

CHAPTER ELEVEN

FEMALE STRATEGIES AND COLLECTIVE BEHAVIOUR

The archaeology of earliest Homo sapiens sapiens

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When and why did symbolic behaviour become 'an integral part of adaptation' (Chase and Dibble 1987: 285)? Can we model within a neo-Darwinian framework preadaptations to ritual and other symbolic activity? Few theories of the origin of symbolic cognition have ventured predictions which are testable against symbolic evidence. This chapter is in two parts. The first aims to model selection pressures promoting quasi-ritual collective behaviour in late archaic *Homo sapiens*. The second examines some of the model's predictions in the light of Southern African archaeological and ethnographic data.

COSTS OF ENCEPHALIZATION

If the central strand in the story of human evolution is encephalization, the materialist subtext must be how females fuelled the production of increasingly large-brained and hence burdensome offspring. We know the basic answer: in the course of *Homo's* 2 million-years of evolution, mothers extracted what by primate standards are unprecedented levels of male energetic investment. Models which address the fine-grained evolutionary mechanisms by which females drove this process may yield fruitful lines of enquiry, helping to explain not only some basic features of human reproductive physiology, but also underlying motives to symbolism. Dawkins and Krebs (1984) demonstrate the function of deceptive signalling in exploiting the muscle power of other animals. On this basis, we propose a hypothesis. *Symbolism emerged as a set of deceptive sexual signals aimed by kin-coalitions of females at their mates for the purpose of exploiting male muscle-power.*

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The extra costs arising from encephalization include the metabolic demands on the mother for sustaining brain growth in the infant (Foley and Lee 1991), and the increased energetic requirements of foraging for a higher quality diet. Humans compensate for their expensive brains by having correspondingly small, and energetically cheap, guts (Aiello and Wheeler, in press). This is only compatible with high quality diet, which in turn requires larger foraging areas (Clutton-Brock and Harvey 1977), with increased overall energy expenditure (Leonard and Robertson 1992).

Because hominid mothers bore these escalating costs, we must suppose that it was females who developed strategies to meet them. As the pressures to encephalization placed maternal energy budgets under strain, natural selection would have acted on two key areas of reproductive physiology: first, on life-history variables (cf. Foley and Lee 1991) – factors critical in partitioning the energy costs of reproduction – and second, on features of the reproductive cycle. As females drove a process of sexual selection, their reproductive signals would have been prime mechanisms for rewarding more attentive ‘investor’ males and punishing philanderers.

HUMAN FEMALE REPRODUCTIVE PHYSIOLOGY

Optimal foraging theory predicts that a roving or philandering male should aim to reduce the time spent searching for a fertilizable female, and then reduce the time spent waiting for access to the female at her fertile moment – ‘search’ time and ‘handling’ time (cf. Srivastava and Dunbar, submitted). The human female appears ‘well-designed’ to waste the time of philanderers by withholding accurate information about her true fertility state.

Concealment of ovulation and loss of oestrus with continuous receptivity have eliminated any reliable cue by which to judge whether a female is likely to have been impregnated. The longer a male must remain with one female to ensure fertilization, the smaller his chances of being able to fertilize another within one breeding season (Dunbar 1988: 160). These features are not unique to humans as against other primates (Hrdy 1981: 158). However, in some species with apparently concealed ovulation, males can track female cycles through olfactory cues (e.g. cotton-top tamarins, Ziegler *et al.* 1993). Studies of variation in human ejaculates (Baker and Bellis 1993: 880) confirm that men are unable to track women’s peri-ovulatory periods. Ovulation in women is well concealed. Alexander and Noonan (1979) argued that through concealment of ovulation and continuous receptivity alone, males would have been forced into prolonged consortships; that even in multi-male group contexts, pair-bonds would have been reinforced; and hence that males would have had greater confidence in paternity, leading to greater parental investment. Against this, Hrdy (1981) proposed that these features could function in a context of

promiscuity to deprive males of information about paternity, so reducing risks of infanticide. Sillen-Tullberg and Møller (1993) estimate that visual ovulatory signs have been lost several times in non-monogamous mating systems, and never within monogamous systems of anthropoid primates. They contend that this supports Hrdy's hypothesis of the original function of ovulation concealment, but that monogamy – with the implication of increased paternity confidence – is far more likely to evolve in lineages where ovulation signs have been lost. While ovulation may be concealed in the first place to counter infanticide risk, once evolved this feature can be exapted to serve a female strategy of increasing male investment.

A further key means of thwarting philanderers is reproductive cycle synchrony. Knowlton (1979) formulated a general model of synchrony as a strategy by the sex which invests most in offspring to secure greater parental investment from their mates. If females synchronize their fertile moments, no single male will be able to cope with guarding and impregnating any group of females. Local, previously excluded males are attracted into groups by potentially fertile females (cf. Dunbar 1988: 140–2). More male energy, support and protection becomes available to the synchronizing females.

Cycle synchrony, manifested as synchrony of menstrual onset, has been documented among humans (McClintock 1971, and reviews in Graham 1991, Weller and Weller 1993). However, several of these studies have been criticized on methodological grounds (see Wilson 1992). Knowlton, following Maynard-Smith (1977), Ralls (1977) and Emlen and Oring (1977), observes that 'the spread of female synchrony is likely to increase the ESS for male parental investment because the payoffs to searching for new mates are reduced' (1979: 1029). Given the large range sizes predicted for Pleistocene hominids (Leonard and Robertson 1992), synchrony would be effective to the extent it was widespread in populations, rather than restricted to local troops, as observed in various baboon species (Dunbar 1988). The modern human female appears well designed for such widespread cycle synchrony, since she has the capacity for cyclicity linked to an environmental cue. Her mean length of menstrual cycle corresponds to the mean lunar synodic period at 29.5 days (Gunn *et al.* 1937, McClintock 1971, Vollman 1977, Cutler *et al.* 1980); and her mean length of gestation at 266 days is a precise nine times multiple of the mean lunar synodic period (Menaker and Menaker 1959, and see Martin 1992: 263–4). In ancestral populations, any tendency to cycle synchrony aligned by lunar phase would have been further constrained by seasonal and ecological factors, affecting nutritional status and fertility rates (Ellison *et al.* 1989, Ellison 1990). Significant seasonality of births has been documented for hunter-gatherer populations (Wilmsen 1978, Hurtado and Hill 1990).

Synthesizing Alexander and Noonan's argument on ovulation concealment with Knowlton's synchrony model, Turke (1984, 1988) originally proposed that 'ovulatory synchrony' formed an important component of

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hominid mating systems under selection pressures for encephalization. He argued that ovulation concealment (with continuous receptivity) functioned to draw males into longer consortships, depriving would-be philanderers of accurate information about fertility. A pattern of ovulatory synchrony in local populations had the further effect of punishing male attempts to philander. This should drive the ratio of sexually active males to females in groups towards one-to-one. Sustained male/female bonds on a one-to-one basis should lead to greater paternity confidence, and greater inclination on the part of males to invest care in offspring.

THE PROBLEM OF MENSTRUAL BLEEDING

The difficulty with the synchrony model of encephalization is that reproductive synchrony will never be perfect on the ground. Even if significant numbers of adult females tend to synchronize fertile cycles during a particular season, others will be at various stages of lactation. We would expect staggering of overall reproductive synchrony by birth season. To the extent that a degree of synchrony was an important female strategy for undermining male philandering, then we would predict minimizing of any signal that gave away information about prospective fertility. If synchrony is not going to be perfect, then the least females can do is not advertise the fact, so giving away information to philanderers.

But one reproductive signal has been amplified in the course of human evolution – women's profuse menstrual bleeding. Profet (1993) puts forward the only functional hypothesis of menstruation yet developed. She hypothesizes that menstruation is adaptive as a defence against sperm-transported pathogens, and predicts that it will be accentuated by either continuous sexual receptivity or promiscuity, citing extensive comparative primate data. Other than women, only common chimpanzees – living in promiscuous multi-male systems – are documented to have 'profuse' bleeding, relative to body size.

Menstrual bleeding as a signal

We do not suggest that signalling constituted the primary function of menstruation. But once ovulation was concealed and oestrus was lost in the human lineage, menstruation would have taken on significance as a cue. It is not an accurate indicator of fertility, because it occurs at the non-fertile time of the cycle. But it is a good indicator of impending fertility. Because menstruation is the only cue which gave males positive information about female reproductive condition then we would expect that hominid males came under selection pressure to respond to that cue. This is not the case with chimpanzee males who have more reliable information concerning female fertility state available in the females' 'loud' oestrus signals.

Because menstruation is not accurate as an indicator of ovulatory timing, the information is not very useful for philanderers. Menstruation should make a female attractive to males who are prepared to wait around and mate-guard. Concealment of ovulation withdraws from males any information about when to bring mate-guarding to an end. So the male who responds to menstrual cues has to spend time with the female to increase his chances of paternity.

This implies that pronounced menstrual bleeding functioned to attract extra male attention, procuring mating effort in the form of protection, some food-sharing, grooming and coalitionary support. But the signal does not necessarily secure genuine *parental* effort from males. Reproductive cycle synchrony is required to reliably secure parental investment from males. Once a female was pregnant, she risked losing that extra male attention to other menstruating females in the vicinity. The 'loud' menstrual signal threatens to destabilize a synchrony strategy in local populations, by marking out those females who may be impregnated in the near future. The menstrual 'flag' could have encouraged mate desertion, incited male competition and led to some monopoly of fertile consortships by dominant males.

Male mating effort, associated with relatively high rates of mate desertion, may have been adequate for females during earlier phases of hominid evolution, when encephalization was proceeding at a relatively slow rate. The increased energetic costs of the first phase of brain expansion could have been offset by such factors as reduction in gut size (Aiello and Wheeler 1995) and increased female body size (Aiello, in press, Power and Aiello, in press). Reduction in sexual body size dimorphism may be better explained by female requirement to meet reproductive and thermoregulatory costs, than by significant changes in mating strategy at this stage (cf. McHenry, this volume). In modelling the energetics of hominid encephalization, Foley and Lee suggest that early *Homo* mothers did not rely on systematic male provisioning to meet their increasing reproductive costs. Left to themselves, mothers could find the additional energy from 'higher quality diet, from feeding for longer each day, or from maintaining lactation over a longer period' (1991: 70). Selection for slower rates of development and an extended period of immaturity enabled mothers to spread their energy load. Development of the fat stores characteristic of human females may have subsidized the costs of lactation, especially during periods of resource stress (Prentice and Whitehead 1987).

Shipman and Walker (1989: 388) model early *Homo erectus* patterns of foetal and postnatal brain growth, compared to that of chimps and modern humans, on the basis of the cranial capacity and pelvic diameter of the adolescent male KNM-WT 15000 (dated to 1.6 Myr). They infer an incipient human-type pattern of altriciality, which they link to shifts towards higher quality diet. At later stages, during the exponential increase

in brain size associated with archaic *Homo sapiens* (cf. Leigh 1992, Aiello, in press), the postnatal trajectory of foetal brain growth became progressively extended (secondary altriciality). Intensification of energetic costs during lactation would have confronted mothers with problems in balancing their energy budgets. These increased costs had to be met by higher quality diet and more reliable supplies, which ultimately meant extracting greater energetic investment from males. Reproductive stress owing to encephalization would have become acute for late archaic females.

Deceptive sexual signalling

Assuming that archaic *Homo sapiens* females required more reliable male parental effort, how could they have resolved the problem of the salience of menstrual bleeding as a signal of impending fertility?

The logical solution is that, within kin coalitions, non-menstruating females 'borrowed' the blood of menstrual females. To the extent that females were able to confuse the information available to males, by showing the same reproductive signal at the same time, coalition members could retain the advantage of menstruation as an indicator of impending fertility for attracting male attention, and retain the advantage of synchrony for maximizing male parental investment.

Sufficient pressure on females to increase or maintain male provisioning effort resulting from increasing costs of encephalization should lead to females, as coalitions, manufacturing synchrony of signals, by displaying sham menstruation on occasions when one of their number was actually menstruating. Females who adopted such a strategy of borrowing the blood of menstruating relatives would be expected to resort to cosmetic means – blood-coloured pigments that could be used in body-painting to augment their 'sham menstruation' displays.

The co-ordinated female display of menstruation would function as a form of advertising for extra male support. Provided females maintained their menstrual solidarity, even if males were aware of which females were actually menstruating, they would not be able to use the information. If males attempted to fight for access to a particular female, they would incur heavy costs, and there would be no benefit since the female is not immediately fertile. Males would be faced with increasing social costs from female resistance to the male strategy of targeting specific imminently fertile females. In this case, males could more reliably increase fitness by maintaining bonds with and existing levels of investment in current partners.

The 'sham menstruation' model gives a basis for describing behavioural adaptations that prefigure symbolic and ritual activity. What was a signal belonging to an individual, capable of extracting energy from males on a one-to-one basis, has become collectivized among a coalition of females

and amplified, broadcasting information of critical importance which males cannot afford to ignore. Quite simply, males are only interested in positive cues to fertility. Sham menstruation is an amplified indicator of the presence of an imminently fertile female in the vicinity. This means that the female coalition now has a powerful signal for manipulating males. To the extent that some females who are not imminently fertile pretend to be, the signal is deceptive. Unlike primate tactical deception, which is always on an individual basis (Byrne and Whiten 1988), in this case, the deception is maintained by a collective. As such, it represents a vital step towards sustaining an imaginary construct and sharing that construct with others – that is, establishing symbolism (Knight *et al.* 1995, Knight, this volume).

PROTO-SYMBOLIC BEHAVIOUR AND THE ORIGINS OF A RITUAL TRADITION

So long as female deceptive displays remain situation-dependent, constrained by the local incidence of real menstruation, they would not be fully symbolic but tied to here-and-now contexts. Symbolic cultural evolution takes off when cosmetic displays are staged as a default – a matter of monthly, habitual performance, irrespective of whether any local female is actually menstruating. Once such regularity has been established, females have effectively created a communal construct of 'Fertility' or 'Blood' – decoupled, finally, from its perceptible counterpart. Body-painting within groups repeatedly creates, sustains and recreates this abstract construct. Such energetically costly repeated ritual must be linked to the level, regularity and kind of male provisioning effort it engenders. We therefore predict that data interpretable as evidence for regular female ritual performance will correlate with the onset of a symbolically structured sexual division of labour.

No matter how amplified, menstrual signalling would not motivate males to embark on logistic hunts; on the contrary, it should promote mate-guarding. We have argued that sham menstruation would have been utilized by archaic female coalitions to attract and retain male support. But it could only function to mobilize male mating effort in contexts of area-intensive foraging, where there were sufficient gatherable resources in the vicinity. It is consistent with fairly similar foraging strategies between the sexes, with females accompanying males for hunting of no more than small to medium game. However, for females burdened with increasingly dependent offspring, and especially for late archaics undergoing maximal reproductive stress, there would be pressure to reduce activity levels, particularly the energetic costs of travel (Prentice and Whitehead 1987). Our hypothesis is that symbolism arose in this context. To minimize travel costs, coalitions of women began to invest more heavily in 'campsites'. To secure the strategy, women manipulated their

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attractive, collective signal in a wholly new way: by signalling refusal of sexual access except to males who returned 'home' with provisions. At this point, collective resistance to potential dominant males – 'counter-dominance' in the terminology of Erdal and Whiten (1994) – constitutes symbolic ritual underwriting the sexual division of labour. Menstruation – real or artificial – while biologically the wrong time for fertile sex, is psychologically the right moment for focusing men's minds on imminent hunting, since it offers successful hunters the prospect of fertile sex soon. Coalitions of women who had already been artificially manipulating information divulged to males, and engaging in a level of collective deception, would have had the preadaptations necessary to construct such a 'no' signal.

Knight's 'sex-strike' theory

Knight (1991) posits a model of symbolic cultural origins based in a female strategy of periodically refusing sex to all males except those who returned 'home' with fatty meat. 'Strike' action organized across a landscape motivated males to collective hunting of big game, and ensured their return to a home base with the product. This strategy was premised on a previously evolved tendency to reproductive cycle synchrony (the Turke ovulatory synchrony scenario). The intense levels of sexual solidarity required, and economic interdependency of female coalitions, would promote optimal conditions for menstrual synchrony (see Graham 1991). Lunar-phase alignment of menstrual cycles would have provided females with the necessary environmental clock for co-ordinating their action. Because of the importance of nocturnal light to long-distance hunters, the optimal time for hunting would have been in the period of waxing moon after first quarter. Hence the preceding 'sex strike' would be organized at dark moon, when women were menstruating, with the hunters' return around full moon, coincident with ovulation. This is the appropriate time for cooking fires to be lit.

Knight argues (this volume) that to signal their non-availability loud and clear, resisting would-be dominant males, women would have interfered with the specific mate recognition system. Through pantomime dance, they would have got their message across by indicating 'we are a different species from you!; we are the same sex as you!', and, given their menstrual condition, 'this is the wrong time for fertile sex anyway'. By pantomiming not only that they were animals, but that they were bleeding animals, women automatically constructed their blood as the blood of the game. This rendered all bloody flesh – female and animal – taboo to the hunter.

On the basis of this model, we posit a 'time-resistant' syntax, preserved in the structure of ritual and myth (Knight *et al.* 1995). According to this syntax, ritual power is switched 'on' by blood/wetness; dark/crescent

moon; extinguishing of cooking fires; hunger (prior to hunting); abstinence from marital sex; and 'animal mode' sexual ambiguity. Ritual power is turned 'off' by light; full moon; cooking fires; feasting; and 'human mode' marital sex.

If we integrate the models of sham menstruation and the sex strike, it can be seen that the later sex-strike strategy would rest on an evolved proto-cultural tradition of female coalitions acting to collectivize and standardize their display of reproductive signals. We posit that pressure to transform proto-cultural sham menstruation strategy into a fully cultural 'sex-strike' tradition built up as females endured acute reproductive stress owing to encephalization in the period 160–140 Kyr BP, this being exacerbated by resource stress during the height of the penultimate glacial cycle.

TESTING THE SHAM MENSTRUATION/ SEX-STRIKE MODEL

This hypothesis of symbolic cultural origins generates a number of tightly specified predictions. For the purpose of this article, these are broken down into two areas: (1) what sham menstruation strategy implies about the record of pigment use; and (2) the predictions of sex-strike theory concerning traditions of female inviolability.

Pigments in the archaeological record

For earlier stages of the brain expansion of archaic *Homo sapiens*, we posit context-dependent sham menstruation displays, triggered by the incidence of menstruation in local populations. Female coalitions used these as opportunity arose to attract and retain male support, securing long-term bonds with mates. This strategy implies less planning depth in obtaining materials for cosmetic usage, with correspondingly greater reliance on biodegradable matter, and only occasional traces of utilized ochre. As late archaic to early anatomically modern females endured acute reproductive stress, we posit the emergence of a habitual and fully symbolic strategy of cosmetic ritual underpinning the sexual division of labour. Greater regularity, planning and organization of performances would lead us to expect abundant and regular use of ochre. Evidence of symbolic ritual activity should correlate with the first indications for a sexual division of labour.

In this section, we present a preliminary summary of the archaeological data on ochre, briefly evaluating contending hypotheses of iron oxide use. We contextualize our conclusions on ochre use with brief comments on early Upper Pleistocene evidence for the sexual division of labour.

Re-evaluation of claims for Lower and Middle Pleistocene use of ochre have called into question several oft-cited instances, most notably

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Olduvai Bed II (Butzer 1980), Ambrona (Butzer 1980) and Terra Amata (Wreschner 1983, 1985). Aside from these, globally there remain about ten or eleven instances of hominid use of iron oxides definitely or possibly predating the Upper Pleistocene (Knight *et al.* 1995). None of these instances is thought to be significantly older than about 250–300 Kyr BP, and seven are from Late Acheulian, Fauresmith and early Middle Stone Age (MSA) contexts in sub-Saharan Africa. It seems reasonable to conclude that the earliest use of iron oxides was by archaic grade *Homo sapiens* rather than *Homo erectus* (*contra* Marshack 1981, Cordwell 1985, Velo and Kehoe 1990). Although this behaviour is geographically widespread, it is neither regular nor frequent; in all cases we are dealing with a single or just a few pieces.

From the beginning of the Upper Pleistocene, we have divergent pictures of iron oxide use in Africa and Europe. Focusing on MSA use of iron oxides in Southern Africa (south of the Limpopo), we adopt Volman's (1981, 1984) chronological scheme based on informal changes in lithic technology and typology.

The MSA1 is thought to span the greater part of oxygen isotope stage 6, the penultimate glacial ~200–140 Kyr BP. Volman suggests that the MSA2a may begin towards the end of Stage 6 – a glacial maximum (Jouzel *et al.* 1993) – and lasts through the onset of the last interglacial. The MSA2b is placed in the later substages of Stage 5 (approximately 110–75 Kyr BP). The only stage of the MSA which can be considered a formal industry is the Howieson's Poort, believed to date to either a cool, late sub-stage of O.I. Stage 5 or the onset of O.I. Stage 4 (Miller *et al.* 1992, Grun *et al.* 1990a, b). The Howieson's Poort is followed by a return to a more orthodox, albeit highly variable, MSA industry in the MSA3 lasting until the transition to the Later Stone Age, variously placed between 38–25 Kyr BP (*cf.* Wadley 1993).

Figure 11.1 presents data on the percentage frequency of pigments (as a proportion of unselected lithic assemblages) over time. Being associated with a glacial cycle, the early MSA has a low archaeological visibility in the region. However, the higher archaeological visibility of the MSA2a suggests that the low frequency of iron oxides in the early MSA is a behavioural phenomenon not attributable to low archaeological visibility (Watts *n.d.*). The graph illustrates an explosion in pigment use across the MSA2a/2b transition, and the maintenance of similarly high levels of pigment use for the duration of the MSA.

Throughout the MSA, red ochres massively predominate over orange-red and brownish-red hues, and reds in general are overwhelmingly predominant over other colours. Blacks are very rarely encountered from the MSA2b onwards, whilst data from Klasies River Mouth and Apollo 11 indicate that whites and yellows first occur in the Howieson's Poort. The rarity of black pigments is notable given the proximity of at least some sites to magnetite and manganese ore deposits. The principal criteria

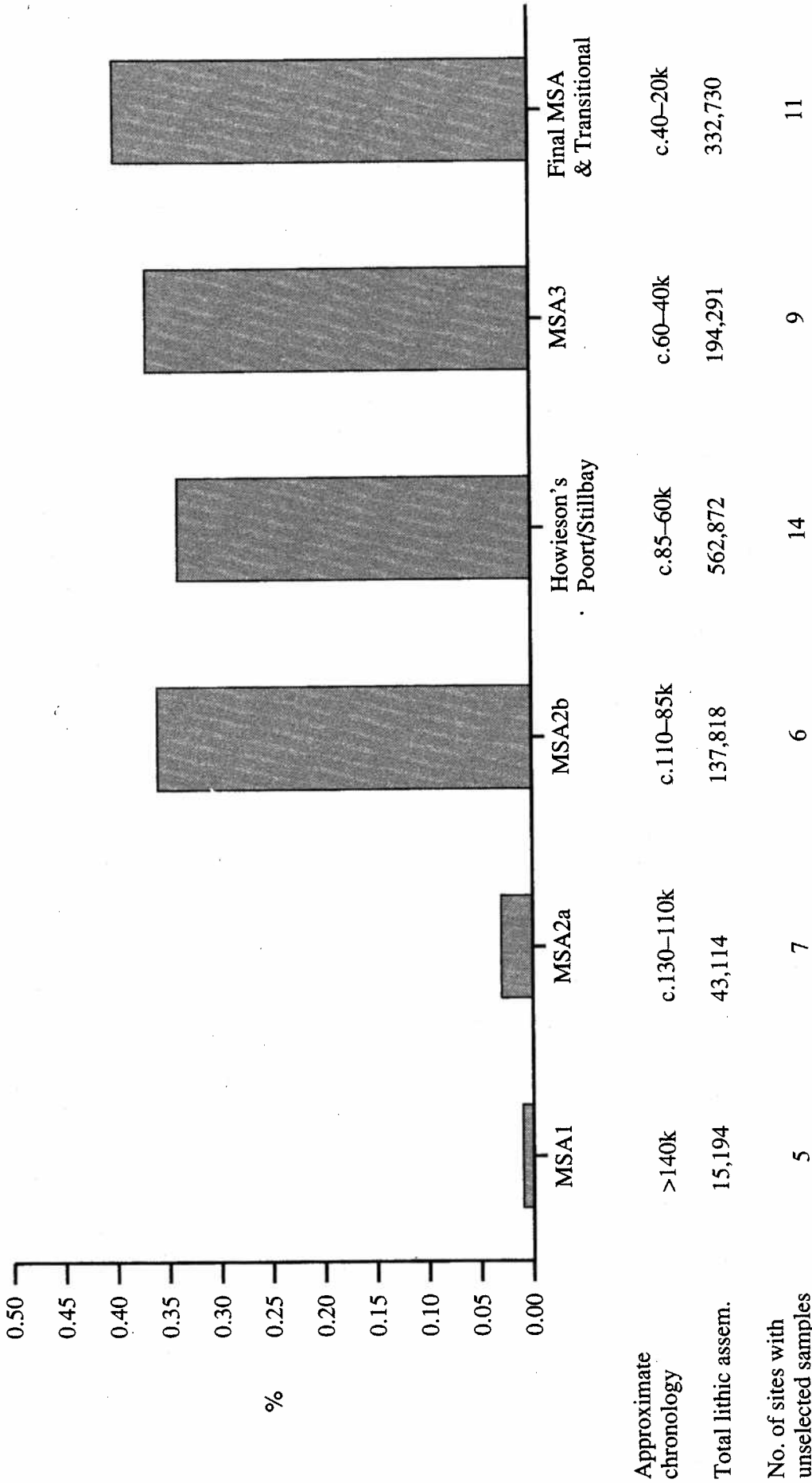


Figure 11.1 The symbolic explosion: ochre frequency as a percentage of total lithic assemblages

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used in the selection of raw materials clearly concerned colour and hue, with strong reds occurring earliest and massively predominating. In several MSA2 and Howieson's Poort assemblages there are unique pieces of red ochre which have been notched, drilled or scored with possible 'patterns' which cannot be explained in functional terms of the production of ochre powder (see Knight *et al.* 1995, for illustrations). The 'patterns' consist of parallel, convergent and perpendicular lines, triangles and complex meanders. The notched pieces of ochre in particular, from Stillbay (Evans 1993) and Howieson's Poort (Stapleton and Hewitt 1928) contexts, strongly suggest symbolic traditions. The scale of ochre use in Southern Africa from the MSA2b onwards is unparalleled elsewhere until the Eurasian Upper Palaeolithic. For the rest of Africa this probably reflects the less intensive history of research, as ochre is reported from a number of Last Interglacial or later MSA/Middle Palaeolithic assemblages in Eastern and Central Africa (see Knight *et al.* 1995, for references).

The contrast between this African data and the pre-Upper Palaeolithic European data is marked. Couraud (1991) lists seventeen French Middle Palaeolithic/Mousterian sites where pigments have been reported. Many of these were excavated in the early decades of this century, so details are scanty. However, a few generalizations are possible. The vast majority of occurrences appear to come from late Mousterian (Wurm I and Wurm II) contexts. The quantities involved are slight compared to both the earlier Southern African sites and the Eurasian Upper Palaeolithic, generally consisting of just a few pieces. Equally striking is that the predominant metal oxide is black manganese (Couraud 1991: 38). It is only during the Chatelperronian, when Neanderthals are widely believed to have been in direct competition with the newly arrived 'moderns', that we witness a dramatic increase in the use of red ochre, best illustrated at Arcy-sur-Cure (Couraud 1991).

Competing hypotheses

Before the early 1980s, virtually all archaeologists commenting on the use of iron oxides took a symbolist position, several using post-hoc arguments to suggest menstrual blood as the ultimate referent. Recently, more functional hypotheses have been proposed (e.g. Keeley 1978, 1980, Audouin and Plisson 1982, Moss 1983, Velo 1984, Cordwell 1985, Lavallée *et al.* 1985, Bahn and Vertut 1988, Dumont 1988, Couraud 1991). Many of these more recent commentators have attempted to demonstrate a technical role for ochre in the treatment of hides, primarily on the premise that iron oxides may protect hides from bacterial decay of collagen (e.g. Keeley 1980 citing Mandl 1961). It has also been suggested that iron oxides were used to protect the human body from cold, from the sun, from infestation, and as an astringent medicine (e.g. Keeley 1980, Velo 1984, Cordwell 1985). Bahn has argued that such

uses are likely to have preceded and have provided the basis for any subsequent symbolic practice (Bahn and Vertut 1988).

On the possible neutralizing qualities of iron oxides on the action of collagenase, an enzyme responsible for the breakdown of collagen (Keeley 1980, Cordwell 1985: 40), Mandl (1961: 196) noted that *all* metal ions inhibit collagenase. We would expect, therefore:

- that iron oxides would only be selected to the extent that they were more available than other metal oxides, e.g. manganese. Whilst the pre-Chatelperronian classic Neanderthal data appears to meet this expectation, the same cannot be said of the Southern African data.
- that within the class of iron oxides, haematite and red ochres would only be selected to the extent that they were more available than other iron oxides, not necessarily producing a red streak, e.g. magnetite, goethite, limonite and siderite. The African data clearly points to the selection of strong reds; that from Arcy-sur-Cure indicates that calcination of yellow ochre to obtain a red pigment was a practice which, on a small scale, extends back to the pre-Chatelperronian levels (Couraud 1991: 37).
- that the rate of hide deterioration attributable to the enzyme collagenase should be greater than the rate of deterioration attributable solely to wear and tear. No experimental data has been generated, but Silberbauer's (1981: 225–226) assessment of the use-lives of articles of hide clothing amongst the G/wi ranged from 6–18 months. Given such a rapid turnover, it seems improbable that the effects of collagenase would outstrip such use-lives.

In an unpublished but comprehensive evaluation of claims regarding the involvement of ochre in hideworking, Volman (n.d.) argues on both experimental and ethnographic grounds that it is much more likely that where ochre was used in the treatment of hides, it was after all scraping activities were completed – as an optional, *decorative* inclusion in a final, manual application of grease or fat (see Knight *et al.* 1995, for a summary). Volman comments: 'What is particularly disturbing about practically all of the studies considered here are the distortions and misrepresentations of ethnographic and experimental evidence to make it support the archaeological interpretations' (n.d.: 25).

No uniformitarian principle can be considered because despite the claimed neutralizing qualities of iron oxides on collagenase, no technical – as opposed to decorative – role for ochre in the treatment of hides in the ethnographic present can be demonstrated. It is worth noting in this regard that many of the ground pieces of MSA ochre are quite small and that reduction is often to a point or an edge, better suited to applying lines of colour than rubbing over a large surface. Similar criticisms can be raised regarding the claimed use of ochre as a bodily protection against the elements (see Knight *et al.* 1995).

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It would seem, therefore, that we have to fall back on the old 'invisible' archaeological stand-by, that Middle Palaeolithic/MSA peoples used ochre primarily as a body paint and possibly in the *aesthetic decoration* of organic materials, a conclusion also reached by Volman. This regular use of pigments, witnessed from at least 130 Kyr BP in Africa, should be regarded as the earliest evidence for a symbolic tradition, as opposed to irregularly expressed capacities (cf. Chase and Dibble 1987, 1992, Soffer 1992).

We have presented a neo-Darwinian processual model which predicts precisely this. To that extent, we are able to go beyond appeals to the universal salience of red (Berlin and Kay 1969, Velo and Kehoe 1990) and the earlier symbolist position which drew on random ethnographic precedents to suggest menstrual blood as the ultimate source of such salience. Our model posits that symbolism can only exist in the context of ritual traditions. Integrating the above data with the model's predictions, 'sham menstruation' behaviour may have been common to all archaic *Homo sapiens*. But it is in Africa, across the Middle/Upper Pleistocene transition, that this context-dependent strategy was raised to the level of habitual performance and a ritual tradition was established. How does this interpretation of ochre data relate to a broader understanding of the development of the sexual division of labour? We summarize our understanding of some of the differences between early anatomically modern and Neanderthal behaviour (see Knight *et al.* 1995): (1) by the onset of the Last Interglacial, MSA caves/rock-shelters were used in ways more closely approximating camp-sites than Stringer and Gamble's (1993) interpretation of pre-'pioneer' phase cave assemblages; (2) from this period, the regular use of grindstones is suggestive of a higher degree of planning depth among early anatomically modern *Homo sapiens* (eamHs) compared to Neanderthals; (3) there is limited morphological evidence to suggest greater division of labour amongst eamHs compared to Neanderthals (Trinkaus 1993); (4) we reject the assertion that symbolic traditions only developed in the period c. 60 Kyr to 40 Kyr BP. Whilst in Europe such a claim appears well founded, in Southern Africa evidence for symbolic traditions, apart from ochre, extends back approximately 100 Kyr. This includes possible recording systems in the form of serially notched bones, symbolically elaborated burial, the transport of marine shells over distances of c 100 km, and engraved ostrich eggshell.

Sex-strike theory and ethnographic traditions of 'female inviolability'

If the origins of a symbolically structured sexual division of labour are as late as the last interglacial in Southern Africa, and possibly considerably later in other continents, then it becomes legitimate to ask whether and

how the ethnography of contemporary hunter-gatherer societies may illuminate such origins.

We assume that some aspects of culture, such as the structural syntax of myth and ritual, are more conservative than others, such as exchange relations. No extant culture is expected to preserve our postulated 'initial situation' of periodic sex-strike intact. Any concordance with the model in the changeable domain of economic and social behaviour would exceed expectations. The model does specify closely the underlying syntax of ritual signalling, and we expect this to be retained with very high copying fidelity in all cultures up to the ethnographic present. Wherever surviving myth and ritual have anything to say about the moon, menstruation, hunting, sexual abstinence, cooking and so forth, then the symbolic connections should accord with the specified 'time resistant' syntax (Knight *et al.* 1995).

The model predicts that periodic female inviolability should be discernible as a focus of ritual traditions. Menstrual taboos satisfy this condition, being sufficiently widespread and invariant to indicate extreme antiquity. Predictably, where hunting is practised, the taboos are closely linked with beliefs concerning hunting luck (Knight 1991 and refs). Ritual potency is expected to display everywhere a characteristic signature, revealing its ancestry in menstrual seclusion.

Turning to ethnography, we first review Khoisan data on the use of red pigments, not as ethnographic precedents but in the light of the sham menstruation model. Next, we discuss the interrelations between hunting, sex, menstrual observances and lunar periodicity. Lastly, we test a counter-intuitive prediction derived from the posited 'time-resistant syntax to the mobilization of ritual power' – that women in menstrual 'power' mode should be engaged in signalling 'we are the wrong sex, and wrong species'.

Pigment use among Khoisan hunter-gatherers

It is clear that ochre and haematite were widely used in Khoisan menarcheal observances (Knight *et al.* 1995). Among the /Xam the most socially inclusive use of haematite occurred in the context of menarcheal rituals (Lloyd 1870–1879: VI–1, 3969 rev.–3973), when the 'new maiden' presented all the women of the band with lumps of haematite for dressing their cloaks and decorating their faces. A !Kung (Zu'/hoasi) new maiden would have a red ochre design painted on her forehead and cheeks (Marshall 1959). The G/wi or G//ana new maiden would be cut during seclusion and a mixture containing her mother's blood would be rubbed into the cuts (Valiente-Noailles 1993: 96). /Xam and !Kung new maidens treated adolescent boys with red pigment to protect them from accidents when out hunting. Similar uses of red pigment, whether animal, vegetable

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or mineral, are reported for menarcheal rites among most other Khoisan hunter-gatherer groups (e.g. Thomas 1960: 210; Silberbauer 1965; Viegas Guerreiro 1968: 223, 226).

Most other ochre/haematite uses were ritual, such pigments being prominent in other rites of transition, healing dances, rain magic, hunting magic and rock painting (see Knight *et al.* 1995, for refs). Moreover, ochre-processing seems to have been characteristically a women's activity. A metaphor in Zu/'hoasi oral narratives for impending ritual action was hearing the sound of women pounding red ochre in camp (Biesele 1993: 163, 196). Several ethnographers of the !Kung have remarked on the structural similarity between menarcheal ritual and other rites of transition (see Knight *et al.* 1995, for refs).

We have argued that cosmetic manipulation of menstrual signals – with 'blood' triggering 'periodic seclusion' or 'removal to another world' – provides a basic transformational template from which other patterns of ritual can be understood to derive. Taken in conjunction with our critical assessment of alternative functional hypotheses of prehistoric ochre use, this ethnographic data permits greater confidence in inferring the operation of similar relations of relevance (Wylie 1988, Lewis-Williams 1991) in the early Upper Pleistocene of Southern Africa. Functional uses of iron oxides were then, and remain today, subordinate to ritual and symbolic ones.

Hunting, sex, menstrual observances and lunar periodicity

Over the year, the most productive form of hunting practised by the Hadza, the !Kung of Dobi and !Kubi, and the /Kaicwa San of the Nata River, took place in the dry season. It consisted of night-stand hunts over game trails leading to water-holes or river-pools (Crowell and Hitchcock 1978, Hawkes *et al.* 1991). Because this was a nocturnal activity such hunts were further restricted to moonlit nights (Bunn *et al.* 1988, Crowell and Hitchcock 1978), optimally the second quarter of the waxing moon, possibly including the nights immediately following full moon. Because the hunter was so close to the prey, spears were frequently used; this implies that the strategy was much more ancient than the more common poisoned arrow encounter hunting. This was a more collective form of hunting than most pursuit hunting (Crowell and Hitchcock 1978). There is strong evidence for the practice of dry season, pan-margin hunting extending back to the last interglacial. In line with modern parallels we infer this to have been primarily nocturnal and lunar phase-locked (see Knight *et al.* 1995, for refs).

For the Hadza, the dry season marks the phase of social aggregation when their most sacred rituals are held – the *epeme* dances held on each night of the dark moon for the duration of the aggregation. All camp

fires are extinguished and the women call upon each man in turn to dance, referring to him exclusively in consanguineal kinship terms (Woodburn 1964, 1982). In Hadza belief, women synchronize their menstruation with dark moon (Bleek 1930: 700), hence at the time of *epeme* rites. The dance emphasizes gender segregation cross-cut by kinship solidarity. As well as being a healing dance, it is believed to ensure success in forthcoming hunts, when portions of the fattiest meat will be offered in brideservice. A coherent pattern emerges from the following set of Hadza beliefs and practices: first, men should not hunt nor have sex while their wives are bleeding (Woodburn 1964, 1982); second, the most successful hunting in the dry season occurs around full moon; and third, menstruation normatively occurs at dark moon, at the same time as the most sacred ritual. In this case, the specifications of the model are met not only at the level of ritual syntax, but also in actual hunting practice.

Several historical and ethnographic accounts explicitly refer to full-moon hunting by Khoisan, whilst others describe nocturnal hunts where some level of lunar phase-locking has to be presumed. Both the historical and ethnographic accounts are replete with references to a normative belief linking success in the hunt to lunar periodicity. Where details are given, it is always the waxing phase which is associated with hunting success (Knight *et al.* 1995). Like the Hadza, most Khoisan groups had a normative belief associating menstrual with lunar periodicities. Where specified, menstruation is always linked to dark, not full, moon. This linkage structured ritual practice. The /Xam, !Xu, and G/wi and/or G//ana would not release a menarcheal girl from seclusion until the appearance of the new moon (Lloyd 1870–1879: VI–2, 4001–4002, Bleek 1928: 122, Valiente-Noailles 1993: 94–97). The !Kung make explicit their belief that women synchronized menstrual onset (Shostak 1983: 68), while there is indirect evidence for behavioural menstrual synchrony (see Knight *et al.* 1995, for refs).

As with the Hadza, the Khoisan generally believe that a man should not hunt while his wife is menstruating (Biesele 1993: 93), and he should not have sex while she is bleeding or while he is preparing for or engaged in a protracted hunt (Marshall 1959: 354 fn.1, Shostak 1983: 239). As predicted, big-game hunting and marital sex are regarded as incompatible. In an early nineteenth-century account this logic is made explicit, with women going on sex strike to force men to raid for cattle:

The Bushmen when they will not go out to steal cattle, are by the women deprived of intercourse sexual by them and from this mode of proceeding the men are often driven to steal in opposition to their better inclination. When they have possessed themselves by thieving of a quantity of cattle, the women as long as they exist appear perfectly naked without the kind of covering they at other times employ.

(Smith n.d.: notebook 4, p. 77 rev.)

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WRONG SEX, WRONG SPECIES

In summarizing the sex-strike model we drew attention to women's interference with the mate recognition system. They should stress non-availability and resist dominant males by going into animal mode and/or being the wrong sex. As a consequence, the menstruating woman is in a paradoxical position: if by becoming the prey animal she initiates the hunt, she is in some sense not only the quarry but the hunter as well. This paradox permeates the ethnographic material. The Hadza and the !Kung have virtually identical terms for a menarcheal girl. The Hadza say 'She has shot her first zebra' (Woodburn pers. comm.), the !Kung say 'She has shot an eland' (Lewis-Williams 1981: 51). While in seclusion and upon emergence, the girl must keep her eyes down; in this way, the antelopes will do the same and not see the approach of the hunters (Bleek and Lloyd 1911, Lewis-Williams 1981). A !Xo menarcheal girl fires a ritual arrow at a gemsbok shield during seclusion to bring luck to the weapons; but on emergence her face is painted to resemble that of the gemsbok (Heinz 1966). Similarly, among the G/wi, the new maiden is taken by her father to touch her husband's weapons so that 'they will not harm her husband' (Silberbauer 1965: 86). Solomon's (1992) analysis of San rock art focuses on the recurring motif of ambiguously female figures with menstrual flows, ambiguous because of their therianthrope features and/or male attributes such as a penis or hunting equipment.

In the Hadza matriarchy myth of Mambedaka (Woodburn 1964), the original owner of the sacred *epeme* meat is an old woman who dresses as a man, hunts zebra and wears a zebra penis which she uses to have sex with her 'wives'. She demands that men bring the *epeme* meat to her cooking pot which she distributes to the 'wives'. Men have no share in the sacred meat until the violent overthrow of Mambedaka's rule. This is a graphic depiction of the logic of women procuring fatty meat from men by signalling 'wrong sex, wrong species'.

Probably the best-known aspect of Khoisan menarcheal ritual is the 'Eland Bull Dance' (Lewis-Williams 1981, Valiente-Noailles 1993). Men are either totally excluded, or a couple of older men in affinal relation to the menarcheal girl are allowed to remain to play the part of the eland bull. The women pantomime the courtship behaviour of eland cows, dancing around the menarcheal girl, exposing their buttocks both to the girl and to whoever may be playing the bull. Among the Kua the women themselves take the role of the bull (Valientes-Noailles 1993). The !Kung clearly identify the menarcheal girl with the eland bull (Lewis-Williams 1981). Although considered a highly erotic performance, the gender segregation emphasizes displaced sex. In line with the time-resistant syntax specified by our model, displaced, pantomime sex which stresses gender ambiguity may be an integral part in ensuring hunting success. Real marital sex is incompatible with hunting.

CONCLUSION

Our focus in this chapter has been on the ritual function of cosmetics. According to our hypothesis, the symbolic domain arose as a response to increasing levels of reproductive stress experienced by females during the rapid phase of encephalization associated with archaic *Homo sapiens* (from 250 Kyr BP). Ovulation concealment and loss of oestrus had deprived males of precise information about female reproductive status, rendering sex in effect 'time-wasting' for males. As pay-offs to mate-desertion were reduced, females could extract more energy, including provisioning from their partners. Once these signals had been phased out, menstruation remained as the only cue offering males positive information on which females were imminently fertile. Males who responded to menstrual cues were drawn into longer-term consortships and relatively greater investment. Because pronounced menstrual bleeding was valuable for extracting mating effort from males, local non-cycling females would have been motivated to exploit its attractions.

On this basis, we have argued that coalitions of female archaic humans resorted to cosmetic manipulation of menstrual signals, such as body-painting, to secure long-term bonds and parental investment from males. This 'sham menstruation' strategy effectively formed a preadaptation to ritual, exercising a capacity for collective deception. We have argued that the explosion of ochre use witnessed in the MSA2b marks the transcendence of sham menstruation by ritual sex-strike. The MSA obviously does not share in the elaboration of symbolic culture witnessed in the LSA, but all the essential elements of a sexual division of labour appear to be in place by the last interglacial, approximately coincident with the evolution of anatomically modern humans. By the MSA2a, the rituals underpinning the first mode of production had become an embedded part of performance in a context of arbitrary, symbolic constructs. The model as presented improves on the form of analogical argument based on ethnographic precedent used both by 'symbolists' and by 'functionalists'. Having tested the relations of relevance derived from the sex-strike model of cultural origins against Hadza and Khoisan ethnographic data, we conclude, first, that this symbolic usage primarily concerned the mobilization of ritual power; and, second, that the function of such power, linking women's menstrual blood to the blood of the hunt, was to establish rules of distribution governing sexual partners and meat.

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