RESEARCH ARTICLES

OCHRE IN THE MIDDLE STONE AGE OF SOUTHERN AFRICA: RITUALISED DISPLAY OR HIDE PRESERVATIVE?

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ABSTRACT

Symbolic and utilitarian interpretations have been proposed for red ochre use in the African Middle Stone Age, but these have rarely been developed. . This paper reviews the hypotheses, recasts them in more explicit form and addresses the need for basic data for quantifying and describing ochre assemblages and for synthesizing observations across a range of sites. Percentages of utilized material, by geological form and streak, from Late Pleistocene shelter sequences in southern Africa are used to investigate past selective preferences. Materials with saturated red streaks are disproportionately represented among utilized pieces, particularly among crayons. The findings are most consistent with use as pigment in a costly signalling strategy involving ritualized display. Theoretical and substantive grounds are given for inferring that the context for such display was probably collective ritual.

Introduction

The presence of red ochre or haematite has been noted at most Middle Stone Age (MSA) shelter excavations but, with few exceptions (e.g. Barham 2000), site reports fail to present data on raw material variability, proportions utilized, temporal variation. In some cases, they fail to present any quantitative data whatsoever (Thackeray 1989; Avery et al. 1997). This is unfortunate, as understanding ochre use has become important in current re-evaluations of the MSA (Barham 1998; Watts 1999; McBrearty & Brooks 2000; Deacon 2001) and in wider debates concerning the evolution of symbolic culture (Klein 1995, 1999; Knight et al. 1995; Mithen 1996; Stringer & McKie 1996; Deacon 1997).

Ochre is a general term for any ferruginous earth, clay, mineral or rock containing sufficient haematite (an iron oxide) or iron hydroxide (e.g. goethite) to produce, respectively, either a red or yellow streak (Bateman 1950; Jercher et al. 1998). It is typically a weathering product where residual concentration and oxidation of iron (with or without hydration) has occurred in complex mixtures with other minerals (predominantly quartz, clay and mica).

Ethnographically, red ochre is the most widely used earth pigment, applied to human bodies and cultural artefacts in the course of symbolic practice, especially rituals. Archaeologically, red ochre is reported from two of the world's earliest modern human burials, at Qafzeh in Israel (Vandermeersch 1969, 1981) at c. 100 kya (Valladas et al. 1988) and the earliest burial in Australia at c. 62 kya (Thorne et al. 1999). Ochre is not reported from Neanderthal burials (Riel-Salvatore & Clark 2001) but, following colonization of Europe by *Homo sapiens*, the majority of burials dating to the early and middle Upper Palaeolithic also contained ochre (Aldhouse-Green & Pettitt 1998; Mussi 2001; Riel-Salvatore & Clark 2001). This suggests that the ethnographic pattern of habitual ritual use is of great antiquity and may be species-specific. If we accept that modern humans have a recent African origin and only began to migrate beyond Africa within the last 100 kya (Hedges 2000), then parsimony would predict use of red ochre in ritual contexts as an established part of early modern human behaviour prior to initial migrations.

However, in Africa, nearly all archaeological associations and contexts that make a symbolic interpretation of ochre-use fairly compelling (e.g. ochred ostrich eggshell beads, rock-painting, ochred burials) are Later Stone Age (LSA), post-dating c. 30 kya (but see Henshilwood et al. 2002). The issue is further complicated because ground pieces of red ochre have much greater antiquity. In Europe, India and Africa occasional pieces date back about 250 kya (Knight et al. 1995) while considerable quantities of ochre have recently been reported from several slightly earlier MSA contexts in south-central and eastern Africa (Barham 1998, 2000; McBrearty 2001). Most MSA archaeologists have inferred that utilized pieces were ground to produce a pigment powder for use primarily as body-paint and possibly the decoration of other organic surfaces (Tobias 1949; Mason 1962; Volman 1984; Walker 1987; Clark 1988; Deacon 1995). This interpretation has rarely been robustly presented and more utilitarian roles have been proposed—the most frequently raised alternative being hide-preservation (Wadley 1993, 2001; Klein 1995, 1999; Mithen 1999).

Evaluation of these contending interpretations has been hampered not only by inadequate data but also by under-theorization of ochre-as-pigment hypotheses, insufficient evaluation of the bases for utilitarian hypotheses and a failure to specify divergent archaeological implications. Here, these interpretations are recast in more explicit form so they may direct observation and evaluation of the archaeological record. The body of the paper concerns a descriptive study of southern African MSA ochre assemblages. Low-level observations are presented on assemblages from eleven shelter sites (treating Klasies River Mouth as a single depository) with Late Pleistocene (beginning 128 kya) sequences predating c. 17 kya. General attributes of the assemblages are outlined, drawing attention to regional variability, selective preferences (based on rates of utilization among geological forms and colour categories) and extremes of high-quality pigments on the one hand and questionable ones on the other. Many of the observations were subjectively made but I am reasonably confident that any biases are fairly consistent and that a more standardized classification would provide similar overall results to those reported here.

Ochre-as-pigment hypotheses

Lacking direct evidence as to how ochre was used in the MSA, proponents of ochre-as-pigment have relied on ethnography (Tobias 1949; Boshier & Beaumont 1972; Deacon 1995), presumed selection for visual salience (Boshier 1969; Dart & Beaumont 1969; Deacon 1995) and the crayon- or pencil-like morphology of some abraded pieces (Deacon 1995). Perhaps because the interpretation has seemed intuitively obvious, these approaches have been poorly substantiated.

Ethnographic precedents do not constitute an analogical argument (Lewis-Williams 1991); relations of relevance (Wylie 1985, 1988; Stahl 1993) linking source-side and subject-side observations are required. In the present context, a background connecting principle is the genetically inferred temporal depth of San populations (Vigilent et al. 1991; Soodyall & Jenkins 1992, 1998; Ingman et al. 2000), suggesting that ancestral San were responsible for most, possibly all, Late Pleistocene archaeological remains in southern Africa. A higher-level relation of relevance, alluded to by Deacon (1995, 2001), concerns the role widely assigned to collective ritual (initiation ritual in particular) in generating and sustaining the symbolic domain (Van Gennep 1960; Durkheim 1965; Turner 1967; Gellner 1992; Maynard-Smith & Szathmáry 1995; Deacon 1997). Collective ritual provides the necessary compulsive constraint to ensure that collective representations—constructs that have no reality in the perceptible world—are faithfully transmitted.

Ritualization is a strategy of power (Knight 1991; Bell 1992), whereby status functions (Searle 1996) are collectively imposed on agents, objects and events. Social relations of power are demarcated, identifying groups with common interests and setting them in opposition to other groups (Leach 1954; Bell 1992). To make credible the intangible nature of symbolic representations (e.g. a promise), it is necessary to bring to the fore the intrinsically credible substructure of symbolic social relationships (Rappaport 1979; Searle 1996; Deacon 1997; Knight 1999). In this substructure, reference depends not on symbolism but on the cognition of relationships of association (indexicality) or identity (iconicity) and is therefore rooted in the perceptible world. Collective ritual typically achieves this through regular, formal performances using multimedia effects of gesture, song and dance in invariant sequences (Rappaport 1979). The signals employed are characteristically eye-catching (Morphy 1989; Clark 1986), costly (Sperber 1975), amplified, stereotyped and prone to massive redundancy (Rappaport 1979). Rituals are essentially deceptive and manipulative (Leach 1954; Lattas 1989; Bell 1992); to the extent that they convey honest information, it is an ostentatious display of their very costliness (Power 1999). Critically, ritualization is also an embodied experience (Bell 1992), with transformations of body surfaces playing a key role (Turner 1980; Gell 1993). Body-painting and cosmetics are among the simplest of such transformational techniques.

These general propositions accord with source-side observations. The most pervasive domain of Khoisan pigment use was in ritual behaviour (Rudner 1982; Watts 1999). Redness and brilliance are consistently associated with constructs of supernatural potency (Watts 1999). A girl's menarcheal initiation was the only ritual where red pigments were almost invariably used and occasioned their most socially inclusive reported use (Knight et al. 1995; Power & Watts 1996; Watts 1998). Menarcheal rituals are also thought to provide a template for other rites of passage in Khoisan hunter-gatherer societies (Lewis-Williams 1981; Knight et al. 1995; Power & Watts 1997; 1999).

A Khoisan-based analogical argument, with collective ritual as the connecting principle, would predict that early collective ritual (unlike speech) should leave a loud archaeological signal—the habitual use of red ochre. However, as ochre use remains the principle line of evidence bearing upon possible symbolism in the MSA, the analogy is in danger of assuming what needs to be demonstrated, namely that MSA ochre use occurred within a symbolic context.

Visual salience provides a way out of this circularity, a linking principle for an analogical argument partially independent of symbolic culture and a point of entry for neo-Darwinian evolutionary theory, specifically, costly signalling theory (Zahavi 1987; Grafen 1990; Zahavi & Zahavi 1997). The linking principle concerns neurological mechanisms and perceptual biases presumed to be common to both modern and ancestral populations. From the continuum of wavelengths in the visible spectrum, we discriminate (find salient) those corresponding to four unique hues. This is achieved by pitting signals from different photoreceptors against one another to derive a difference signal, such that red is opposed to green and yellow to blue (De Valois & De Valois 1993; Abramov 1997; Wooten & Miller 1997). Other examples of perceptual biases are that we respond more rapidly to variation in luminance than chromatic stimuli (Boynton 1979:308) and that red is the only unique hue that remains saturated in peripheral vision (Gordon & Abramov 1977).

Perceptual biases constrain the pragmatic use of percepts in signalling behaviours, including, in the human case, symbolic use and labelling of such percepts (Deacon 1997; Morphy 1989). For a visual signal to be effective it needs to be eye-catching and salient (Guilford & Dawkins 1991; Zahavi & Zahavi 1997). As boundary conditions for perception, lightness and darkness are necessarily the most salient visual experiences. However, red is the most common colour signal deployed in nature, partly because it is highly contrastive (Humphrey 1976). Humans find red and brilliant percepts particularly eye-catching (Humphrey 1976; Ratliff 1976; Bradshaw & Rogers 1993). Cultures employ between two and eleven basic colour terms (Berlin & Kay 1969; Kay et al. 1997). Binary classifications comprise composite light/warm and dark/cool terms. Despite red being a colour of relatively low brightness (Solso 1994), it is a focus of the light/warm term, along with white and yellow (Heider 1972; Kay et al. 1997). In the classic study of such a system (Heider 1972), the most commonly selected focal point (best example) of the light/warm term was not white, as Berlin and Kay (1969) had proposed, but a saturated dark red, followed by a saturated pale pink. As cultures acquire additional colour terms, red is invariably the first chromatic colour to be named, followed by either yellow or green and then blue (Kay et al. 1997). Neurological biases can account for the naming of unique hues before other basic colours (e.g. brown or orange) and explain why maximally saturated colour chips are selected as best exemplars of basic colours. They may also explain why, in comparison to blue and green (short-wavelength colours), red and yellow (long-wavelength colours) elicit high levels of cross-cultural agreement regarding a narrow range of best examples (D'Andrade 1995). However, such biases cannot account for variation in the number of basic terms, nor why red is invariably the first unique colour to be named. The point I wish to stress is that colour reference has evolved in adaptation to both the human nervous system (with its biases) and the pragmatic constraints of human use (Deacon 1997). Such pragmatic constraints are thought, in the first instance, to concern ritualized performance (Turner 1967; Morphy 1989; O'Hanlon 1989; Knight 1999).

To infer that red ochre was collected for its visual salience presupposes a signalling context. Habitual procurement, processing and use of red ochre in the MSA would thereby imply a stereotyped, costly, volitional signalling behaviour. According to Zahavi's handicap principle (Zahavi & Zahavi 1997), stereotyped, costly signals typically occur in contexts of ritualized display. In the animal world, the characteristic features of such display are similar to those just summarized for human ritual, except that they are ego- rather than socio-centric and reference remains exclusively indexical. Ritualized signals must be amplified and costly in order to be effective, signallers and receivers having different interests. Signallers, advertising individual quality, exploit perceptual biases. Receivers evaluate the credibility of the signal indexically, in terms of the hard-to-fake currency of high costs (the handicap). Stereo-typing and formalizing of the signal are positively selected by receivers to facilitate comparison between signallers.

Durkheimian and neo-Darwinian paradigms, while methodologically opposed, converge in their respective characterizations of ritualized signalling. If it can be shown that red ochre was used as pigment, we have compelling, independently derived theoretical grounds for inferring that its use evolved in contexts of ritualized display. With a robust causal mechanism, an ethnographically-based analogical argument for ritual use of pigments as body-paints or cosmetics can be placed on a firmer footing. Combined with the findings of cognitive anthropologists and visual scientists regarding universals of colour-labelling and perceptual biases, an early and enduring interest in red and a preference for saturated reds would also be predicted.

What indexical salience did redness originally have? What conflicts of interest provided the selection pressure for such costly displays? How did a ritualized signal in the human case become the property of a coalition? These interesting questions lie beyond the scope of the present paper (for discussion of the sham menstruation hypothesis concerning the origin of symbolic culture, see Knight et al. 1995; Knight 1998, 1999; Power & Aiello 1997; Power 1998, 1999). However, where pigment use can be shown to be habitual and ubiquitous, we are probably closer to collective ritual than individual ritualized display, with iconic and/or indexical reference now subsumed within an over-arching web of symbolic meaning. If utilitarian hypotheses prove inadequate in accounting for regular use (see below), then such use may meet a relaxed version of one of Chase & Dibble's (1987, 1992) archaeological criteria for identifying symbolism, namely, repetition of form.

So-called crayons or pencils are widely reported from MSA shelter sites (Watts 1998). If the morphology of such pieces is not simply the result of intensive powder reduction and if, relative to the background population, they have colour properties consistent with preferential selection, then the use implied by their designation—creating colour patterns—becomes more plausible. This would meet another of Chase & Dibble's (1992) proposed criteria: grounds for inferring intent to produce a visual design. With crayons sometimes reported from LSA contexts (e.g. Leslie-Brooker 1987; Kaplan 1990; Mitchell 1993) and scanty historical observations (Rudner 1982), the category may also meet their proposed test for inferring symbolism, that there be analogues from known symbolic contexts.

Ochre as hide preservative

The hide-preservation hypothesis, provoked by the occasional discovery of traces of ochre on endscrapers and blades, has been explored primarily in relation to late Upper Palaeolithic and Mesolithic contexts in Europe and Israel (Keeley 1978, 1980; Audouin & Plisson 1982; Moss 1983; Vaughan 1985; Dumont 1988; Bueller 1993; Phillibert 1994). Without any similar engagement with the archaeological record, it has been raised several times as a possible alternative interpretation of MSA ochre use (Wadley 1993, 2001; Klein 1995, 1999; Mithen 1999). The bases of the hypothesis (experimental, ethnographic and archaeological) have been reviewed elsewhere (Knight et al. 1995; Power & Watts 1996; Watts 1998, 1999) and are only summarized here.

While laboratory experiments indicate that, at sufficient concentration, most metal ions have an inhibiting effect on bacterial production of collagenase, a collagen-destroying enzyme (Mandl 1961), field experiments failed to demonstrate that ochre had any preservative effect (Audouin & Plisson 1982) and taxidermists doubt its efficacy (Phillibert 1994). Claimed ethnographic support for the hypothesis (references in Keeley 1980; Audouin & Plisson 1982; Moss 1983; Vaughan 1985) is ambiguous. Several cited accounts do not concern hide-working (e.g. Roth 1890; Bonwick 1898; Sollas 1924 cited in Keeley 1980). Where a functional role is implied, this seems to concern the use of fats and greases, which are known to have an emulsifying effect (Audouin & Plisson 1982) but which also often served as a medium for applying red ochre. The involvement of ochre in hide-working is almost invariably at the finishing stage as a decorative inclusion, a generalization amply supported by Khoisan data (Rudner 1982; Watts 1998). In Eurasian later Upper Palaeolithic and Mesolithic manufacture of prestige goods like buckskin (Hayden 1990, 1998), similar decorative inclusions could have preceded final tailoring, which may account for Bueller's (1993) and Dumont's (1988) micro-wear determinations regarding ochre polish on blades. Ochred endscrapers at several sites had a specialized morphology (Keeley 1978; Phillibert 1994). Replicative experiments led Phillibert (1994) to interpret these scrapers as having been used with an ochre abrasive to raise the nap of already tanned buckskin. Production of prestige goods is unlikely to be informative about much earlier contexts of ochre use.

Mandl's (1961) experiments imply that the hide-preservation hypothesis should be treated as null with respect to colour selection; materials rich in manganese or goethite should be as effective as haematite. With little difference in iron content between goethite and haematite (61% and 70% respectively [Taylor et al. 1988]) and both minerals being common weathering products, we might expect both to have been widely exploited if use was primarily utilitarian. Similar considerations apply regarding proposals that ochre served as a sunblock or barrier cream (Bahn & Vertut 1988; Wadley 1993). For such proposals to stand as alternative general accounts for ochre use it would need to be shown that other clay or mud applications, with or without grease, failed to provide similar protection.

The study sample

South of the Limpopo River, archaeologists widely employ Volman's (1981, 1984) informal techno-typological framework of MSA sub-stages. I previously employed this framework to investigate change in the relative frequency of ochre across a large number of shelter sites (Watts 1998, 1999). The 11 sites reported here represent the majority of excavated deep sequences in the region, biased towards earlier (MSA 2) sub-stages. For present purposes, the examined material is treated as an aggregated sample, the vast bulk representing sub-stages falling within the Late Pleistocene, bracketed by a few terminal Middle Pleistocene MSA 2a assemblages, e.g. Border Cave (Grün & Beaumont 2001) and some MSA/LSA transitional and early (>17 kya) LSA assemblages. The sub-stages will only briefly be touched on here. However, given the interpretative significance placed on habitual ochre use, it must be stressed that probable Middle Pleistocene MSA assemblages in the region, whether designated MSA 1 or MSA 2a, have produced either no ochre or only isolated pieces (Watts 1998). By contrast, younger MSA 2a assemblages, such as the basal LBS member at Klasies River Mouth, dating to early in the Late Pleistocene at c. 110 kya, show regular use of ochre, as do all subsequent sub-stages (Watts 1999).

The derivation of a sample of 4038 examined potential pigments is presented in Table 1, along with total and mean weights by site. Site locations are shown in Fig. 1. Numerically, by far the largest contributions are from Umhlatuzana and Hollow Rock Shelter. By mass, Olieboompoort accounts for half the sample. The finely-sieved Rose Cottage Cave Gail assemblage was not included in the original database (Watts 1999). It is included in Tables 1 and 5 for comparative purposes but is excluded from column totals. A breakdown of the sample by excavation units, with techno-typological sub-stage designations, counts of potential pigments and of the combined total of definite and probable pigments is given in the Appendix.

The need for a large sample and the limited time available meant that most observations were made subjectively rather than based on standardized measures. Although not recommended, this approach had the merit of approximating the kind of common sense discriminations (Atran 1990) or folk taxonomies (D'Andrade 1995) that people employ in classifying salient attributes of the natural world, such as colour.

Methods

Geological form

Wherever possible, the form of both typical and unusual specimens was briefly discussed with either the excavator or the analyst. However, I frequently found it impossible to assign pieces (particularly small debris) confidently to any geological form, so ochre is necessarily a default as well as a generic category. The default assessments were:

- fine- to medium-grained texture (fine equivalent to shale and mudstone, medium equivalent to siltstone or fine sandstone)
- fairly soft (an approximate range of 2–4 on Mohs hardness scale)
- sufficiently ferruginous to leave a red or yellow streak, but not such as to be unusually dense (making a haematite designation more likely).

This default category inevitably contains enormous variability (Watts 1998). Twenty-eight other categories were also used, some conveying the continuum of change in bedding and texture from mudstone and shale to fine sandstone, rather than indicating any geological species. Mudstone also contains considerable variation, partly because it embraces massive, fine-grained forms with light-brown streaks. Specularite is a glittery, micaceous expression of haematite. In Table 2 the original designations are grouped into 11 categories with their respective sum weights.

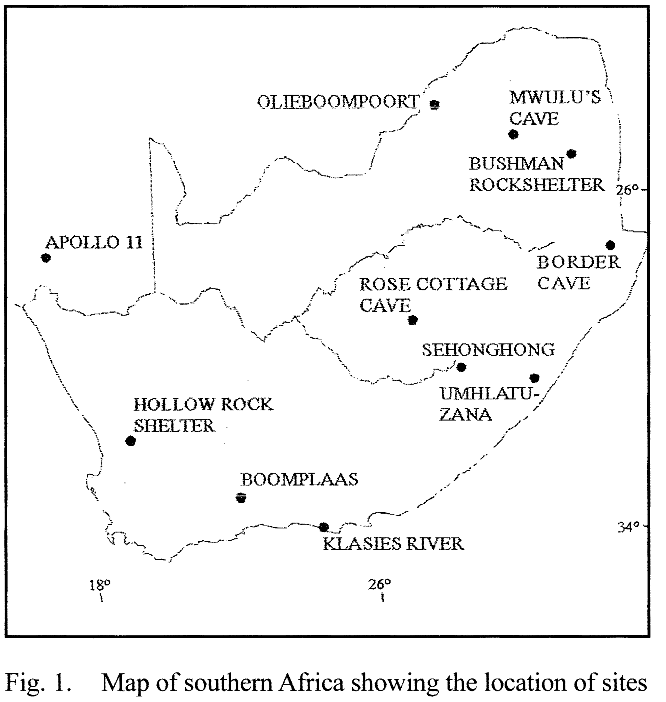

Fig. 1. Map of southern Africa showing the location of sites providing the examined assemblages.

Table 1. Derivation of examined potential pigment assemblages. 'Valid n' refers to the number of weighed pieces.

	Mesh (mm)	Potential pigment (n)	Valid n	Sum (g)	Mean mass (g)	s.d.	Reference
SHG+	1.5	99	99	66.2	0.7	1.1	Mitchell 1995
RCC (Gail) *	2.0	296	295	243.8	0.8	2.0	Clark 1997
BC 1987	2.0	105	105	292.1	2.8	6.5	Unreported
AP11	2.5 & 4.0	105	105	889.4	8.5	15.0	Vogelsang 1998
BP	3.0	134	133	1340.0	10.1	21.2	Deacon et al. 1983
BC 1970+	3.0	6	6	39.5	6.6	4.4	Beaumont 1978
HRS	3.0	1143	1123	1345.3	1.2	4.0	Evans 1994
BRS	3.0	58	41	907.7	22.1	40.5	Unreported
UMH	3.0?	1721	1675	3436.2	2.1	3.7	Kaplan 1990
KRM1A (H–P)	6.5	179	163	1268.5	7.8	11.0	Singer & Wymer 1982
RCC	not known	112	112	1335.1	11.9	19.9	Wadley & Harper 1989
MC	not known	13	13	477.8	34.5	27.5	Tobias 1949
OBP	not known	304	304	11953.1	39.3	65.5	Mason 1962
KRM1A (non–H–P)	13.0	19	19	293.0	15.4	12.8	Singer & Wymer 1982
KRM1	13.0	37	32	1419.0	44.34**	75.4	Singer & Wymer 1982
KRM1B	13.0	3	3	100.5	33.5	6.3	Singer & Wymer 1982
Total		4038	3933	25163.4			

+SHG = Sehongohong; RCC = Rose Cottage Cave; BC = Border Cave; AP11 = Apollo 11; BP = Boomplaas; HRS = Hollow Rock Shelter; BRS = Bushman Rock Shelter; UMH = Umhlatuzana; KRM = Klasies River; MC = Mwulu's Cave; OBP = Olieboompoort.
* Rose Cottage 'Gail' (Transitional MSA/LSA) could not be included in the main database and is excluded from column totals.
** Klasies Cave 1 has an outlier value of 437.2g, if this is removed, the mean falls to 31.7g with an s.d. of 23.8g.

Colour

The colour of a potential earth pigment may be determined by its streak—the colour of its powder, usually taken by rubbing a sample on unglazed porcelain (hardness 7 according to Bates & Jackson [1984]). In this study, white vein quartz was found to give satisfactory results and was more convenient. As far as possible, observations were made under bright natural light. Although streaking requires very little material, it is a destructive procedure and testing of utilized surfaces must be avoided.

Mineralogists describe streak adjectivally; haematite, for example, has a red-brown streak (Lurie 1977). However, in a study of potential earth pigments, the streak of most ferruginous forms will be brownish, with haematite redder than most ochre, hence the emphasis on the redness of streak here.

Forty-seven adjectives or combinations of adjectives were used in the original classification (Watts 1998), here grouped into 10 categories (Table 3). The category strong-reds predominantly comprises streaks I perceived as poppy, blood-red and dark-red. Two additional categories of various reds (n=1904) and various colours (n=57) relate almost exclusively to collectively described unmodified pieces from HRS and Umhlatuzana, accounting for 1902 of the 'various reds' and 42 of the 'various colours'.

Ochre studies have employed a variety of colour notational systems (Jercher et al. 1998; Hughes & Solomon 2000; Henshilwood et al. 2001), any of which would have provided greater standardization and precision than adjectival description. However, comprehensive matching would have greatly reduced the sample size. Regardless of method, some consistency problems would remain (e.g. variable lighting conditions). While adjectival description of streaks is indicative of hue, it is less useful for brightness and saturation, the English language having sacrificed brightness-based discriminations in favour of hue-orientated ones (Casson 1997).

Other variables

Hardness was assessed in the course of streaking, with subjective designations occasionally compared to Mohs hardness scale. No quantitative measures of texture or iron content were employed. Subjective assessments of iron content, based largely on relative density, were useful for highlighting variability within gross geological forms. For example, the densest haematites were classified as ore-grade material, while haematised shales were described as highly ferruginous to distinguish them from the default assessment of ferruginous.

The four original assessments regarding the presence of use-wear traces (definite, probable, possible and absent) are treated here as two pairs. Use-wear traces were themselves divided into two broad categories, abrasive (grinding, rubbing, polish) and fixed-position utilization (scraped, scored, notched). Grinding was loosely defined as flat facets bearing multiple, fine, parallel striations. Intensively ground pieces with multiple facets converging to a point were categorized as crayons. Rubbed or polished were terms applied where pieces appeared to have artefactual surfaces but where striae were only very faint or not detectable. Both terms need refining but, unlike Couraud's (1991) study, where such use-wear traces were imputed to reflect different modes of use relative to grinding, here they are viewed as primarily reflecting hardness properties of the pigments. Scraped or scored pieces had wider, deeper striae, which were less evenly aligned and less densely distributed than grinding striae. Inferences about the likelihood of pieces having been collected as pigments were made at several levels of confidence. The most robust were based on observations of use-wear in combination with streak and texture (coarse-grained forms, having poor pulverulence [cf. Brabers 1976] will generally make poor pigments). Probable and possible designations (largely relating to unmodified pieces) were arrived at more contextually, where the assessment drew upon streak, texture and the frequency of use-wear across geological forms. The grounds for less confident or negative assessments will be illustrated as the overall sample is characterized.

Results

Raw material variability

Table 6 tabulates geological form assessments by site. Despite the loose parameters of default ochre, most assemblages are clearly heterogeneous, consistent with archaeometric observations elsewhere (Smith et al. 1998; Hughes & Solomon 2000). Two comments on the grouped categories are needed before discussing general patterns. Although shale is predominant (39.7%) at Bushman Rock Shelter, the original designation was shaley-mudstone—almost exclusively restricted to this site. On a range of grounds, most notably the forms of use-wear, most of this material was judged to have served primarily as hammers, burnishers or rubbers rather than as pigments (Watts 1998). The grouped sandstone category (n=77) comes almost exclusively from two sites: at Klasies River Mouth, 92% of this material (n=50) was originally designated shaley-sandstone or mudstone-sandstone, explicitly finer textured than the ferruginous sand (n=21) and sandstone (n=3) at Rose Cottage Cave.

Table 2. Proportions of grouped geological categories, numerically and by weight. 'Valid n' refers to number of weighed pieces where geological form was determined

Grouped Geol. Category	% total n	Weight (valid n)	sum (g)	% total mass
Default ochre	56.5	2217	5002.4	19.9
Mudstone	6.0	239	598.7	2.4
Sand/stone	1.9	76	1645.8	6.5
Shale	19.2	753	3160.3	12.6
Grit	0.4	16	132.2	0.5
Haematite	4.1	161	1475.2	5.9
Specularite	7.7	307	12180.2	48.4
Manganese	0.4	16	35.1	0.1
Other	1.5	54	747.4	3.0
Carbonate	0.3	14	41.0	0.2
Not known	2.0	78	141.4	0.6
n or total g	4002	3931	25118.7	
Missing	36	107		

The distribution of the more distinctive forms agrees with the broad outlines of regional geology, ethno-historical accounts of pigment exploitation (Beaumont 1973; Watts 1998) and commercial pigment quarrying (Brabers 1976). In the highly metalliferous rocks of Limpopo and Mpumalanga Provinces (Olieboompoort, Mwulu's Cave, Bushman Rock Shelter), haematite and specularite predominate. Haematite also figures prominently at Rose Cottage Cave in the eastern Free State and Border Cave in KwaZulu-Natal. The Border Cave haematite (several pieces designated as ore-grade, a couple described as specular [Watts 1998]) may be of particular significance; the nearest source of such materials is thought to be Ngwenya Ridge and the MSA specular-haematite mine of Lion Cavern, 120 km to the northwest (Beaumont 1978; Watts 1998; see also Barham 1989 re Sibebe). Elsewhere, haematite is never more than a minor component. Specularite, except for two pieces at Apollo 11, is restricted to sites north of the Vaal River.

The predominant category in the Eastern and Western Cape sites (Klasies River Mouth, Boomplaas and Hollow Rock Shelter) is shale (57.3%, 56%, 45% respectively), much of which might be better described as well-bedded siltstone (Henshilwood et al. 2001). Commercial pigment quarrying in South Africa (De Villiers 1959) has primarily focussed on red and yellow ochres associated with weathered Bokkeveld shales, which are widely distributed through the southern and southwestern coastal regions (Visser 1937).

Default ochres predominate at the remaining sites. The absence of magnetite and rarity of manganese rules out any significant utilitarian role for these materials, suggesting that manganese should be treated as a minor class of earth pigment. In this and several other respects (Power & Watts 1996), the MSA record of metal oxide use differs from its Mousterian counterpart, suggesting that the two should not be elided (contra Klein 1995).

Mesh size and utilized proportions

Before the 1970s, most MSA assemblages were coarsely sieved (mesh ≥4 mm). Quarter or half inch mesh can be inferred for the Not known values in Tables 1 and 2. This affects the mean weight of pieces (Table 1) and the representation of utilized pieces (row marginal percentages in Table 5). The most finely sieved assemblages (mesh <3 mm) have low utilized percentages (<6%). Of the coarsely sieved (>4 mm) assemblages, with the exception of Olieboompoort (see below), between 29% and 70% of material bore signs of utilization. Among the 3 mm-sieved assemblages, utilized percentages range from 8% to 39%. Much of this variation seems to reflect human behaviour rather than taphonomic or excavation biases. At Hollow Rock Shelter, for example, while the overall mean weight is comparable with values from the finest-sieved assemblages, the mean for utilized pieces is statistically indistinguishable from counterparts at most other 3 mm- sieved sites (5% level of Watts [1998[). Perhaps because of the very small size of this shelter (c. 27 m^2) and the consequent redundant use of space, we are simply seeing much more small processing debris. The small area would have prohibited hide-processing.

Table 3. Frequencies of grouped streak values. Missing values = 42.

Grouped Streak	n	%
Whites	16	0.4
Yellows	22	0.6
Orange & yellowish–browns	125	3.1
Light browns	199	5.0
Mid & dark browns	55	1.4
Light reds	663	16.6
Strong reds	720	18.0
Reddish–browns	176	4.4
Blacks	12	0.3
Greys	8	0.2
Various reds	1904	47.6
Various	57	1.4
No streak	39	1.0
Total	3996	100.0

Utilization and geological form

The within-site frequency at which different materials were utilized can help identify preferential selection as well as unlikely pigments. Table 5 provides frequencies of use-wear within raw material categories at each site (arranged by mesh size) and the percentage this represents of the respective material at the site. With only two specimens of calcium carbonate or manganese definitely utilized, these forms are here grouped into the Other category.

Several site-specific effects strongly influence the overall rates of utilization within geological forms (column total percentages in Table 5). The overall frequency of utilization among default ochre (8.4%) is severely depressed by the sample size effect of Umhlatuzana (where mean weights are comparatively low and much of the ochre was judged to be of fairly low quality). Exclusion of this site increases the percentage utilized to 15.6%. The very large Hollow Rock Shelter assemblage has a similarly depressing effect on the proportion of utilized shale. Exclusion would see an increase from 14% to 25%, intermediate between the range of values for the majority of materials and haematite. Exclusion is warranted for indicative purposes on the grounds that shale contributes disproportionately to the small debris at Hollow Rock Shelter (Watts 1998). The large variation in rates of utilization among the three reasonably sized mudstone assemblages is largely attributable to site-specific factors concerning colour (see below).

Table 4. Percentages of grouped geological forms by site, grouped by geographic region. See Table 1 for full names of sites.

Geological Form	Limpopo & Mpumalanga			Western & Eastern Cape			Free State	Lesotho	KwaZulu–Natal		Namibia
	OBP	MC	BRS	HRS	BP	KRM	RCC	SHG	BC	UMH	AP
Default ochre	1.0	15.4	12.1	30.9	38.1	8.8	56.4	88.9	40.5	93.2	35.2
Mudstone	–	–	–	13.4	–	1.3	0.9	–	0.9	3.9	14.3
Sand/stone	–	–	–	0.1	–	22.0	21.8	–	–	–	1.9
Shale	–	–	39.7	45.2	56.0	57.3	–	2.0	–	0.1	25.7
Grit	–	–	–	0.5	–	3.5	0.9	–	–	0.1	-
Haematite	1.3	38.5	29.3	3.3	–	4.0	18.2	6.1	30.6	1.7	1.0
Specularite	97.7	46.2	3.4	–	–	–	–	–	–	–	1.9
Manganese	–	–	–	1.2	–	–	–	–	0.9	–	1.0
Other	–	–	15.5	0.1	5.2	2.2	0.9	3.0	27.0	0.2	1.0
Carbonate	–	–	–	–	–	–	–	–	–	–	13.3
Not known	–	–	–	5.2	0.7	0.9	0.9	–	–	0.7	4.8
n =	304	13	58	1123	134	227	110	99	111	1718	105

Table 5. Modification across grouped geological forms by site, arranged in order of increasing mesh size. Mod' = number of modified pieces, % M = modification as percentage of respective raw material category at the site, derived from Table 4, column total percentages are percentages modified for all sites (excluding Rose Cottage level Gail). See Table 1 for full names of sites.

Site	Mesh size (mm)	Grouped Geological Form																All mod'	% of site
		Dflt' Ochre		Mudstone		Sandstone		Shale		Haematite		Specularite		Other ^		Not Known			
		Mod'	% M	Mod'	% M	Mod'	% M	Mod'	% M	Mod'	% M	Mod'	% M	Mod'	% M	Mod'	% M	(n)	Total
SHG	1.5	–	0.0	–		–		–		1	16.7	–		–		–		1	1.0
RCC (Gail)*	2.0	10	6.3	–		–		2	3.8	4	9.1	–		–		–		16	5.4
BC	2.0 3.0	1	2.2	1	100	–		–		5	14.7	–		2	6.7	–		9	8.1
HRS	3.0	41	11.8	5	3.3	–		42	8.3	3	8.1	–		2	13.3	1	1.7	94	8.4
UMH	3.0?	86	5.4	34	50.7	–		–		17	56.7	–		3	75.0	2	16.7	142	8.1
BP	3.0	13	25.5	–		–		12	16.0	–	–	–		1	14.3	–	0.0	26	19.4
BRS	3.0	3	42.9	–		–		5	22.7	10	58.8	–		4	44.4	–		22	38.6
AP11	2.5 4.0	12	32.4	7	46.7	–		8	29.6	–	0.0	2	100.0	2	12.5	–		31	29.5
KRM (H–P)	6.5	2	40.0	–		13	44.8	30	26.3	3	37.5	–		–		–		48	28.6
RCC	n.k.	20	32.3	–		2	8.3	–		11	55.0	–		–		–		33	30.0
MC	n.k.	1	50.0	–		–		–		2	40.0	4	66.7	–		–		7	53.8
OBP	n.k.	3	100.0	–		–		–		2	50.0	35	11.8	–		–		40	13.2
KRM (non H–P)	13.0	7	58.3	2	100.0	17	81.0	10	62.5	1	100.0	–		2	100.0	–		39	69.6
All sites		189	8.4	49	20.5	32	34.8	107	14.0	55	34.1	41	13.6	16	17.6	3	3.8	492	12.3

* Rose Cottage level 'Gail' is excluded from column totals of modification and the percentages modified for all sites.

^ Manganese and Carbonate are here grouped into 'Other'.

Given that coarser materials tend to make poor pigments, a surprisingly large proportion of sandstone was utilized. However, 29 of the 32 utilized pieces are fine sandstone from Klasies River Mouth, the high incidence of utilization across all forms at this site being attributable to extremely coarse sieving. Of the remaining sample (n=42), only three pieces were utilized.

Once the exceptionally high sandstone value has been accounted for, a higher proportion of haematite was utilized (34.1%) than any other category. The low utilized percentage at Hollow Rock Shelter, below that of several other categories at the site, is depressed by 20 small nodules, 15 of which had orange-brown streaks and would better have been classified as limonite (grouped into Other). Despite this, MSA people evidently regarded haematite as having especially attractive properties. The high rate of utilization, particularly at sites where haematite is not common, also suggests it may often have been of non-local origin.

That relatively little specularite exhibited use-wear (13.6%) can be attributed to the influence of Olieboompoort, which accounts for 96.4% of the sample. The sheer mass of material (c. 12 kg) at this site indicates that the source outcrop was nearby. The shelter may have served a special role in the procurement of this brilliant pigment. The low utilized percentage, compared to the overall haematite sample and other coarsely-sieved assemblages, suggests that procurement and caching may have been more important than processing. Of the remaining 10 pieces of specularite, from three sites, six were utilized, indicating more generally, that specularite was at least as likely to be utilized as haematite.

None of the grits (n=16) and only 3.8% of the Not Known pieces (n=79) were utilized. If utilized percentages are taken as proxy indicators of the esteem in which different materials were held, then the resulting ranking is very similar to regional ethno-historically documented valuation of different earth pigments (How 1962; Beaumont 1973; Rudner 1982; Watts 1998, 1999). Taking the assemblage biases just discussed into account, specularite and haematite are most likely to be utilized, probably followed by shale, other ochres (including fine sandstone) and other pigments.

Mode of use

Of the 480 pieces deemed definitely or probably utilized (Watts 1998, excluding open sites), 80.4% were definitely ground (29 in combination with other use-wear traces) and 10.2% were probably ground (three in combination with other traces). Traces of utilization were sometimes harder to identify on the few very soft materials (most notably at Apollo 11), consistent with Armstrong's (1931) observations at Bambata Cave. Most of the rubbed pieces were soft, while polish was largely restricted to hard, crystalline haematitic forms. Ground pieces were presumably abraded on stone. Ochred grindstones are present at Klasies River Mouth, Apollo 11, Olieboompoort and Bushman Rock Shelter (Watts 1998), with further examples at Die Kelders (Avery et al. 1997) and Blombos (pers. obs.). Although the evidence is infrequent, grindstones suggest that ochre was generally ground to produce a powder rather than abraded in the course of direct application.

However, the presence of crayons raises a possible qualification to such an inference. As originally coded (Watts 1998), these intensively ground pieces (n=48) account for 10% of the utilized sample. Eleven of these were deemed probable rather than definite examples but an additional four cases were identified after coding (Watts 1998). While disproportionately represented among coarsely sieved assemblages, crayons were encountered in most shelters and across all sampled MSA substages (Watts 1998). All major geological forms are represented (Watts 1998) but Default ochre and shale predominate; the morphology cannot, therefore, be explained by the grinding of generally harder forms such as haematite. Equally, the morphology of most examples, along with examples of bevelled edges (Watts 1998), is unlikely to be accounted for simply in terms of the requirements of powder production (where we could expect maximization of the surface areas of ground facets). Although replicative experiments are required, these observations suggest that at least some pieces were directly abraded on surfaces to be coloured and that there was a requirement for defined areas or lines of colour, consistent with design. Colour selection among the crayons (see below) further supports such an inference.

Scraping or scoring was only identified on 14 specimens, frequently in combination with grinding (Watts 1998). A tighter definition (Henshilwood et al. 2001) would probably increase the representation of this form of use-wear. The function of scraping remains unexplored; one possibility is that the scraping implement, loaded with ochre powder, might have been used to apply pigment directly. At least one repeatedly scored piece from Klasies River Mouth (MSA 2a) can also be described as deliberately engraved, with the connotation of design. (In Knight et al. [1995] the caption to Fig. 5 incorrectly assigns this piece to layer 33; this should be layer 38 [Watts 1998]). Subsequent research at Blombos (Henshilwood et al. 2002) has provided examples of unequivocal geometric engravings on ochre from Still Bay layers. Fragments of ostrich eggshell painted with red ochre were recovered from the MSA 3 layer at Apollo 11 (Vogelsang 1998), several of which indicate deliberate design (Watts 1998).

In summary, most utilized pieces were probably ground to produce pigment powder. However, the crayons suggest that some pieces may have been used to execute designs, with rare examples of geometrically engraved ochre and painted ostrich eggshell directly testifying to abstract design.

Colour selection

Reds account for 86.6% of the total streak values; yellows, orange-browns and yellowish-browns account for 3.7%; other browns (excluding reddish-browns) account for most of the remainder (Table 6). Although streak should not be used in isolation to distinguish between iron oxides and hydroxides, streak assessments can serve as proxy indicators of their relative contribution in the absence of mineralogical analysis and given the crude nature of the classification of geological form. On this basis, iron hydroxides (yellowish streaks) were rarely collected. This is unlikely to be entirely attributable to encounter rates. Yellow ochres are widely encountered where Bokkeveld shales have been deeply weathered (Visser 1937) but are rare in archaeological sites of the Western and Eastern Cape, while red ochreous shale or siltstone of similar origin is common.

Table 6. Colour proportions for entire sample and utilized pieces (having grouped all reds). Missing values = 42. No streak = 3

	% of total	%
Whites	0.4	0.4
Yellows	0.6	0.8
Orange & yellowish–browns	3.2	4.5
Light browns	5.0	3.1
Reds	87.5	87.7
Mid– & dark–browns	1.4	3.3
Black	0.3	0.2
Grey	0.2	–
Various colours	1.4	–
Total n	3957	489

Three-quarters of the haematite had strong-red streaks (Watts 1998). The appearance of specularite is dependent on mica abundance and the manner of processing; when highly micaceous specularite is pounded, the product is glittery black but when it is ground the streak is generally a sub-metallic greyish-red (Watts 1998). The range of streaks among the principal argillaceous and arenaceous forms is much broader but, with the exception of mudstone, the distributions remain focussed on reds. The anomalous position of mudstone is mainly attributable to the large contribution from Hollow Rock Shelter, where much of the mudstone had a light-brown streak (see below).

Table 7. Percentages of colour categories for all potential pigments and for utilized pigments, excluding Hollow Rock, Umhlatuzana, and non-pigment 'shaley-mudstone' from BRS. No streak = 5.

	% of total	No utilized	% utilized	% of total utilized
Whites	1.4	2	12.5	0.8
Yellows	1.9	4	18.2	1.6
Orange & yellowish–browns	3.7	8	18.6	3.2
Light browns	2.4	4	14.3	1.6
Light reds	44.8	92	17.8	36.7
Strong reds	34.1	133	33.8	53.0
Various reds	0.2	–	–	–
Reddish–browns	6.9	8	10.1	3.2
Mid– & dark–browns	2.2	–	–	–
Blacks	0.3	–	–	–
Greys	0.7	–	–	–
Various	1.3	–	–	–
Total n	1151	251		251

Collapsing all reds in order to accommodate the unmodified material, collectively described as various reds, from Hollow Rock Shelter and Umhlatuzana. Table 6 compares the proportional contribution of colour groupings to the entire sample with their representation among utilized pieces. Most categories were utilized in proportions approximating or slightly above their percentage contribution to the total. That orange- & yellowish-browns and mid- & dark-browns are better represented among utilized pieces than one might expect is largely attributable to the non-pigment category of shaley-mudstone at Bushman Rock Shelter (Watts 1998) and a small sub-group of high-quality micaceous mudstone pigments from Umhlatuzana, many of which were described as having rich streaks. It is also possible that in collectively describing the streaks of much of the unmodified ochre from Hollow Rock Shelter and Umhlatuzana as various reds, I inadvertently included some pieces that should more appropriately have been placed in either of these perceptually adjacent categories. Nevertheless, among the larger colour groupings (where n=>100), the most striking difference between overall percentage contribution and contribution to the utilized total is the under-representation of light-browns among the latter. Most unmodified material in this category is mudstone (n=98) or shale (n=45) from Hollow Rock Shelter, originally designated as having a beige streak and interpreted as less ferruginous expressions of materials introduced as pigments, i.e. pigment waste (Watts 1998). Eight of the 15 utilized light-browns had an original streak designation of pinkish-brown. A tighter definition of the grouped category would therefore have produced an even lower rate of utilization.

Light-browns aside, the broad comparability between the contribution of grouped streak categories to the overall and utilized totals is consistent with colour-based selection across a diverse range of raw materials. Utilitarian hypotheses requiring a high metal ion content are inconsistent with the occasional utilization of pieces with pale streaks (e.g. pinkish-browns) and with the use of calcium carbonate at Apollo 11 (calcium being one of the few metals having no inhibitory effect on collagenase [Mandl 1961]).

While the collection of red ochre was clearly the overriding concern, the crudely aggregated data do not indicate any preferential utilization of reds. More interesting patterning emerges if we exclude the non-pigment category of shaley-mudstone from Bushman Rock Shelter and all of the Hollow Rock Shelter and Umhlatuzana material, where collective description led to considerable information loss (Table 7). More than two fifths of the remaining sample (n=1151) had light-red streaks and a third had strong-red streaks, but less than one fifth of the light-reds was utilized, compared to a third of the strong-reds—more than half the utilized total (n=251). This preference cuts across the main raw material categories (Watts 1998) so it cannot be attributed to the abundance of unmodified specularite nodules from Olieboompoort (mostly coded as light-red streaks). Site-specific sub-groups where strong-reds predominate, such as haematised shale at Klasies River Mouth (n=16) and ore-grade haematite at Bushman Rock Shelter (n=7), show exceptionally high rates of utilization (75% and 57% respectively). The same preference is particularly pronounced among intensively utilized pieces, with 60% of crayons having strong-red streaks (Watts 1998). Not only were MSA people preferentially collecting red pigments but there was also preferential selection of pieces to utilize, with more intensive use of darker, more saturated reds. Similar, more accurately described selection has recently been demonstrated for the MSA 2b and Still Bay sequence at Blombos Cave (Henshilwood et al. 2001).

MSA mining of specular-haematite at Lion Cavern (Ngwenya Ridge, Swaziland) and the large quantities of specularite at Olieboompoort suggest that redness was not the sole criterion by which potential pigments were assessed. At Ngwenya Ridge, plain haematite was more accessible than the micaceous expression encountered in the cliff-face location of the adit mine (Dart & Beaumont 1969). The targeting of specular- over plain-haematite would not be predicted by the hide-preservation hypothesis. This said, brilliance in the MSA seems to overlap with redness rather than being an autonomous criterion: specularite, while frequently black in appearance still gives a red streak and saturated reds are themselves brilliant (Morphy 1989: D'Andrade 1995). The use of materials with a black or white brilliant appearance, such as talc, mica, or ilmenite is almost exclusively restricted to the LSA (Barham 1989; Robbins et al. 1993; Mitchell 1993, 1994). To my knowledge, the only instance where such materials have been reported from an MSA context is Mitchell and Steinberg's (1992) account of ilmenite from the MSA 3 at Ntloana Tsoana, Lesotho.

I judged 90% of the total sample (excluding open sites) to be definite or probable pigments, 8.2% to be possible pigments and 1.8% to be doubtful or non-pigments (Watts 1998). Of the definite and probable pigments (n = 3634) only 4.1 % provided non-red streaks (Watts 1998). Most of these were orange- and yellowish-browns from the large Hollow Rock Shelter and Umhlatuzana assemblages, hues that among some Khoisan groups are embraced within an extended range of red (Wilhelm 1954). Of the remainder, the small amount of black manganese was mostly from Still Bay layers at Hollow Rock Shelter and most of the white and yellow pigments came from Apollo 11, largely from the Howiesons Poort layer where they predominate over red ochre (Watts 1998). Klasies River Mouth also sees some use of yellow ochre in the Howiesons Poort (Watts 1998). There is no comparable broadening of the range of pigment hues until well into the LSA, with late Robberg and Oakhurst/Albany assemblages (Beaumont 1981; Mitchell 1995; Watts 1998).

Conclusions

The descriptive methods employed in this study require improvement and supplementing with archaeometric observations, but they permit an evaluation of the two principle contending interpretations of MSA ochre use.

A principal reason that hide-preservation and similar hypotheses have been invoked is scepticism as to whether any symbolic behaviour predates the LSA. The problem has been compounded because of a tacit presupposition on both sides of the debate that pigment use implies symbolism. It is this presupposition that underlies the questioning of the pigment status of earlier ochre occurrences. In this paper, I invoked Zahavi's handicap principle to show that the evolution of pigment-use could be addressed as a case of costly ritualized display without assuming symbolism. However, the convergence of features with a Durkheimian characterization of human collective ritual suggests that where the archaeological record indicates habitual pigment use we are probably dealing with coalitions of signallers.

No compelling ethnographic or archaeological support and little experimental support could be found for suggesting that ochre played any hide-preservation role. Some observations were inconsistent with this or similar functional roles: these included the rarity of yellow ochre and manganese, the occasional use of paler ochres and calcium carbonate, the selection of specular- over plain-haematite at Ngwenya Ridge and the copious use of ochre at Hollow Rock Shelter—a shelter too small to permit hide-dressing. The vast majority of the samples produced hues within an extended range of red; among utilized pieces, the largest hue sub-group were those I described as strong-red, approximating a saturated focal range. Taking crayons as exemplars of the most intensively utilized pieces, these show particularly pronounced selection for strong-reds. An overlapping rather than autonomous selective preference was for materials with brilliant appearance, most notably specularite. Late Pleistocene MSA people were prepared to go to considerable effort to obtain these materials as is graphically testified at Lion Cavern. Cognitive anthropology and vision research suggests that redness and brilliance are likely to have been perceptual qualities exploited from an early stage in ritual display. Both percepts are deeply implicated in Khoisan constructs of supernatural potency, but the only Khoisan ritual where use of red pigment was virtually ubiquitous was menarcheal initiation. Initiation ritual is widely thought to have played a critical role in the establishment of symbolic reference. I conclude that the vast majority of materials was collected for visually salient properties of redness and brilliance and used accordingly as pigments, in the first instance in 'skin-changing' collective ritual performances. This places previous, similar interpretations on a more secure footing than hereto. Ochre may well have served additional roles (whether utilitarian or as a pigment in contexts other than collective ritual) but these cannot provide an alternative general account for MSA or later ochre use.

Applying Chase and Dibble's (1987, 1992) archaeological criteria for identifying symbolism, the evidence presented suggests that symbolic use of red ochre had been established by early in the Late Pleistocene. Alternative (functional) accounts have been discounted. The use of red pigment was regular and ubiquitous. Similar behaviours (including 'crayon' manufacture) are documented from later contexts where symbolism is not in doubt. The rare examples of geometric engravings provide direct evidence for graphic representations, while crayons provide more wide-spread, indirect evidence arguably consistent with design. For the vast majority, perhaps all, of the Late Pleistocene in southern Africa, red ochre was used within an overarching web of symbolic meanings, a uniquely human cultural context that the behaviour itself had helped establish. North of the Limpopo River, symbolic use of red ochre may have still greater antiquity.

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Appendix. Derivation of the sample by excavation unit. n1 = total potential pigments, n2 = total Definite & Probable pigments. Site acronyms as in Table 1. For divergences from Volman's (1984) sub-stage designations (Mwulu's Cave) and des-ignations made for unpublished assemblages (BRS & BC 1987), see Watts 1998.

Units	Sub-stage	n1	n2
AP11 Lyr. H	MSA 2a	20	10
AP11 Lyr. G	MSA 2b	48	43
AP11 Lyr. F	Howiesons Poort	23	17
AP11 Lyr. E	MSA 3	14	12
OBP Bed 2	MSA 2b	304	304
BRS Lyrs. 53-32	MSA 2a ?	5	3
BRS Lyrs. 31-19	MSA 2b ?	41	22
BRS Lyrs. 18-16	MSA 3	12	4
MC Bed I	MSA 2a	1	1
MC Beds II-III	MSA 2b	12	12
SHG Lyrs. RFS-OS	Transitional MSA/LSA	99	99
RCC spits 242"-213"	MSA 2b	48	46
RCC spits 213"-204"	Mixed Assemblage	8	7
RCC spits 204"-144"	Howiesons Poort	44	27
RCC spits 144"-81"	MSA 3	12	11
BP LPC3	ELSA	77	57
BP BP K	MSA 3	38	33
BP OCH (inclusive)	Howiesons Poort	19	19
HRS Sand IA-IIB	Still Bay	1071	875
HRS Sand IIIA-IIIB	MSA 2b	72	48
UMH Lyr. 28	MSA 2b	7	7
UMH Lyr. 27	Mixed Assemblage	19	19
UMH Lyrs. 26-22	Howiesons Poort	405	404
UMH Lyrs. 21-19	MSA 3	359	359
UMH Lyrs. 18-14	Transitional MSA/LSA	723	723
UMH Lyrs. 13-10	ELSA	208	203
BC 1987 6BS & 5WA	MSA 2a	4	4
BC 1987 5BS-4BS	MSA 2b	101	92
BC 1970+ BACO D	MSA 2a	1	1
BC 1970+ RGBS A	Howiesons Poort	5	5
KRM1 Lys. 40-37	MSA 2a	11	8
KRM1 Lys. 17-14	MSA 2b	26	24
KRM1A Lyrs. 21-10	Howiesons Poort	179	113
KRM1A Lys. 9-1	MSA 3	19	19
KRM1B Lys. 12-1	MSA 2b	3	3
Total		4038	3634

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