors until 50,000–40,000 years ago, when neural changes kicked in to create "us" and a late "Out of Africa" dispersion took place. While the growing body of genetic evidence points to the separation of *H. neanderthalensis* from *H. sapiens*, age estimates for this speciation event remain variable (e.g., Ingman, Pääbo, and Gyllensten 2000, Knight 2003, Krings et al. 1999 and references in these works). The dating of the FOXP2 gene, which may be implicated in the ability to make the mouth and facial movements essential to speech, to 200,000 at the earliest (Enard et al. 2002) is controversial (Balter 2002). Indeed, this study raises the hope that future research may underpin a clear relationship between genetic changes and dispersal events out of Africa—but not just yet. Moreover, the FOXP2 gene may have been selected for "*precisely* because it improved vocal communication *once language had already evolved*" (Pääbo, in Balter 2002, emphasis added). Its evolution into its known modern form may in fact point to the earlier existence of language. Archaeologically, the Late Out of Africa model may with some difficulty explain the European Upper Pleistocene record but not that of the Levant prior to 50,000 years ago. The Qafzeh Cave ochre record clearly satisfies the criterion established by Chase and Dibble (1987) and by Klein, namely, that credible claims for modern human behavioral markers before 50,000 years ago "must involve relatively large numbers of highly patterned objects from deeply stratified, sealed contexts" (Klein 2000: 28). A number of African sites possibly attest to similar patterning from roughly the same and even earlier time (Barham 2002; Brooks et al. 1995; Deino and McBrearty 2002; Henshilwood et al. 2001, 2002; Yellen 1996, 1998; see discussion in Klein 2000). These occurrences can (with difficulty, we believe) be explained as the products of humans who were "cognitively advanced in the direction of modern humans," as Klein suggests. But what is to be made of the Levantine Upper Paleolithic record post–50,000 years ago, in which little of the traditional package of "behavioral modernity" is to be found beyond the proliferation of blade technologies (Belfer-Cohen 1988; Hovers 1992, 1997)? The overall picture would seem to suggest that both *H. neanderthalensis* and *H. sapiens* had the capacity for symbolic behavior and that the difference in the expressions of this capacity may be due to demographic and social circumstances more than to biological differences. The sporadic and erratic expressions of modern behavior in the Eurasian Middle Paleolithic (and, indeed, the Upper Paleolithic as well) may reflect the instability of mechanisms of long-term communal memory and failure to retain and inherit social knowledge, possibly due to the instability of demographic systems. This would also account for the different trajectories of establishment and development of modern human behavior in various geographical regions (Belfer-Cohen and Hovers 2002, Hovers and Belfer-Cohen n.d.).

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