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The Signs of All Times
Entoptic Phenomena in Upper Palaeolithic Art'

by J. D. Lewis-Williams
and T. A. Dowson

Elucidation of the geometric signs in Upper Palaeolithic art is hampered by an absence of directly relevant ethnography and by the logical impossibility of inducing meaning from numerical rock-art data. This paper approaches the signs by constructing a neuropsychological model of the apprehension of entoptic phenomena in three stages of altered states of consciousness. The utility of the model is assessed by applying it to two known shamanistic rock arts, San and Shoshonean Coso. It is then applied to Upper Palaeolithic mobile and parietal art to show that this art was also associated with altered states of consciousness. Some of the implications of this conclusion for understanding the meaning of entoptic elements, the diverse contexts of Upper Palaeolithic art, the co-occurrence of signs and representational art, and the origins of art are briefly considered.

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Signs are small measurable things, but interpretations are illimitable.
GEORGE ELIOT, Middlemarch

The so-called signs of European Upper Palaeolithic art2 have been a persistently intractable challenge to archaeologists. By and large, two approaches have been employed to elucidate their meaning. Some writers, especially those of earlier decades, invoked ethnographic analogies to argue that the signs were traps, huts, or shrines inhabited by spirits (e.g., Breuil 195-2:24). More recently, writers have turned from ethnography to internal analysis, believing it possible to discover an inherent order and then, without recourse to analogues, to induce meaning from that order (e.g., Laming 1962; LeroiGourhan 1968a, b; Marshack 1972; Sauvet, Sauvet, and Wlodarczyk 1977; Sauvet and Sauvet 1979; Faris 1983). Various patterns have been suggested and supported, some more, some less convincingly, by quantitative work (Parkington 1969, Rosenfeld 1971, Stevens 1975), but the next step, induction of meaning, has run into snags, for it is logically impossible to induce meaning from numerical rock-art data, as it is from any data (Lewis-Williams I983b:ioi; Lewis-Williams and Loubser 1986). Although much of this inductive work has proved valuable and provocative, no explanation for the signs has won general acceptance. Today there is a "swing away from a fruitless search for meaning to a consolidation of all we know about the art" (Balm 1986b: 55; see also Conkey 1983). Many believe that "it is very probable that we shall never know the meaning of Palaeolithic art" (Sieveking 1979:2o9; Halverson 1987:70).

Less pessimistically, we develop a model for classifying and addressing Upper Palaeolithic signs that avoids simplistic ethnographic analogy (Wylie 1985) and the impasse of induction from internal analysis. This approach derives from current research on San (Bushman) rock art in southern Africa, where the shamanistic nature of the art has turned attention to altered states of consciousness. Southern Africa is a particularly favoured area because shamanistic images can be approached simultaneously from two directions. In the first place, neuropsychological research explains the forms of certain depictions, and, secondly, the meanings of some of these depictions can be established from directly relevant ethnography. But southern African examples only underscore the difficulty of rock-art research in regions and periods for which no ethnography exists (Davis 1982; Jones 1982; Sauvet 1982; Marshack 1986:8o-81). Sieveking (1979:2 8) and others (e.g., Conkey 1983:223) are no doubt right in an absolute sense that Upper Palaeolithic art has "no real counterpart in any present-day primitive community," but we respond to their "ethnographic despair" by arguing that a

2. "Palaeolithic art" is an unsatisfactory term that prejudges aesthetic sensibilities and obscures the variety of genres, but, in the absence of a better and equally succinct phrase, we retain it (cf. Conkey 1984, n.d.; Davis 1986:193).

neurological bridge affords some access to the Upper variety of means. Under laboratory conditions, electl Palaeolithic. stimulation (e.g., Knoll and Kugler 1959, Knoll el 1963, Brindley 1973, Eichmeier and H6fer 1974)

flickering light (Young et al. 1975) produce them,
Entoptic Phenomena although flickering fire light may have played a rol
the past, we clearly have to look elsewhere to exp
The strong evidence that chimpanzees, baboons, mon- prehistoric experience.
Psychoactive drugs generate keys, cats, dogs, and other animals hallucinate
suggests percepts, but fatigue, sensory deprivation, intense (that altered states of
consciousness and hallucinations centration, auditory driving, migraine,
schizophre are a function of the mammalian, not just the human,
hyperventilation, and rhythmic movement are s nervous system (Siegel and Jarvik
1975:81-104) and that other generating factors (Kliiver 1942; Horowitz ic "non-
real" visual percepts were experienced long before 512-18; Sacks 1970; Siegel
and Jarvik 1975). Much,, the Upper Palaeolithic. Indeed, australopithecines prob-
research will have to be done before it can be estabhs ably hallucinated. Be that as
it may, the nervous system whether specific geometric forms are associated v is a
human universal, and we accept that, by the Upper particular circumstances of
generation (but see Kno] Palaeolithic, it Was much the same as it is now. The al.
1963). content of early human mental imagery is, however, Nomenclature for
these visual percepts poses s(
more problematic than its existence, because cultural problems. Hoping to avoid
a diversionary logomachy, expectations inform the imagery to a considerable ex-
follow Tyler (1978:1633) in using entoptic phenom tent. For a conservative
beginning to an investigation of (from the Greek, "within vision") to mean visual
sei possible Upper Palaeolithic mental imagery we therefore tions derived from
the structure of the optic system comment less on culturally informed
hallucinations where from the eyeball to the cortex. This term co, than on a
feature of altered states completely controlled two classes of geometric percept
that appear to de by the nervous system. from different parts of
the visual system-phosphe
Under certain circumstances the visual system gener- and form constants.
Phosphenes can be induced by pl ates a range of luminous percepts that are
independent of ical stimulation, such as pressure on the eyeball, and light from an
external source (e.g., Kluver 1926, 1942,; thus entophthalmic ("within the eye")
(Walker 1i Knoll et al. 1963; Horowitz 1964; Oster 197o; Richards Form
constants derive from the optic system, prob. 1971; Eichmeier and H6fer 1974;
Siegel and Jarvik I975; beyond the eyeball itself (Knoll et al. 1963, Siegel 19
Siegel 1977, I978; Asaad and Shapiro 1986). Although We distinguish these two
kinds of entoptic phenom there was interest in these visual percepts in the 19th
from hallucinations, which have no foundation in century and at the beginning of
this one, it was not until actual structure of the optic system. Unlike phosphe the
I92OS that Heinrich Kliver began the systematic and form constants,
hallucinations include iconic analysis of the phenomena. Working under
laboratory sions of culturally controlled items such as animals conditions,
Klfiver (1926; 1942:177) concluded that well as somatic and aural experiences.
These definiti these percepts were not just visual "dust"; they had are somewhat
complicated by similarity between , form. Abstracting redundant form elements

from his tain phosphenes and form constants and the simultv subjects' reports of altered states of consciousness, he ous experience of form constants and hallucinati arrived at four groupings of the percepts. Some years and, moreover, by a tendency for writers to use "halli later, Horowitz (1975:178), unaware of Kliiver's work, nation" to cover phosphenes, form constants, and I similarly abstracted redundant form elements from re- lucinations as now defined. One of us (JDL-W) has h ports of altered states. He then found that his elements, guilty of such confusion, but we feel that gre despite their "indescribableness" (Khiver 1926:503), cor- definitional clarity should be sought if we are to att responded very largely with Kluiver's categorisation. more precision in our understanding of shamanistic Other workers (e.g., Knoll 1958, Horowitz 1964, perience. Nevertheless, at the present stage of researc
Richards 1971, Eichmeier and H6fer 1974, Siegel 1977) is premature to distinguish between phosphenes have confirmed these findings and identified further re- form constants (cf. Hedges 1983:59), and we there curring form elements. Their research has shown that use only the generic term "entoptic phenomena" these visual phenomena, although complex and diverse, "entoptics") for the largely geometric visual perce] take geometric forms such as grids, zigzags, dots, spirals, We reserve "hallucination" for more complex iconic and catenary curves. All these percepts are experienced sions (Siegel 1977:134; Reichel-Dolmatoff 1978a:] as incandescent, shimmering, moving, rotating, and I3). sometimes enlarging patterns; they also grade one into another and combine in a bewildering way (Kliiver 1942:176). Because they derive from the human nervous A Neuropsychological Model system, all people who enter certain altered states of consciousness, no matter what their cultural back- The universality of entoptic phenomena encourages ground, are liable to perceive them (Eichmeier and H6fer to construct a model of the ways in which mental im 1974, Reichel-Dolmatoff 1978a). ery is perceived by people in certain altered states
These geometric visual percepts can be induced by a consciousness. Ultimately, such a model should be r(

vant to all arts derived from these altered states. Because we are concerned principally with entoptics, we say less about iconic hallucinations, but the intimate relationship between the two must be clarified by any model that seeks to explain the imagery of altered states. We distinguish three components within our model: types of entoptic phenomena, principles governing their perception, and stages in the progression of altered states of consciousness.

ENTOPTIC FORMS

Although there are numerous entoptic forms, certain types recur. We have selected six of the commonest types from the range established by neurologists and Spsychologists (see, for example, KlIver 1942:172-77; Knoll and Kugler 1959; Horowitz 1965; Oster 1970; Richards I971; Eichmeier and H6fer 1974; Siegel 1977). (An important omission is the spiral or vortex, but we feel this deserves special treatment.) These are (I) a basic grid and its development in a

lattice and expanding hexagonal pattern, (2) sets of parallel lines, (3) dots and short flecks, (4) zigzag lines crossing the field of vision (reported by some subjects as angular, by others as undulating), (5) nested catenary curves (in a developed form the outer arc comprises flickering zigzags), and (6) filigrees or thin meandering lines. Because these phenomena are mercurial, we do not suppose our six categories to be as rigid as this list seems to imply. Nevertheless, we take the six entoptic types to be fundamental because they were established by abstracting redundant elements from a large number of reports.

PRINCIPLES OF PERCEPTION

According to neuropsychological studies, the ways in which subjects perceive both entoptic phenomena and iconic hallucinations are many and varied. We have, nevertheless, formulated seven general principles that govern their perception: replication, fragmentation, integration, superpositioning, juxtapositioning, reduplication, and rotation.

When a subject perceives an entoptic phenomenon in one of the fundamental forms, we speak of replication, our first principle. The entoptics subsumed under this principle are, in a sense, unmistakable; those covered by the second principle, fragmentation, are less so because research has shown that an entoptic phenomenon may be broken down into minimal components (Horowitz 1975:178); a grid, for example, may be fragmented into a ladder-like form. The third principle, integration, moves in the opposite direction and blends images to build up complex patterns (Khiver 1942:177; Siegel 1977:134). For instance, a grid may blend with a series of zigzags. Two less intimate ways of bringing together visual images are superpositioning and juxtapositioning. One entoptic form may be projected against another (Knoll et al. 1963: 205, 2o8, 214; Walker 1981:148) or simply appear next to it. The next principle is reduplication. What may start as a single image becomes a series of duplicated images, such as festoons of catenary curves (Kliiver 1942:177, 182, 187; Reichel-Dolmatoff 1972:92; Siegel 1977:134). Finally, entoptic phenomena rotate in the field of vision (Kliver 1926:504, 505; 1942:181; Knoll et al. 1963:204-6).

Although we have referred to only entoptic phenomena, these seven principles also apply to iconic hallucinations and in some cases link the two kinds of percept. In such an experience a grid, for example, may be integrated with an animal; in other instances an animal may be blended with characteristics of another species. The principles are necessarily a simplification of the many distortions and alterations experienced in mental imagery (Kliiver 1942: 187), but, after the identification of entoptic forms, they are a second step in building a neuropsychological model of the ways in which mental imagery is apprehended.

STAGES IN THE DEVELOPMENT OF MENTAL IMAGERY

As a third step we examine three broadly conceived stages in the progression of mental imagery during altered states of consciousness.

In Stage i subjects experience entoptic phenomena alone (Siegel and Jarvik 1975:111; Siegel 1977:132). These are perceived with the eyes open or closed (Khiver 1942:503; Siegel 1977:132) and tend to be located at reading distance (Siegel 1977:139), though they also ap-' pear to recede and advance. The phenomena cannot be consciously controlled; they seem to have a life of their

own (Kiver 1926:504; Siegel 1977:132). They are, furthermore, characterized by varied and saturated colours (Knoll et al. 1963; Siegel 1977:132). Sometimes a bright light in the centre of the field of vision obscures all but peripheral images (KlUver 1926:503; Siegel 1977:134). The rate of change of the phenomena seems to vary from one hallucinogen to another (Knoll et al. 1963:221) but is generally rapid. Laboratory subjects new to the experience find it difficult to keep pace with the rapid flow of imagery, but, significantly, training and familiarity with the experience increase their powers of observation and description (Siegel 1977:134). In Stage . subjects try to make sense of entoptics by elaborating them into iconic forms (Horowitz 1964:514; 1975:177, 178, 181). In a normal state of consciousness the brain receives a constant stream of sense impressions. A visual image reaching the brain is decoded (as, of course, are other sense impressions) by being matched against a store of experience. If a "fit" can be effected, the image is "recognised." In altered states the nervous system itself becomes a "sixth sense" (Heinze 1986) that produces a variety of images including entoptic phenomena. The brain attempts to recognise, or decode, these forms as it does impressions supplied by the nervous system in a normal state of consciousness. Horowitz (1975:177) links this process of making sense to the disposition of the subject: "Thus the same ambiguous round shape on initial perceptual representation can be 'illusioned' into an orange (if the subject is hungry), a breast (if he is in a state of heightened sexual drive), a

cup of water (if he is thirsty), or an anarchist's bomb (if he is hostile or fearful)." As subjects move from this stage into Stage 3, marked changes in imagery occur (Siegel 1977:132). Many laboratory subjects report experiencing a vortex or rotating tunnel that seems to surround them, and there is a progressive exclusion of perceptual information (Horowitz 1975:178). The sides of the vortex are marked by a lattice of squares like television screens. The images on these "screens" are the first spontaneously produced iconic hallucinations; they eventually overlie the vortex as entoptics give way to iconic images (Siegel and Jarvik 1975: 127, 143; Siegel 1977:136). The iconic images appear to derive from memory and are often associated with powerful emotional experiences (Siegel and Jarvik 1975:1'1; Siegel 1977:136). This shift to iconic imagery is also accompanied by an increase in vividness. Subjects stop using similes to describe their experiences and assert that the images are indeed what they appear to be. They "lose insight into the differences between literal and analogous meanings" (Siegel and Jarvik 1975:128). Nevertheless, even in this essentially iconic stage, entoptic phenomena may persist: iconic imagery is "often projected against a background of geometric forms" (Siegel 1977:134).

These three stages are not necessarily sequential. Some subjects appear to move directly into the third stage, while others do not progress beyond the first. It does, however, appear that exclusively entoptic imagery is characteristic of the first stage. Nor should the stages be considered discrete. Construal, for instance, may occur in Stage 3, with construed entoptics accompanying true iconic hallucinations. Although entoptics still occur in Stage 3, they are secondary and

tend to frame the principal iconic elements (Reichel-Dolmatoff 1978a:147). The three stages we propose should therefore be seen as cumulative rather than sequential.

This three-stage progression was established by research using mescaline and LSD. We do not know if the trajectory of mental imagery is identical for all drugs and for non-drug-induced states, but we believe that a broad similarity can be accepted. This assumption is partially justified by the identification by the Tukano of the Colombian northwestern Amazon of three stages in their yaji-induced visual experiences (Reichel-Dolmatoff 1978a:I2-13). They speak of an initial stage in which "grid patterns, zigzag lines and undulating lines alternate with eye-shaped motifs, many-coloured concentric circles or endless chains of brillant dots" (ReichelDolmatoff 1978b:291-92). During this stage they watch "passively these innumerable scintillating patterns which seem to approach or to retreat, or to change and recombine into a multitude of colourful panels." We emphasise that these forms are depicted by the Tukano and identified by them as elements in their yaij visions. Reichel-Dolmatoff (1972, 1978a, b) has demonstrated their isomorphism with entoptic phenomena established quite independently by laboratory experiments. In the second stage recognised by the Tukano there is a diminution of these patterns and the slow formation of
larger images. Together with these they perceive rec nisable shapes of people, animals, and monsters. 'I intense activity of this stage gives way to more pla visions in the final stage. The Tukano's Stages i conform to our Stages i and 3 respectively.

The model we propose thus comprises a set of six e optic forms, seven principles governing the perception entoptic phenomena and iconic hallucinations, 1 three stages in the progression of altered states of c(sciousness.

Entoptic Phenomena in Shamanistic and Upper Palaeolithic Art

To examine the applicability of this neuropsychologi, model we apply it to two known shamanistic arts fr(different continents. If the model proves appropriate these arts, we can use it to assess arts not known a pri to be associated with altered states.

The first shamanistic art is that of the San. Becat San rock art is now widely accepted as shamanistic,' do not rehearse the debate about it here.4 We mer(point out that I9th- and 2oth-century ethnography cords San shamanistic practices in some detail and p vides a firm foundation for the interpretations that f low (for an account of the ethnography and its relevar to San rock art, see Lewis-Williams and Biesele 19, Lewis-Williams 198o; I98Ia:25-37; 1987a).

In referring to the San we use "shaman" rather th the more usual "medicine man," but we do not there imply anything about the social position of the pers his or her mental health, or, indeed, many of the ott characteristics often associated with the very h, erogeneous phenomenon called shamanism. Instead emphasise what we believe to be the most importa and overriding feature of shamanism and the one wi which this paper is principally concerned-alter states of consciousness. This emphasis is echoed by S words for "shaman." The modem Kung of the northe Kalahari Desert use n/urn k"au, which means "owner n/urn." N/urn is a supernatural potency that Marsh (1969:351) likens to electricity: harnessed it is be

eficial, uncontrolled it is dangerous. The 19th-centu southern /Xam San spoke of a !gi:xa (pl. !gi:ten). !Gi the /Xam equivalent of n/um, and the final syllable, -: means "-full," as in "wrathful." /Xam shamans tivated their potency to enter trance, as the Kung st do today, either during large dances or in more solita circumstances (Lewis-Williams n.d.a). Hallucinoge

3. See Lewis-Williams (i98o, I98Ia, 1982, 1985a, b, 1987a), Lew Williams and Loubser (1986), Huffman (1983), Maggs and Se, (1983), Yates, Golson, and Hall (1985), Manhire et al. (1986), Pa ington et al. (1986), Campbell (1986, 1987).

4. Traditionally, San rock art was seen as the product of hunti magic rituals or as a narrative of daily life with a small "mythica component. For the various positions adopted in this debate, s Lewis-Williams (1982, 1983a, b, 1984a, b, 1987a, b), Cooke (198 Hammond-Tooke (1983), Nettleton (1984), Willcox (1984, 198 Woodhouse (1984), and Lewis-Williams and Loubser (1986).

are little used in the Kalahari today (Lee 1968; Marshall 1969:372; Katz 1982.:18o-81, but there is some suggestion they may have been used more commonly in the past (Dobkin de Rios 1986). Southern San shamans were believed to enter trance to cure the sick, undertake extracorporeal journeys, make rain, and control animals. The artists depicted the trance dance itself, symbols of supernatural potency, hallucinations experienced by shamans, and, most significant for our argument, entoptic phenomena. Although it might have been possible under certain circumstances, we do not suggest that these depictions were executed by people actually in trance. It seems more likely that San shaman-artists recalled and depicted their powerful experiences in relative tranquility. Today the San listen attentively to shamans' recollections of trance experience; in the past, depiction may have been a parallel (but not identical) activity.

For a second assessment of our model we turn to the Shoshonean Coso rock art of the California Great Basin. The paucity of direct ethnographic references to rock art in this area has led some students to believe that its social context is virtually unknowable. By inference from the art alone others have thought it to have been associated with a hunting cult focused on bighorn sheep (Heizer and Baumhoff 1959, 1962; Grant 1968; Ritter 1970). Recently, closer attention to Great Basin and southern Sierra Nevada ethnography has suggested that it was shamanistic (Whitley n.d.a, b; for more on shamanistic rock art in North America see, among others, Kroeber 1925; Grant 1965; Kirkland and Newcomb 1967; Ritter and Ritter 1972a; Vastokas and Vastokas 1973; Hedges 1973, 1976, 1983; Applegate 1975; Blackburn 1977; Lee 1977; Snow 1977; Wellman 1978, 1979a, b; Garvin 1978; Schaafsma 198o; Hudson and Lee 1984). There are many relevant though not direct ethnographic data. Whitley (n.d.a) argues that, if all the references to rock painting within the southern Sierra Nevada area (and across a number of ethnolinguistic groups) "are viewed within the regional patterns of shamanism, a coherent pattern emerges." The most explicit statement was collected by Driver (I937) from a Western Mono informant: "doctors, po'hage .... painted their spirits (anit) on rocks 'to show themselves, to let people see what they have done.' The spirit must come first in a dream." Among the Coso Shoshone and other groups

(Tubatulabal and Kawaiissu), rock art was ascribed to "water babies," a concept common in the region. Although these mythical creatures have been dismissed as mere "brownies" (Voegelin 1938:61), they were in fact dream or animal helpers of shamans. Moreover, in south-central California there is little lexical difference between "spirit," "dream helper," and "shaman" (Whitley n.d.a, b). Among the adjacent Tubatulabal the "water babies" themselves were identified as the painters and were seen in jimsonweed trances. Although ethnographic evidence for a shamanistic interpretation of Coso rock art is not as rich and varied as that for San rock art, it is sufficient to justify using it in a second, though subsidiary, evaluation of our model.

ENTOPTIC FORMS

In figure i we assess the first component of our model, the six entoptic categories, against San and Coso rock art.

In dealing with San art, we distinguish between engravings and paintings because entoptics are, for unknown reasons, considerably more prominent among the former. These two depictive techniques are, by and large, confined to different parts of the subcontinent (Van Riet Lowe 1956), but there is reason to believe they were both employed by San people who entertained similar belief systems (Lewis-Williams and Biesele 1978; Lewis-Williams 1983c:31-37). Certainly, all six forms occur in both engravings and paintings.

The six entoptic categories are also abundant in Coso art, though not in the same proportions. The first entoptic, a grid, is often part of the enclosed shieldlike forms. Sets of lines (II) are sometimes similarly enclosed, but on one side only. The example in IE is accompanied by a row of dots (III). Dots, like other forms, are also often depicted enclosed. Zigzags and undulating lines, the fourth entoptic, are as common. Catenary curves (V) seem to be comparatively rare, but examples do exist. The one in figure i is accompanied by concentric circles. These circles probably represent a vortex, as is more clearly seen in the depiction next to the example of VI.

We take the presence of all six entoptic forms in both San and Coso art to be an initial confirmation of the utility of our model in explaining one component of these arts.

Figure 2 shows that the six formal categories are depicted in European Upper Palaeolithic art (cf. Eichmeier and H6fer 1974:table 7; Bednarik 1948b:fig. i). As in the San and Coso cases, many examples have been chosen almost at random and could easily be multiplied. Dots, zigzags,and grids, for instance, are ubiquitous throughout the Upper Palaeolithic. In distinguishing between mobile and parietal art to show that all six categories are found in both, we do not imply that there is an exact correspondence in content between mobile and parietal art. Neither have we attempted to distinguish between periods of the Upper Palaeolithic or geographical regions. Subsequent research will, we feel sure, draw these important distinctions and perhaps suggest social and ritual factors that informed them.

The six categories of figure 2 embrace most but not all Upper Palaeolithic signs. Because the seven principles govern entoptic and iconic mental imagery and because the three stages of our model are not mutually exclusive, the number of

possible permutations is high. Among our omissions are spearlike forms, claviforms, and tectiforms (fig. 3). Some of the spearlike signs may well be realistic depictions and thus not relevant to this discussion, but some are marked with zigzags (Marshack 1969: figs. 2b, 33b, 36, 38, 39a). Similarly, some claviforms, such as those at Les Trois-Fr~res, Niaux, the Apse at Lascaux, and elsewhere (Leroi-Gourhan 1968a: 513), may indeed be simplified female forms, as Leroi-Gourhan (1968a:145-46) argues (but see Bahn 1986b). Other clavi-

ENTOPTIC PHENOMENA
p
FIG. I. Six categories of entoptic phenomena compared with San and Coso rock-art depictions. Redrawn from th following: IA, Siegel (1977:138a); B, Richards (1971:93); C, Thackeray et al. (198r:flg. 3); D, Manhire, Parkington and Yates (1985:fig 4); E, Grant (1968:82); HA and B, Siegel (1977:138d and c); C, Fock and Fock (1984:fig. 258); D, Pager (1971:fig. 307); E, Grant (1968:102); liA and B, Siegel (1977:138b and k); C, Fock (1979:pl. 1OO); D, Lewis-Williams (198ia:fig. 20); E, Wellmann (i979a:pl. 164); IVA, Siegel (1977:138e); B, Horowitz (1975:fig. 2); C Fock and Fock (1984:fig. 259); D, Pager (197:fig. 338); E, Grant (1968:66); VA, Siegel (1977:I38j); B, Richards (197i:9ib); C, Wilman (1968:pl. 59); D, Lewis-Williams (n.d. b); E, Grant (1968:28); VIA, Horowitz (1975:fig. 2); C, Fock and Fock (1984:fig. 251); D, Lewis-Williams (1981b:fig. 2); E, Grant (1968:ior).
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FIG. 2. Six categories of entoptic phenomena compared with Upper Palaeolithic mobile and parietal art depictions. Redrawn from the following: (I)F, Marshack (1972:fig. 34); G, Marshack (1979:fig. 34); H, Marshack (1985:fig. 17); I, Leroi-Gourhan (1968a:fig. 73); (II)F and G, Marshack (1972:figs. 4 and 36); H and I, Leroi-Gourhan (1968a:figs. 157 and 126); (III)F, Marshack (1972:fig. 12); G, Marshack (1972:fig. 36); H and I, Leroi-Gourhan (1968a:figs. 64 and 165); (IV)F, Marshack (1972:fig. 43); G, Marshack (1972:fig. 200); H and I, Leroi-Gourhan (1968a:figs. 152 and 710); (V)F, Marshack (1979:fig. 29); G, Marshack (1972:fig. 84); H, Leroi-Gourhan (1968a:277); I, Marshack (1977:pl. 45); (VI)F and H, Marshack (1977:pl. io and 32).

- A
C
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D
FIG. 3. Upper Palaeolithic signs not covered by the neuropsychological model. a, spearlike signs superimposed on a horse: Lascaux (after Marshack 1972:fig. .115); b, spearlike signs with zigzags: Polesini (after Marshack 1969:fig. 38); c,

claviforms: Villars (after Leroi-Gourhan 1968a: 515), Le Gabillou (after Leroi-Gourhan i968a:51 5); d, tectiforms: Bernifal (after Leroi-Gourhan 1968a:fig. 33), Font-de-Gaume (after Sieveking 1979:fig. 64b).

forms (e.g., Leroi-Gourhan 1968a:72, 331, 142, 321, 324) are more difficult to account for. Tectiforms are similarly intractable, but those enclosing grids (Sieveking 1979:107) and those rendered in dots (Leroi-Gourhan 1968a:fig. 505, 72) may suggest a connection with entoptic categories I and Ill. Yet other forms, the convergent nested lines, may represent animal tracks (Delluc and Delluc 1985). More research is required on all these residual forms. In any event, the remaining signs are not numerous, and we believe our classification is more comprehensive than, say, Leroi-Gourhan's (1968a:I 36-48), which omits the very numerous zigzags, fleck filigrees, and festoons. Our omissions are, in fact, strength rather than a weakness in our argument,b cause they render invalid the potential criticism tl virtually any mark can be interpreted as an entoptic ph, nomenon.

Even though our six entoptic categories do not count for every Upper Palaeolithic sign, the presence all six suggests that at least some of the art originated certain altered states and leads on to the assessment the other two components of our model.

STAGES AND PRINCIPLES

Because it is impracticable to deal with each of the categories in all stages in terms of all the principles, consider a single commonly experienced entoptic pi nomenon. In its simplest variant this entoptic (V) is a of nested catenary curves (cf. Richards 1971; Eichmei and H6fer 1974:231-35, 255-57, 276, 287-89; Sieg 1977:139). In a more complex form it is a boat-shap area of invisibility with a flickering, zigzag outer (Richards 1971:9). This complex variant can be frt mented into two parts: the navicular area of invisibili and the outer zigzags. It is therefore difficult to be sur some depicted zigzags derive from this entoptic or fro another entoptic that seems to comprise "pure" zigza (IV). Migraine sufferers, who experience the catena entoptic, sometimes report only one or other of its tw parts, but encouragement to observe it more closely usu ally results in their perceiving both parts.

By considering just this one entoptic, figure 4 elui dates some of the obscuring transformations and conte tualizations that it and other entoptics underwent a transformed by one or more of the seven principles, the were perceived by shamans in one of the three stages trance and then rendered on the rock face. The first ro illustrates our first principle by showing replicated de pictions of this entoptic phenomenon. The San exampl is one of a series of red boat-shaped depictions (Mag and Sealy 1983). Here the navicular form comprises fou curves and a peripheral zigzag (cf. fig. i, VB). In Coso nested curves like these are uncommon, and the eu ample in figure 4 is exceptional. Zigzag and undulatin, lines are more common.

The second row gives examples of fragmentation, eac of which shows the zigzag broken down into chevrons The San example is a set of chevrons. The containin, line around such forms (see also the Coso example in th third row) may be

entoptic, for Kliver (1942:177) note, "boundaries" of "lines so thin that it may be impossibli

FIG. 4. Entoptic phenomena in the three stages of altered stages of consciousness as depicted in San, Coso, and Upper Palaeolithic art. I, replications; H, fragmentations; III, integrations; IV, construals; V, integrations with animals; VI, integrations with human figures. Redrawn from the following: I, Maggs and Sealy (1983:fig. 5), Grant (1968:64), Leroi-Gourhan (I968a:3o4); II, Marshack (1972:fig. 16); I, Grant (1968:1o7a), Marshack (1979:fig. 35); IV, Pager (1971i:fig. 387, 8b), Grant (1986:2ir), Leroi-Gourhan (1968a:fig. 27); V, Grant (1968:63), Leroi-Gourhan (1968a:632); VI, Lewis-Williams (1986a:fig. 3c), Grant (1968:69) and Ritter and Ritter (i972b:pl. 4), Marshack (1976:fig. 4), and Leroi-Gourhan (1968a:fig. 58).

yvrv
qz!"
%P

to say whether they are black or white." The Coso example is similar but lacks the containing lines. Another example of fragmentation is IC of figure i, a form that in some expressions is very like what we understand by a ladder and in others has more than two long lines or only one and a number of equal or unequal transverse lines. The third row illustrates the integration of two entoptic phenomena. The San depiction integrates grids and a zigzag; by filling in one side of the zigzag with grids a series of triangles results. The Coso example is one of a series that has been interpreted as shields. All the depictions so far discussed are purely entoptic. In the next stage of altered states subjects try to make sense of their mental images. For example, during the period of his training a Samoyed shaman is encouraged to "guess" what each element of his vision represents (Siikala 1985). This "guessing" is, of course, not random but constrained by the shaman's tradition and by what he is expected or desires to see. Sometimes very little manipulation of an image is required to give it an iconic referent, but in more complex construals the entoptic raw material may be swamped by iconic elaborations. The San example in the fourth row, however, affords a nice balance between entoptic and iconic elements. In the wild, honeycombs often assume the form of nested catenary curves (Pager 1971: 15 I), and the accompanying bees in numerous painted examples of such curves suggest that a shaman interpreted the entoptic as a honeycomb (Lewis-Williams n.d.b). This is because bees are, for the San, a potent symbol of the supernatural power shamans harness to enter trance. This construal of catenary curves was thus controlled by beliefs about trance performance and was probably also encouraged by a buzzing in the ears experienced in certain altered states (Harner 1973:119; Munn 1973:119; Christie-Murray 1978; Bootzin 198o:343; Halifax 198o:49, 144). Other San artists appear to have construed the same entoptic in different ways (for more on southern African construals, see Lewis-Williams n.d.b); the U-shapes on "decorated handprints," for example, probably represent the physical sensation of tingling in

the hands reported by 19th-century San shamans (cf. Bleek and Lloyd MS L.V.4.4224, Jagger Library, University of Cape Town; see Wellmann 1979a:fig. 423 and Schaafsma 198o:119, pl. ii for similar decorated handprints in Arizona). Another interesting San example of construal is IVD of figure i. Here a zigzag has been transformed into one of the buck-headed serpents that occur widely in San rock art; the blood falling from the noses of many such serpents (e.g., Lewis-Williams I98ia:fig. 23; Johnson and Maggs 1979:flg. 5I) links them to shamans, for southern San shamans frequently suffered a nasal haemorrhage when they entered trance (Lewis-Williams 198ia:75-IOI). Snakes are also analogous to San shamans in that they go underground and then surface elsewhere as shamans do when they are on out-of-body travel (Biesele 198o). A somewhat different San construal is the flecks surrounding the dancer in IIID (for full panel, see Lewis-Williams I98Ia:fig. 20). San sha-
mans believe the place where a trance dance isp formed to be redolent with potency that can be seen o by people in trance. We suggest that flickering dot a fleck entoptics (III) were sometimes construed as tjj potency and then depicted here and in numerous ot1 more clearly hallucinatory scenes (e.g., Vinnicon 1976:figs. 239, 240).

In each of these San examples an entoptic has be construed as an element in the complex of shamanist beliefs. Two of the examples, nested catenary curves honeycombs and a zigzag as a snake, both construe e optics as items from the "real" world, though the sna has a buck head. The third is different because the artis construed an entoptic as something (supernatural tency) that exists in belief only. In contrast to the San construal, the Coso example, bighorn sheep so characteristic of this art (Wellm 1979a:figs. 173-8o), is of the more complex version the entoptic. The curved horns recall the simple foM but the body is an entoptic boat shape to which hea legs, and tail have been added. The placing of animal le on the arc, also done by some San artists (fig. i, VD suggests that the flickering margin of the arc may ha been construed as the flashing legs of galloping anima (Lewis-Williams n.d.b). Moreover, at a number of Co sites the heads of bighorn sheep and antlered deer hav been added to identical navicular bodies, and in at lea two cases a navicular body has been given two heal (Grant 1968:68; Wellmann 1979a:fig. 18o). The bod was a basic entoptic "given" that could be turned in more than one species. One particularly instructi Coso composition shows bighorn sheep with an antlere4. deer (fig. 5a). Two of the sheep are linked by a now realistic line (cf. Lewis-Williams 1981 b), another sugge] tion that these pictures should not be seen "rea

A

A

FIG. 5. Construed entoptic phenomena from Coso. a, antlered deer and bighorn sheep with navicular bodies: Coso Peak No. 2 (after Grant 1968:98); b, non-realistic line linking bighorn sheep and three sets of horns: Sheep Canyon (after Grant x968:72).

istically." In an even more clearly hallucinatory composition a similar line joins three sheep and then runs off to at least two sets of horns as seen from the front (fig. 5b). In two cases the line becomes one of the curving horns, and in another the horns sprout from the line. One site has 82 head-on pairs of horns, some of which have the head and ears as well (Grant 1968:12). The line itself may derive from Entoptic VI (cf. VID in fig. I).

In the final stage of altered states of consciousness, iconic elements are spontaneous rather than construals. For convenience we have divided this stage into two parts. The first, exemplified in the fifth row, comprises entoptic phenomena combined with animals, and the second, in the sixth row, introduces the human figure. The San example of the integration of entoptics with animals has traditionally been seen as a poor attempt to draw a zebra, but the quadruped is part of a large composition that includes two well-delineated "rain-animals" (Lewis-Williams 198ia:Io3-i6) and many zigzags (for full panel see Lewis-Williams I987a:fig. 5). Rather than poor draughtsmanship, a failing seldom evident in San rock art, this painting is an instance of the integration of a fragmented entoptic (chevrons) and iconic imagery. Generally, entoptics in San rock paintings are not immediately evident because incorporation is so intimately achieved. In the Coso example an iconic lizard is juxtaposed with a zigzag. Such zigzags, a common feature of North American rock art, seem sometimes to have been construed as snakes.

All the visual experiences we have described so far are witnessed, as it were, from outside, but at peak hallucinatory periods subjects begin to feel dissociated from their bodies and frequently become part of their own imagery (Siegel 1977:136; Siegel and Jarvik 1975: 128). In this climactic period, images are fantastically combined, and the subject inhabits rather than merely witnesses a bizarre hallucinatory world. We call this condition participation and illustrate it in the last row. Some rock-art depictions of human beings probably represent participation, but we must allow that it would be difficult to distinguish between images of the subject himself and images of other persons he might encounter in his altered state of consciousness.

The San example of what may be participation introduces another important dimension in the perception and depiction of entoptic phenomena for which San beliefs about trance experience offer an explanation. When a San shaman enters trance, his or her legs and arms tremble. At the same time a painful sensation in the stomach is ascribed to the "boiling" of supernatural potency. When the boiling potency rises up the spine to the head, the shaman succumbs and enters deep trance. Katz (1982:236) believes that this rising and boiling sensation is represented by the spirals and zigzags drawn by shamans whom he asked to draw themselves. By contrast, people who had never entered trance drew simple stick figures. Although Katz does not himself make the point, it seems probable that the shamans were depicting entoptic phenomena which, because of their shimmering, are analogous to trembling and boiling potency. In other words, they believed themselves to be what they saw (Lewis-Williams 1986a). Katz's work leads us to suppose that the zigzag legs of the San depiction in the last row represent a similar process in which somatic trembling was represented by visual zigzags.

Such confusion of the senses, synesthesia, is a fairly common feature of altered states of consciousness; a touch on the skin, for example, may feel blue (Kliiver 1942:199; Fischer 1975: 222; La Barre 1975:io; Emboden 1979:44). Serko (cited by Kluver 1942:181), in a report that recalls the San painting of a man with zigzag legs, said he felt his legs consisted of "spirals" and that these somatic spirals blended with a luminous spiral rotating in the visual field: "One has the sensation of somatic and optic unity." Another subject reported that he became identical with an entoptic "fretwork" pattern as his arms, hands, and fingers turned into fretwork: "The fretwork is I" (Beringer, cited by Kluver 1942:182).

Similar confusion of the senses probably accounts for the entoptic patterns integrated into the rectangular Coso anthropomorphs (see also Wellmann 1979a:figs. 195-2oi; Hedges 1982:fig. 5). The astonishing variety of patterns in these figures may represent beliefs about personal internal power (Hedges 1982:6) rather than ornate garments, as has been suggested (e.g., Grant 1968:39). This point will be clarified when North American ethnography is more intensively deployed in interpreting the rock art of the continent.

Identification of such Stage 3 rock-art depictions incorporating entoptics with hallucinatory iconic percepts faces serious problems. In Stage I, entoptic phenomena, projected onto external objects, may be so strong as to inform perception of those objects. Kliver (1942:178) cites one of Beringer's subjects, who, looking at a small branch, said, "The leaves . . . suddenly appeared in an ornamental pattern as if joined in a circular design having the form of approximately a cobweb. I looked at other branches, and, looking at them, all leaves assumed the same lattice-like arrangement." Stage i pseudoincorporations, as we shall call them, thus incorporate entoptic with perceptual elements, whereas Stage 3 incorporations do not have a perceptual component. Further research may distinguish between pseudoincorporations and Stage 3 incorporations, but for the present we must be alert to potential confusion.

So far we have shown that the stages and principles of our model clarify and order depictions in both San and Coso art. Fuller discussion of a range of entoptics and their almost infinite transformations, contextualisations, and variations would be repetitious. Perusal of the San and Coso literature will demonstrate the effective range of the model. Because these other two components of our model have proved appropriate to these known shamanistic arts, confidence in its efficacy as an explanation for an important component of Upper Palaeolithic art increases.

The next part of this explanation is illustrated4n the Upper Palaeolithic column of figure 4. In contrast to the San and Coso depictions, the European example of replication is of a simpler variation of

the entoptic-unadorned catenary curves. In Upper Palaeolithic art such curves are usually further developed by reduplication to form a festoon (fig. 2, VI) or symmetrically inverted (VG).

The second Upper Palaeolithic example is particularly interesting because it illustrates the process of fragmentation (cf. Leroi-Gourhan's [19821 "abbreviation"). On this engraved pebble are a zigzag line, a set of overlapping

chevrons which form, in effect, a zigzag, and a number of discrete chevrons. The derivation of the chevrons from the continuous zigzag line seems clear, though we do not, of course, imply that the artists did not discriminate semantically between the replicated and the fragmented expressions.

The next example illustrates juxtapositioning: a grid has been placed next to a series of zigzags (cf. Sauvet, Sauvet, and Wlodarczyk 1977:551). This is a less intimate way of combining images than the integrations from the San and Coso arts.

Upper Palaeolithic examples of Stage 2 are more difficult to identify. We do, however, tentatively suggest that the exaggerated curved ibex horns with a zigzag outer margin at Niaux (in the fourth row here) and the equally exaggerated horns of the ibex engraved on the La Mouthe lamp (Graziosi i96o:pl. 113) are probably construals. Another instance may be the mammoths of Rouffignac. A salient feature of these paintings and engravings is the nested, curved tusks. To these curves has been added a dorsal line; the rest of the mammoth is often exiguously depicted. Many have superimposed zigzags and undulations (Graziosi I96o:pls. 148, 149). The Rouffignac mammoths may also exemplify reduplication, for some are depicted in lines, the curved tusks being a prominent repeated motif (cf. unconstrued reduplicated U-shapes in fig. 2, VI). Another Upper Palaeolithic example may be the line of horses' heads that Leroi-Gourhan (1982:fig. 3) believes were reduced to a zigzag line. If there is any association at all, we suggest the opposite to be more likely: a zigzag was interpreted as the heads of a line of galloping horses, the movement of the heads being analogous to flickering entoptic zigzags. Further reduplications and construals may be the ibex heads at Lascaux (Graziosi i96o:pl. 194b) and the reindeer at La Mairie Teyjat (Graziosi i96o:pl. 89e). These suggestions are tentative, but as Upper Palaeolithic research of the kind we advocate proceeds, we expect examples as convincing as the San and Coso ones to come to light.

In Stage 3 the Upper Palaeolithic example of an entoptic combined with an animal is like the San one in that zigzags have been superimposed on an animal (or vice versa), but it poses problems of association because one cannot be sure, in the confused cluster of engravings of which it is part, that an artist intended this exact relationship. The entoptic may have been done at a different time from the iconic, but this is not, of course, sufficient reason to suppose that an association was not intended. An instructive example of intentional addition of entoptic elements to an iconic image is the horse frieze at Pech Merle (fig. 2, MH. Infrared analysis has indicated that the horses were originally empty outlines
and that red and black dots and other forms were add in sets (Marshack 1985:102-3). When the space wit and around the first horse was exhausted, a second o line was painted, and it too was filled with dots. T time lapse between the additions is not known. A though we cannot always be sure if such associated e optic and iconic representations are part of a single i sion and depiction, the combination of the two kinds image was suggested and made acceptable by the expe ences of altered states of consciousness. In contrast such cases, the bison executed in dots at Marsoul (Graziosi I96o:pl. 213b) and the dotted outlines of mals at Covalanas

(pls. 23ob, 23Id, e, 232c, e) are mo clearly depictions of visions that combined entoptic a iconic elements.

The first Upper Palaeolithic example of integrati with a human figure is comparable to the San and Co depictions because it shows zigzags superimposed on human figure. The striking universality of this combi tion, whether by integration or superposition, is furth evidence for somatic and visual synesthesia operating similar ways in different cultures. The second examp not only juxtaposes entoptic and iconic images but als6 integrates two iconic images, human and animal, in single therianthropic figure. Hallucinations integratin human beings with animals are fairly common. Klive (1926:505) recounts his own hallucination of a hum head acquiring the hair of a cat and then becominga cat's head. A more vivid and complete transformation was described by one of James's subjects: "I thought of d fox, and instantly I was transformed into that animal I could distinctly feel myself a fox, could see my long ea and bushy tail, and by a sort of introversion felt that mv complete anatomy was that of a fox" (Siegel and JarviI 1975:105). In Europe and in southern Africa, paintedend engraved therianthropes have been interpreted as hunt ers or shamans wearing masks. In southern Africa, a lack of ethnographic support for hunting masks (Pager 197 5, and numerous non-realistic painted features such as hoofs, long streamers emanating from the shoulders, and flywhisks protruding from the shoulders or head suggest that therianthropes are hallucinatory rather than realistic paintings (Lewis-Williams I98Ia:75-102). Although we allow that, in certain rituals, Upper Palaeolithic people may have attached antlers or horns to their heads, we argue that the Palaeolithic therianthropes are also better explained by hallucination than ritual costume because they, like the southern African ones, have clearly non-realistic features. Indeed, we reject the notion that "primitive mentality ... failed to establish definitive boundaries between humans and animals" (Graziosi 196o:34) and suggest that the rather unlikely concept of a half-man/half-animal was initially presented to early people by the nervous system as, in altered states, it integrated different iconic images. The therianthrope in figure 4 thus probably represents a shaman participating in and integrated with his own visual imagery.

We can now summarize our assessment of the utility of the neuropsychological model in elucidating a signi-

ficant component of Upper Palaeolithic art. In figure i we showed that a set of entoptic forms occurs in San and Coso shamanistic art. In figure 4 we demonstrated the applicability of the second and third components of the model to the same arts. We argue that the model exposes the neuropsychological order underlying the seemingly chaotic integrated, superimposed, juxtaposed, fragmented, and reduplicated iconic and geometric depictions of these two arts. Far from being anarchic, San and Coso art are ordered products of identifiable stages of altered consciousness and neurologically based principles in the formation of mental imagery. The painted and engraved images are, in fact, informed by the functioning of the human nervous system in altered states.

Because the order that results is different from the order Westerners are predisposed to seek in artistic creations, it has escaped notice.

We have also applied the model to Upper Palaeolithic art (figs. 2 and 4) and shown that it is as appropriate here as it is to the two known shamanistic arts. In doing so, we emphasise that we take into account a large number of features; a single zigzag, for instance, would not in itself be persuasive evidence for an entoptic component. There is thus a strong suggestion that at least a significant component of Upper Palaeolithic art also derives from altered states of consciousness and that many of the signs depict entoptic phenomena in the various transformations we have described. Because our entoptic categories, principles of apprehension, and stages of altered states are established by independent neuropsychological research and not derived from the art itself, our model greatly reduces the inferential component that looms so large in many arguments about Upper Palaeolithic art that try to avoid ethnographic analogy.

We do not argue that San and Upper Palaeolithic religions were identical or any similar simplicity. All that the parallels exhibited here allow us to conclude at the moment is an association with altered states and, further, because shamanism is so pervasively associated with foraging societies, that in the Upper Palaeolithic this association probably had at least some features in common with what we understand by shamanism. We are, of course, by no means the first to suggest that shamanism in some form existed in the Upper Palaeolithic (see, among others, Lommel 1967; La Barre 1970, 1972; Eliade 1972; Eichmeier and H6fer 1974; Furst 1976; Halifax 1980:3, 17; 1982; Pfeiffer 1982; Bednarik 1984a, 1986). We simply strengthen this hypothesis by developing a neuropsychological model that reveals the order in two shamanistic arts and provides a more secure way of addressing Upper Palaeolithic art.

Implications

The depiction of entoptic phenomena in Upper Palaeolithic art invites reflection on many issues. For the moment we select only four for brief comment: the meaning of entoptic elements; the depiction of entoptic phenomena on Upper Palaeolithic artefacts and in deep caverns; the co-occurrence of geometric and iconic elements; and, finally, the origins of representational art. As we suggested at the beginning of this paper, meaning is a question writers now tend to shy away from; we too offer only tentative and cautionary observations. To begin with, it must be said that entoptic phenomena doubtless had different meanings and associations in different times and places and even for different artists within a single society. The San artists' construal of Entoptic V as honeycombs, antelope legs along an arc, and other forms suggests some idiosyncrasy. But, because even these various construals all derive from specific San beliefs about trance, we believe that, whether replicated, fragmented, integrated, superimposed, juxtaposed, or reduplicated, entoptic phenomena probably had a restricted range of specific meanings. Even novel construals would have been intelligible to San viewers because they would have been constrained by and located within the belief structure of San shamanism. Similarly, because we now know the provenance of Upper Palaeolithic signs, their interpretations are no longer, in George Eliot's phrase, "illimitable."

The Tukano go further than the San and provide a potential clue to one aspect of the significance of the selection and repetition of entoptic phenomena in Upper Palaeolithic art, a clue that may suggest another dimension to Conkey's (198o) work on Upper Palaeolithic design elements, some of which are clearly entoptic in form (cf. Eichmeier and H6fer I974:table 7). Each exogamic Tukano group considers itself to "own" a certain type of vision (Reichel-Dolmatoff 1978a:4, 9). These socially distinguishing visions are associated with different kinds of yaj6: the Desana, for example, "own" at least four named kinds of yaj6, the southern Barasana three kinds. Some kinds of yaj6 are, in turn, linked to animals. The Tukano themselves say that their shamans use "fish yajf" to contact the Master of the Animals, while the Barasana of the Pira-Parani recognize "yaj6 of the red jaguar" and "yaj6 of the jungle animals" (Reichel-Dolmatoff 1972:97).

In discussing the cultivation of such visions in shamanism, Noll (1985:445-46) identifies two goals of shamanistic training that are relevant to the Tukano experience. Novices learn to increase the vividness of their imagery, and they learn to control the content of their visions by "actively engaging and manipulating the visionary phenomena." As part of the second skill we suggest the cultivation of specific entoptic images. Because expectation sharpens perception, certain entoptics tend to be perceived at the expense of others, and a social group thus develops a characteristic repertoire of formalised, codified entoptics. The response of a laboratory subject asked to draw his entoptic percepts after a lapse of time may give some clue to the processes whereby entoptic phenomena become standardised (Knoll et al. 1963:2o8-12). After a period of 5-26 days, the subject tended to produce more elaborate and better-defined depictions than those done during the experiment. After five months, he produced what he considered to be even

more generalised depictions rather than specific pictures.

Moreover, specific entoptic phenomena can repeat themselves as afterimages for up to six months and "can appear in the visual field at any instant when they are triggered off by a change in body chemistry or an external stimulus" (Reichel-Dolmatoff 1978b:298). These afterimages are superimposed on normal vision in otherwise ordinary daily experience. "The particular spectrum of [entoptic phenomena], together with their cultural interpretations, can be said to accompany the person in a permanent manner" (pp. 298-99). Regional differences in Upper Palaeolithic iconic and entoptic iconography may thus have arisen from different expectations and standardisations of visions and afterimages. That such visions would have had social implications, as they do for the Tukano, is highly probable. A more specific statement is currently impossible, but the cultivation of mental images leads to our second questionthe location of so much Upper Palaeolithic art in deep caverns.

To approach this problem we again turn to southern Africa. The supernatural potency that San shamans activate to enter trance is named after powerful animals and things, supreme among which is the eland (LewisWilliams and Biesele 1978, Lewis-Williams I981a). The eland is also the most frequently depicted antelope in

many regions (Maggs 1967; Vinnicombe 1972, 1976; Lewis-Williams 1972, 1974, I98Ia; Pager 1971), and part of the function of these depictions was recently explained by an old woman, probably the last survivor of the southern San (Jolly 1986, Lewis-Williams 1986b). She demonstrated how dancers seeking power turned to face the paintings on the wall of the rock-shelter and how some people placed their hands on the paintings of eland to gain power. The paintings, she said, had been put there by shamans and contained power. Although this incident took place in an open rock-shelter and not in a dark cavern, there is an important potential parallel with Upper Palaeolithic art: depictions are both a result of visions (as the presence of entoptics, integrations, fragmentations, and other features shows) and a factor in inducing or at any rate informing them. Both situations may have obtained in the Upper Palaeolithic caverns.

The sensory deprivation experienced in such places induces entoptic phenomena, as Walker (198I:146) reports from his own experience, and also hallucinations (e.g., La Barre 1975:14; Pfeiffer 1982:211; Siegel 1984). Aspirant shamans seeking visions to give them access to the spirit world frequently meditate in remote places, often caves (Eliade 1972:50-5 1, 110-14; Halifax 198o:6), and Hultkrantz (i1981:39, 40) records Shoshone shamans' seeking visions at rock-art sites. Under laboratory conditions, a subject asked to turn his or her attention inward to entoptic phenomena becomes absorbed in the experience, and "typical signs of trance state (immobility, slow regular breathing, etc.) become evident" (Hunchak I98O:223). Prehistoric people, isolated in dark caverns and expectantly scrutinizing their entoptic phenomena in the hope of seeing specific forms, would similarly have induced an altered state. It is thus possible that the painted caves of Western Europe provided circumstanc especially conducive to the generation of entoptic ph nomena and hallucinations. Locations like the small "sanctuary" in La Pileta com to mind: "The entrance is a few feet from the floor, ai one has to climb up and crawl in. It is only a few i high and long, and it is necessary to kneel or squat it side" (Marshack 1977:287-89). Although there is i room for communal activity, the vast number of mart on the clay wall of this "sanctuary" suggests, asMa shack notes, that it has been repeatedly touched. Sorn simple iconic depictions, entoptics, and finger flutiag (Anati 1981; Bednarik 1948a, b, 1986) swiftly execute in the soft surface of the walls of such locations mi have been made by novices who, having entered caverns on a vision quest, reached out to the existig depictions to absorb their power and to trace their ow1 visual percepts during or after their altered state of con sciousness. Significantly, the less accessible parts o caves such as Les Trois Frres, Lascaux, Altamira, an Niaux contain simpler and more fragmented figures more detailed depictions tend to be nearer the entrani (Lorblanchet 1977:53). If certain remote locations be came known as "powerful" places where visions coul(be obtained, such depictions would accumulate there. An interesting addendum to this explanation for re mote locations is the placing of many depictions o felines and other dangerous animals in the depths of thi caverns. Writers have argued that much of what Lero, Gourhan proposes about the distribution of paintings it the caves does not stand up to scrutiny (Ucko and Rosen feld 1967:195-221; Stevens 1975), but the placing a many dangerous animals in the remote chambers anc passages does

seem acceptable (Parkington 1969). It ii certainly possible that the greater depths would hav induced greater dread and that shamans and noviceE would therefore have tended to hallucinate dangeroui creatures. In many cases the remote parts seem to havc been visited rarely or, perhaps, only once for the execution of art. On the other hand, large painted galleries were probably the location of more elaborate rituals involving a number of people-as is suggested by the remains of scaffolding (Leroi-Gourhan and Allain 1979, Ruspoli 1987). These communally produced images should be seen in contrast to (but certainly not to the exclusion of) those that could have been the work of a few moments. The communally constructed galleries may have been vestibules where novices absorbed the power of imposing and sometimes ritually renewed depictions before venturing farther into the caves or being left alone for their personal quest. The array of depictions that prepared them for what they were about to see comprised entoptics, therianthropes,and "powerful" animals of the kind they hoped to hallucinate. These animals, we suggest, were, at least on one level, the spirit helpers from whom shamans obtained power. Technique of depiction and location in the caverns thus suggest distinct though related ritual components.

But not all Upper Palaeolithic art is in locations implying arcane activities and experiences. The presence of

similar but not an identical range of depictions on artefacts has sometimes been contrasted with hidden locations to suggest a parallel "secular" artistic tradition. Whatever the differences between mobile and parietal art (differences that should be explored in terms of the stages and principles outlined here), the simple presence of entoptics in both contexts suggest an embracing unity. Notwithstanding Conkey's (1983) sensible observations, elucidation of that unity must precede elucidation of distinctions; the differences must be subsumed under the unity rather than seen as vitiating it. The presence of entoptic phenomena on mobile art suggests that, although the experiences of the caverns may have been in some sense hieratic, elements of the visions there obtained were also demotic. Free access to visions is indeed characteristic of the Tukano; they depict their entoptic percepts on house walls, ceramics, bark cloth, gourd rattles, stamping tubes, and basketwork (ReichelDolmatoff 1978a, b). The user or beholder of an artefact with these designs is continually reminded of their message-as the San inhabitants of a painted rock-shelter must have been continually aware of the "other" world. Upper Palaeolithic people too were thus reminded of the large body of shamanistic lore and social norms encoded in entoptic designs on artefacts.

In the caverns and on mobile pieces entoptic phenomena are frequently accompanied by iconic depictions. Their co-occurrence in single "compositions" or, for that matter, during a single cultural period has been one of the central puzzles of Upper Palaeolithic art. Marshack (1977) and others, denying an evolutionary link, see the two forms as parallel graphic systems. This judgment may be correct in a general way, but it does not explain why early man and the makers of so many rock arts around the world maintained two graphic systems.

The answer to this problem is not that man invented and purposefully maintained two parallel or complementary systems but that the structure of the human nervous system produces these two kinds of image. The "naturalness" of combining them was well illustrated by Reichel-Dolmatoff's (1978a) informants when he asked them to draw what they saw under the influence of yaj6; as on their artefacts, entoptic and iconic elements were mixed. In Upper Palaeolithic Western Europe, southern Africa, the Great Basin, and elsewhere, entoptic phenomena were intentionally associated with iconic images simply because that is the way the human visual system works; the association is intrinsic to altered states of consciousness.

The universality of the association between entoptic and iconic elements is a clue to the answer to our final question: how did people come to realise that twodimensional marks could represent three-dimensional objects? The early view that representational art grew out of non-representational, self-sufficient marks, once discredited, has recently been cogently reargued by Davis (1986a). He does not believe that representational art evolved out of the formal "signs," suggesting instead that it evolved out of chance or random marks. Sooner or later, he argues, as a result of the perceptual ambiguity of natural marks and features, early people would have

tumbled to a likeness between their own and naturally formed marks and some object in nature. "Continually marking the world will continually increase the probability that marks will be seen as things" (Davis 1986a:2oo). In contrast to this view, we argue that the answer lies in the operation of the human nervous system in altered states. Kliver (1926:5o5, 5o6; see also Knoll et al. 1963:2o8) found, from his own experience, that both entoptic phenomena and iconic hallucinations seemed to be localised on the walls or the ceiling. Szuman (cited by Siegel and Jarvik 1975:1O9) described this experience as "pictures painted before your imagination," and Siegel (1977: 134) likened it to "a motion picture or a slide show." Klfiver (1942:179) also found that entoptic images recurred after he had awakened from an altered state and that they were then projected onto the ceiling. The Tukano too experience their entoptic images projected onto plane surfaces, and, as afterimages, they may recur in this way for several months (ReichelDolmatoff 1978a:8).

Such reports suggest that early people similarly experienced mental imagery and afterimages projected onto their surroundings. Their surroundings were thus already invested with "pictures." Because altered states of consciousness produce iconic images that are "completely disengaged from any kind of natural surroundings" and are perceived "without regard to size or position relative to one another," as well as distorted and geometric percepts, and, further, because these images, as they are projected onto a wall, attain their "own freefloating existence, independent of scene or surface" (Halverson's [1987:66, 671 phrases to describe Palaeolithic art), early people were neurologically provided with the salient features of Upper Palaeolithic art. They did not have to "invent drawing," as Delluc and Delluc (1986) suggest. Tracing projected mental images with a finger in the sand or on the soft wall of a cave to experience them more fully would have "fixed" them and would have been an initial step in the history of art. They were

merely touching and marking what was already there. The first depictions were thus not twodimensional representations of three- (even four-) dimensional reality. Rather, they were "fixed" mental images. In all probability their makers did not suppose that they stood for "real" animals any more than the accompanying entoptic depictions represented (iconically) things in the real world. It is, furthermore, possible that, for their makers, the earliest depictions were visual images: hallucinations and depictions were one. The social circumstances in which mental images that had been experienced for millennia came to be fixed will clearly require elucidation; the images must have acquired a significance that caused people to reach out to touch and fix them.'

This is not to say that all Upper Palaeolithic depictions are images fixed by people in altered states or expe5. It is worth noting that the possible tracing of eidetic imagery in the Upper Palaeolithic has been discussed (for an overview, see Kubler 1985), but we believe the presence of entoptic elements suggests the imagery of altered states rather than eidetic imagery.

riencing afterimages. Once that initial step had been taken, the development of Upper Palaeolithic art probably followed three courses. One stream remained mental imagery fixed while it was being experienced. A second stream derived from recollected mental imagery processed in the ways we have suggested. A third stream derived from contemplation of the graphic products of the first two streams and the realization that they could be duplicated even by someone who had never experienced an altered state of consciousness. Beliefs about mental imagery and its fixing doubtless changed through the Upper Palaeolithic, but the continued association of entoptic phenomena suggests that even these thirdstream depictions, in a sense the most realistic pieces of Palaeolithic art, were also understood as fixed images from the world of altered consciousness, even though some were socially produced. The accurately delineated animals of San art show that realism is not incompatible with the imagery of altered states.

Because altered states persisted throughout the Upper Palaeolithic (and, of course, beyond), the products of these three streams were variously interwoven in different periods and places. The "style" of any period is thus much more than the manner in which people reduced real objects; it is a complex mix of or, perhaps, balance between fixed mental images and afterimages, codified recollections of these images, and independently created representations of entoptic and extrasomatic subjects. Moreover, because the action of fixing the images would have been the same for entoptic phenomena and iconic hallucinations, there is no need to postulate different origins or a genetic relationship between Upper Palaeolithic signs and representational art. Both signs and iconic representations are "realistic" in that they both depict what people "really" experienced. If we are correct in this economical explanation, we must accept that the projection of geometric and iconic imagery was part of humankind's experience throughout the Palaeolithic and in all parts of the world. Like Davis (1986b: 5 15), but for different reasons, we believe that depiction had (perhaps still has) many independent origins.

The very earliest markings are, however, geometric rather than iconic. An engraved bone from Pech de l'Az6 has been dated to the Acheulian, ca. 300,000 B.P. (Bordes 1969). Marshack's (1977:291) microscopic examination of the piece showed that the "central form consists of a hanging 'scallop' image." The design (fig. 6a; cf. fig. 2, VI) in fact comprises a series of chevrons and two overlapping reduplicated U shapes. Another complex image-a set of double zigzags (Marshack 1976:fig. 7)-is engraved on a Mousterian bone fragment (fig. 6b). Marshack (1977) traces the zigzag/meander from these early beginnings to a number of Upper Palaeolithic sites where it is sometimes associated with representational images. He considers these "festooned or serpentine images" to be "the most prevalent motif of the Upper Palaeolithic" (Marshack 1976:278). We believe that he is correct in identifying the longevity and ubiquity of the zigzag/meander and the overlapping U shapes; we, however, ascribe the persistence of the forms not, as he does,

B

FIG. 6. Engraved entoptic phenomena dated to period" earlier than Upper Palaeolithic. a, Acheulian: engrave bone from Pech de L'Az6 (after Marshack 1977: pls. 2 and 6b); b, Mousterian: engraved bone from Bacho Kiro, Bulgaria (after Marshack 1976:fig. 7c).

to a continuing symbol tradition but to the antiquity the human nervous system and its generation of en optic phenomena. We thus agree with Gamble (198 203) that bones can be scratched intentionally withou this implying a symbolic act; we simply go further b pointing to the origin of the specific forms. Anothe form occurs later, in the Chrtelperronian-sets of paraE lel lines (cf. fig. 2, second row) that, according to Dellu. and Delluc (1986), "seem to play, from the beginning the role of the geometric signs." We argue that parallel, lines (fig. i, II) are "geometric signs."

In the light of these observations, the fragmentary na ture of Aurignacian iconic representations (Delluc and Delluc 1978) is less enigmatic.6 As we have seen, both entoptic and iconic mental imagery is subject to fragmentation. It seems that, in the early millennia of image control and fixing, artists fixed fragmented hallucinations. These Aurignacian depictions are not necessarily metonymic abstractions; they are more probably fragmented hallucinations depicted in their entirety. The trajectory from these fragmentations to the complex Magdalenian iconic representations should be seen not as a striving for greater reality or indeed in any direct relation to the real world but rather in relation to the real world as mediated by the human nervous system in altered states. Throughout the Upper Palaeolithic, mental imagery remained the same; what people made of it changed through time. Art did not "evolve" cumulatively and uniformly through the Upper Palaeolithic. In fact, we explicitly reject Upper Palaeolithic social and artistic homogeneity and a unilineal trajectory (cf. Bahn 1978:125; Conkey 1983, 1984, n.d.; Jochim 1983). We see our position as preparatory to the elucidation of syn6. Our account omits discussion of pieces in the round, such as the Vogelherd horses (Marshack 1976), some of which are marked with entoptic forms.

chronic and diachronic variability. The stages of altered consciousness and the principles of perception we have adumbrated are analytical tools for addressing this complexitY.

At one point between the Acheulian and the Magdalenian, the beginning of the Upper Palaeolithic, there was an intensification of production, an apparent increase in the artists' entoptic repertoire, the addition of representational images, and, quite possibly, a new desire for durable depictions (Conkey 1983:213-14). The few very early examples of engraved entoptic phenomena suggest that this intensification was not the result of changes in the human brain and nervous system. Rather, social circumstances changed, and in these new circumstances mental imagery, its projection and fixing, achieved new significance. Probably, new social forms (see, for example, Conkey 198o, 1984; Gamble 198o, 1982, 1983; Faris 1983; Gilman 1984; White 1985) provided a niche for an experience and associated practice that had its roots deep in the past.

Comments

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As one who greatly admires Lewis-Williams's work and his contribution to the way we think about rock art and its possible meanings, I greatly enjoyed this paper. It may well provide some long-needed insight into what lies behind some of the "signs" of the Upper Palaeolithic. However, I intend to play devil's advocate here and voice some points on which I would welcome clarification.

First, I wonder if the answer is not being brought at the same time as (or even before) the question. The recent appearance of phosphenes in papers on Palaeolithic art has certainly opened up fresh avenues of thought but also incorporates a number of assumptions and truisms. Being totally ignorant of the nonarchaeological literature on the topic, I would like to know how well established the claim is that these things are truly universal. Have they been recorded in every human group in existence, or merely in a few sample populations scattered around the globe? Even if they are truly universal today, one still has to make the considerable assumption that the very first members of our subspecies, 30,000 years ago, had the same hallucinations as modem people. The authors themselves point out that the content of early human imagery must have been greatly influenced by cultural expectations, which were surely different to Ours.

Tautology is difficult to avoid in prehistoric art studies, and we appear to have a degree of it here: the simpler Palaeolithic signs are assumed to be hallucinated images, from which it is claimed that these entoptic phe-
nomena were the same then as now, and this is proved by the shapes of the ancient signs.

Ethnographic analogy is equally difficult to escheweven Leroi-Gourhan's approach relied heavily on the assumption that Palaeolithic people thought like 2othcentury French structuralists. Where truly universal phenomena are concerned, one is on safer ground; I tried this myself in a paper cited by the authors that focused attention on the fact that water seems to play a role in every known religion and is therefore likely to have been a contributing factor in

whatever beliefs lie behind Palaeolithic art. If entoptic phenomena are indeed universal, then it is reasonable to make the same supposition for them. I am a little uneasy, however, that the hypothesis relies so heavily on only two, albeit excellent, ethnographic studies.

It also appears that the theory cannot fail simply because there are very few basic shapes that one can draw, whether they come from the mind's eye, hallucinations, or idle doodling: dots, lines, grids, squiggles, and simple geometric shapes. It is hardly surprising that these occur with some frequency in Palaeolithic contexts and that the simpler "signs" are found all over the place; it is the more complex designs, such as "tectiforms" and "scutiforms," that are limited to particular regions and/ or phases. With the authors, one can interpret these as "different expectations and standardisations of visions and afterimages," but what does this add to earlier suggestions such as ethnic markers (Leroi-Gourhan 198o), and so forth?

My criticism is therefore not (as anticipated by the authors) that virtually any mark can be interpreted as an entoptic phenomenon but that in any collection of nonfigurative art there are bound to be lots of marks that look like some or all of the six entoptic categories presented in the paper. There are so many apparently nonfigurative shapes and combinations of shapes in Palaeolithic portable and parietal art that it would be amazing if these basic categories were not present. Thus, although it is reasonable to suppose that entoptic phenomena were a contributing factor to Palaeolithic signs, the authors run the risk of producing another of those all-embracing theories that are no longer acceptable for prehistoric art-particularly where they dismiss signs that do not fit their categories as being realistic depictions, simplified females, or intractable despite the numerous permutations their categories provide.

Similarly, I do not see why "therianthropes" should all be hallucinatory rather than depictions of ritual costumes and masks or simply of imaginary or mythological figures. If such images were commonly seen in hallucinations, I would have thought that they would be rather more abundant in the art: as it is, in parietal art they are limited to about 15 sites, with no more than half a dozen apiece (Leroi-Gourhan 1983:26o).

To be fair, the paper claims only that some Palaeolithic depictions were fixed by people in altered state or experiencing afterimages, and one can hardly argue with that; most scholars would agree that shamanism and

hallucination (with or without mushrooms!) probably My theorem establishing entoptic forms as our princi played a role in this period in Eurasia, although so far means of access to the Palaeolithic mind (Bedna there has been no solid evidence for such phenomena. 1984b) has been enthusiastically adopted by the ; The authors believe that they have found such evidence, thors. Another crucial proposition of mine, that of and if they can strengthen their case it will indeed be of phylogenetic longevity of entoptic forms (Bedna importance, particularly if it provides some insight into 1984b:28), is essential to their hypothesis. This and i the meaning of the depictions. Somewhat ominously, use of other concepts

earlier expressed by me prompt I however, they admit that entoptic phenomena had dif- to moderation in tempering their enthusiasm. ferent meanings and associations in different times and Not surprisingly, I concur with the authors' under places, even within a single society. Their hope is that ing theoretical postulates and find their neuropsycho there may be a restricted range of specific meanings. ical argumentation persuasive, but their attempt Nevertheless, even if they can obtain good ethnographic utilize the valuable research tools they have forged I information that delimits the meanings, this in no way comes progressively less convincing as their model proves that Palaeolithic meanings fell within that range: developed. This is partly because they fail to jettis it merely makes it more plausible. ethnographic analogy and imaginative interpretation

I have been deliberately pessimistic in this comment; the right moment and partly because the narrow p it is obvious that we can prove virtually nothing about spective presented precludes evidence contradicti the meaning of Palaeolithic art in the absence of the their final inferences. A regional rock-art sequence su artists as informants. The one possible road to salvation, as that of the Franco-Cantabrian area, which represet however, lies in establishing factors which hold true only on the order of 0.03% of the world's surviving ro across space and time, and the human nervous system is art, provides no adequate basis for identifying univer certainly a prime candidate. The authors are therefore to trends that have strikingly profound implications be applauded for stepping out onto such thin ice; their Anati's [1986] warning). future studies, as well as work by other phosphene fans, The authors' opinion that entoptic phenomena a may well take us as far as we are ever likely to get into iconic hallucinations have always coexisted is ovi the minds of the Palaeolithic artists. whelmingly refuted by the evidence from at least fc

continents. For instance, every completely repatinat petroglyph (and I am not suggesting that degree of pa

H.-G. BANDI nation is a function of age alone [Bednarik 19791) tha

Scharnachtalstr. 12, CH-3oo6 Bern, Switzerland. 6 x 87 have ever examined in North and South America is o. noniconic and entoptic form; among the hundreds

Commenting on this paper is a rather difficult task be- thousands of Australian petroglyphs that one can r(cause it demands, besides knowledge of Ice Age art, a sonably attribute to the Pleistocene I am not aware o certain intimacy with other disciplines, especially physi- single design element that is not an entoptic form (Bt ology and psychology. I prefer therefore to limit myself narik i986b:i64, 1986c:242); and the authors thei to some general remarks. Though I am not totally per- selves cite Marshack's pioneer work on pre-Aurignaci suaded by the authors' interpretation of signs-I hesitate marking traditions in Europe, which are also complete to accept that the enigma of Ice Age art, with its empha- noniconic. The duration of this "noniconic period" w sis on animal figures, can be solved with the help of the greater than that of the succeeding "iconic period," "entoptic phenomena"-I think it is very good to at- least in Europe and Australia. The only

explanation t' tempt to approach our impressive heritage from the Ice authors would offer for this worldwide development Age in different ways; the far-reaching theories that that of changed social circumstances. This feeble co have been employed for decades offer no hope of a solu- struct provides no real challenge of Davis's (1986 tion. As shown in a symposium held in Switzerland attempt to explain the "discovery" of iconicitysome years ago (Bandi et al. 1979), collaboration among model which can account for the empirical phenome archeologists, zoologists, and ethologists can help us to Lewis-Williams and Dowson cannot address with theii learn more about the imagination of Upper Palaeolithic Moreover, a sophisticated debate involving neuroph) man. Another way might be to consider the testimony iological and neuropsychological concepts as well as ci of symbolism. The considerations raised in this article ative and deductive reasoning (e.g., Davis 1986c; Ham: should certainly be looked at seriously, ton-Smith 1986; Faulstich 1986, n.d.) has recent demonstrated how prefigurative markings can be exar
ined scientifically. Such endeavors to account for the
ROBERT G. BEDNARIK phenomena involve no altered states, shamans, or et
Australian Rock Art Research Association, P.O. Box nographic analogies, yet they are not even mentioned 1
216, Caulfield South, Victoria 3x62, Australia. the present authors.
21 viii 87 By attributing iconic hallucinations to Middle Palae
lithic hominids Lewis-Williams and Dowson merely d
The central premise in this innovative paper is that the fer the question of origins instead of providing an answ order governing prehistoric art is derived from the func- for it. If one were to probe the origins of the early cor tioning of the human nervous system in altered states. prehension of iconicity as postulated by the authors, oi

would in effect be striving to explain a phenomenon the 0ere existence of which is not supported by one iota of evidence. No intellectual capacity "was always there," and most certainly not-the aptitude for cerebral image conceptualization. Moreover, the authors' own hypothesis offers a perfectly adequate explanation. In Stage 2. of their progression of mental imagery, subjects consciously elaborate entoptics into spontaneous iconic forms, which presupposes an ability to visualize selfgenerated figurative iconography. The corollary that hominids lacking that ability would not have been capable of proceeding from Stage i to Stage 2 offers itself as a variation of Lewis-Williams and Dowson's ideas-one that would not just accommodate the empirical evidence but even facilitate the explanation of certain other developments heralding the Upper Palaeolithic.

Trance hypothesis is no panacea for the immense complexities facing us in prehistoric art. Once we peel away the hardened, almost fossilized layer of unsubstantiated assumptions, half-truths, prejudices, and misidentifications we have allowed to accumulate (cf. Bahn i986a, Clottes 1986), how much do we

really know about the social attitudes, structures, and values of, say, the Aurignacians? Over the years I have deliberately resisted the temptation to seek a link between the entoptic phenomena of the Pleistocene and those known from several recent rock-art traditions, and I have indeed emphasized that my theories derive no support from certain ethnographic claims or observations (Bednarik 1986b:i65). While it may have been preferable for this separation to have been maintained, the authors have taken the plunge, and their propositions must be considered.

Despite my reservations and criticism, I find some interpretive aspects of the paper surprisingly plausible. In particular, the illustrations of Upper Palaeolithic therianthropes and of possible associations of entoptic forms with figurative art present some attractive alternatives to previous ideas. They will have to be carefully considered in the light of chronological or geographical distribution patterns and other evidence.

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This provocative paper gives us new ways to analyse pictures. The model should have cross-cultural validity, but its use presents problems of control. Prehistorians working with text-free pictures (Hawkes 1954) have few suitable models. Until recently the literature hardly mentioned art historians, critics, aestheticians, or even the Egyptologist Schiifer (i974) but used unstated and diffuse norms (naturalistic, childlike, schematised, stylised, iconic, and so forth), undefined, uncontrolled, and almost useless. Psychologists once believed that certain aspects of patients' pictures were diagnostic of mental illness. Anne
Anastasi found exactly the same traits in pictures made by respectable everyday, sane people who had no academic training as artists (Anastasi and Foley 1940:355):

Only by observing the artistic behaviour of a wide variety of groups, each differing from the others in a different aspect, can we tease out the factors conditioning the particular behaviour. Observations limited to a single type of subject may lead to incorrect generalizations. A given characteristic of children's drawings,
for example, may be superficially attributed to maturational level; or some recurrent feature in the drawings of the insane may be ascribed to their emotional disorder or mental deterioration. Examination of the drawings by untrained normal adults, however, may
reveal the same features and thereby suggest that
such characteristics follow only from the lack of formal artistic training common to the three groups.

Knowledge about untrained normal adults' pictures would be valuable to prehistorians (Clegg 1979) as well as psychologists. A symposium of the First AURA Congress in Darwin next September is broadly aimed at this topic (Clegg 1987a).

Few of us would rule out the possibility that altered states of consciousness sometimes accompanied Palaeolithic pictures, and it would be interesting to

identify "altered-state" pictures. Lewis-Williams and Dowson seem careful to avoid claiming such a capacity. In the absence of a control-perhaps pictures produced in the laboratory before the artists entered their altered states-we cannot tell whether the traits described are produced only by artists who have undergone some altered state of consciousness. Since these sorts of pictures are the products of neurological hardware, they could be expected in ordinary people's ordinary pictures. The six entoptic forms amount to a good basic graphic vocabulary, and the seven principles are a good basic guide to variation. Graphic artists as well as musical composers sometimes work (or play)' with variations on a theme. I like this paper and wonder how easily it might be applied to the data I struggle with (Clegg 1984, 1987b), several thousand old (some may be Pleistocene) petroglyphs at a large site in western New South Wales. Many of the marks can be recognised as depictions of animals' tracks and simple non-figurative lines, spirals, asterisks, and circles. Very few look like pictures of people, kangaroos, or lizards. Several of the petroglyphs do not look like anything and are classified as complex non-figuratives. No two are alike, though some are variations on a theme (see fig. I). Some overlap "tracks." I have failed to infer their relative age from the overlap. Until reading the present paper, I had thought of them as exploratory variations. Now I realise that the explorations may have been performed by a psychoneurological system in an altered state of consciousness, and I feel I almost have a way to analyse them.
i. The exploratory business of artists can be described by either word.

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FIG. I. Complex non-figurative petroglyphs from the "Nebula" subsite, Sturt's Meadows, western New Soutl Wales. Average distance between originals approximately io m, average diameter about 400 mm. Petroglypi like these occur nowhere else on the site. Whether the bird and kangaroo tracks are associated with them is unknown.
Oil

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14 ix 87
Lewis-Williams's various papers for CA in the last five years have aroused in me a deep respect for his scientific personality. He has expressed ideas about the meaning and function of rock art that have provoked intense criticism among investigators. He supports revolutionary forms of description of rock art, and he has the great virtue of continually revising his ideas. Besides, he is an honest man who really believes what he says. His papers perform the role of a spur for the rock-art specialist community. At the same time, because of all this, it is very difficult to produce a methodical criticism of this paper, in which he takes a

pseudoepistemological approach to the subject (a mixture of axioms, assertions, and beliefs and ethnographic, neurophysiological, and biological data) that takes into consideration a period of more than three thousand years on three continents. My comments are quite similar to those made by others on an earlier effort (Clegg 1982, Groenfeldt 1982, Vastokas 1982). I do not accept the Lewis-Williams and Dowson model. To accept it would amount to acquiring a universal, timeless decoder for all signs. The authors start from altered states of consciousness produced by use of mescaline and LSD and extrapolate to any other kind of trance, overlooking the evidence of ethnic differences in pharmacokinetics (Kalow, Goedde, and Agarwal 1986). They say that all the geometric signs are phosphenes, but they do not tell us that the informant on those altered states can only describe what is filtered through his own cultural information (ReichelDolmatoff 1985:296). Nor do they warn us that in such altered states it is almost impossible to separate figure from ground (Davson 1963). They do not mention the more than 3o phosphenes currently identified, of which they selectively refer to only 6. They do not consider that the Tukano perceive these phosphenes with "notorious lateral symmetry" (Reichel-Dolmatoff 1985:293). They include in the category "shaman" both the lone visionary of the Siberians and the collective Tukano. They consider San and Coso arts comparable, but anyone can observe that the motifs (assemblages of signs) are very different. This paper forces us again to accept San art as unconditionally shamanic. They cannot simply say that it has shamanic components; their model calls for wholeness. They disregard previous criticisms in these pages (Bardill 1982, Inskeep 1982, Willcox 1983, Woodhouse 1984). We are asked to accept that Coso art is shamanic because a modern informant suggests it, overlooking the fact that this informant was acculturated, completely removed from his social context, and thus unable to provide an emic interpretation satisfying the Western observer. This kind of informant, generally surrounded and harassed by ethnologists and anthropologists, can only express his ignorance about the meaning of iconic forms by saying that they are "supernatural beings" or commonplaces.

Lewis-Williams and Dowson think that the U shapes on "decorated handprints" represent the sensation of tingling in the hands reported by shamans in the I9th century. What are we to think, then, about the fact that most South American handprints (in Argentina, Brazil, Uruguay, and Chile) are child-size? Perhaps that South American shamans were dwarves? I am uneasy about their methodology. Everyone accepts social explanation in archaeology, but I cannot accept as "social explanation" the state of mind of certain shaman's apprentices more than 40,000 years ago, inside European caves, absorbing the power from depictions. Lewis-Williams and Dowson make too many assumptions. They have enough to tell us without forcing on us these inconceivable exercises in postdiction. They say that their omissions strengthen their proposition, and this is true in the sense that if one takes out of a model what doesn't make sense, it will appear more convincing. The weakest point in their model arises from juggling only six phosphenes and seven principles governing their perception to cover rock art from San, Coso, and Upper Palaeolithic contexts. They do not say that phosphenes are culturally selected and this is the source of their variety. The model is like a wonderful

kaleidoscope in which a few phosphenes combine with a set of principles neglecting cultural selection in three stages obtained only with mescaline and LSD in specific lab situations to interpret prehistoric art. No time, no place, no culture: these are "the signs of all times."

I can accept their assertion that "it is logically impossible to induce meaning from numerical rock-art data" only in part. Deprived of direct sources (and this does not necessarily mean ethnography), we must work with quantitative and qualitative data. It is true that the meaning of the signs is impossible to determine from numerical rock-art data. Nor is it possible to obtain any kind of meaning without taking into account the structure of synchronic depictions, as they claim. I believe that we can avoid misuse of numerical rock-art data if (I) we accept (or even believe) that there are regularities in human behaviour that are expressed in the structure of synchronic depictions; (2) we do not seek to extract meaning directly from symbols but rather attempt from synchronic depictions and their corological and spatial relationships to obtain a probabilistically controlled pattern of regularities and anomalies from which some meaningful structure or model (not necessarily the meaning of the signs themselves) may emerge. With this structure-which one might even call "style"-we will be in a better position to consider social information from a particular period of human behaviour as a whole. Partition of the context into similar simple forms cannot be accepted (see also Pretty 1982).

I am surprised by Lewis-Williams and Dowson's statement "We see our position as preparatory to the elucidation of synchronic and diachronic variability." For me, these kinds of elucidation are technical devices that we must employ from the beginning of any rock-art research. Nowadays infrared films, spectral colour sliding,

and quantitative analysis are standard procedure (Con- not familiar with the detailed findings or structure sens 1986). argument of the unpublished paper cited for Co

Their paper is stimulating, nevertheless, and their in- shamanism and rock art. Their model of six types telligent proposals will compel all investigators to think entoptics, seven modes of "perceiving" them, and tbrc about their objectives. This kind of paper clarifies the stages in a subject's experience of the altered state limits beyond which we fall into science fiction or consciousness, although perhaps overly complex an paleopsychology. certainly tendentious at the moment, at least gives N somewhere to start. As they say, it is founded in '!u versals" of hominid perceptual neurology. It may ther,

WHITNEY DAVIS fore serve as an appropriate control for the study ofc

Department of Art History, Northwestern University, Evanston, Ill. 602o8, U.S.A. 21 viii 87 tural conventions of what Noll (1985) has called "men imagery cultivation." Finally, they put all their cards the table in proposing some specific examples of Uppi

This is a clear and provocative paper. It builds from well- known research to some unexpectedly strong conclu- sions. The strong dose of speculation and downright un- proved assertion-with the required "academic" mix of views. As a "position paper," the article is e tremely elegant.

The hypothesis that entoptic phenomena may be "ex- temalized," "fixed," depicted, or otherwise genetically or referentially related to nonrepresentational or repre- sentational graphic displays, however these in turn are consciousness"-tendentious enough terms to begi with!-are clear as far as they go. However, the litem stance, in 1965 two neuropsychologists and a specialist on these subjects is immense, ranging from b4 in children's drawing reports of subjects' experiences to highly complex the(retical accounts; moreover, it is various in its ontoo, or sketched by adult subjects (Kellogg, Knoll, and Kugler ical and epistemological claims (see Noll 1985 an 1965; cf. Anderson 1975). Although they drew no abso- Asaad and Shapiro 1986 for two reviews) and somewh, lutely explicit inferences, they evidently believed that confusing, to this outsider at least. I would reserve jud) the entoptic experiences were somehow carried over ment on Lewis-Williams and Dowson's presentationinto the drawing. In my opinion, a clear understanding of which is not, of course, for publication in a journal this process of transfer has not yet been achieved. The perceptual or cognitive psychology. vague terms used for it-"externalization" or, as in this More to the immediate point, I find the identificatio paper, "fixing"-still require elucidation. of an "entoptic" component in the Upper Paleolithi Application of the hypothesis to rock arts has been actually cited here (fig. 4, r made repeatedly in the literature (e.g., Blackburn 1977; and V) somewhat strained. It seems difficult to distif Reichel-Dolmatoff 1978b; Davis 1986c:53; Lewis- guish morphologically between a stylized iconic repr(

Williams 1986a). In a series of important papers (which sentation of horns or hair (that is, where stylization Lewis-Williams and Dowson do not really engage), Bed- not symbolic or, at least, does not refer to entoptic pht narik (1984a, b; 1986a, b; n.d.) has investigated mor- nomena) and "entoptically" derived forms "construed phological correlations between entoptics (phosphenes) representationally. (Moreover, even if entoptic and pi(and apparently noniconic European and Australian Up- ture are morphologically identical, this is not enough, i per Paleolithic parietal markings (the comments on Bed- itself, to show they are related; a film I make might b narik 1986b should be useful to readers of the present morphologically indistinguishable from a dream I onc paper).

had without that film's thereby deriving from and/c

Lewis-Williams and Dowson advance the discussion depicting that dream-but more on this below.) This i
of the hypothesis in several ways. Although it will al- not to say that I reject the hypothesis. It is logicall ways be difficult to distinguish in practice between "ent- possible that images in the technical sense could evolv optics" and "hallucinations" and between "noniconic" from the second-order "construal" of entoptics. I woul and "iconic" patterns, their terminological clarifications subsume that process under the general rubric of "set are helpful (see also Tyler 1978:1633 and Davis 1986c:5 3 ing-as" and "disambiguation" that I have considere for use of "entoptics" vs. "phosphenes," "form con- elsewhere as one of the fundamental perceptua stants"). For readers who may be unfamiliar with the neurological events determining depiction (Davis I986t rock arts of various North American Indian societies and 1987)-for depictions of entoptic phenomena may we. of the southern San, their remarks on the shamanistic be one kind of "ground" (along with natural forms, foi context and reference of iconography, with some intrigu- tuitously produced man-made marks, nonrepresent. ing further examples, will be useful. Lewis-Williams's tional but semantic marks, etc.) for the replication c research on the southern San constellation of trance images of "external objects." dancing and rock painting is well known, and his Despite some rhetoric about underlying "universal
findings have been pretty much broadly accepted; I am processes and the "origins" of representation as suc

(more about this below), in this paper Lewis-Williams and Dowson have really offered an iconographical decipherment of previously puzzling visual displays, just as Lewis-Williams has done already (e.g., I98ia) for the iconography of southern San rock art. I expect that most debate will center upon the plausibility of their decipherment in relation to (possibly in combination with) competing decipherments. Obviously, we have no direct access to Paleolithic or any other minds: as always, we have to interpret the physical properties and context of the graphic display-its apparent morphology, distribution, mode of manufacture, deposition, and preservation-as most compellingly and comprehensively explained by supposing it is a sign and/or assigning it suchand-such a reference (Davis 1987:127-28; n.d.). This is the necessarily roundabout and uncomfortable but in some ways preeminently anthropological, archaeological, or historical fate of interpretation. In this light, it may be recalled that Marshack's decipherment of a "notation" in some Paleolithic graphics is really quite penetrating. For instance, whereas LewisWilliams and Dowson take what they call the "zigzag line, set of overlapping chevrons which form, in effect, a zigzag, and a number of discrete chevrons" engraved on the famous supposedly Upper Perigordian pebble from Barma Grande, Grimaldi (they illustrate only one face, fig. 4, II), to exemplify the "fragmentation" of the "catenary curve" entoptic (Principle 2 for fig. i, V), Marshack (1972:81-86, figs. 16, 17) can account rather more precisely for almost every line and for the overall structure or "composition" of the display-in this case, as having the notational differentiation of a calendrical statement for a three-

month lunar period (no "fragmentation" in this!). I am not asking Lewis-Williams and Dowson to dispute Marshack or the various structural semiotic readings of Paleolithic syntax (without much semantic decipherment) by Leroi-Gourhan (e.g., 1968c), Sauvet, Sauvet, and Wfodarczyk (1977), and others, for they are entitled to present their own alternative; moreover, it is even conceivable that Marshack-like notations or other scripts could have derived, like images, as "construals" of entoptics, as a general model would admit (Davis 1986a, 1987). Nevertheless, in comparison with Marshack's as it stands their decipherment, although perhaps covering many cases, lacks the power precisely to account for specific morphology and syntax. Alternatively, it buys this power too easily and cheaply, for, as they come close to admitting, anything and everything can be interpreted as a permutation of one of the rather casually defined entoptic "types." True denotation, whether depictional or not, must definitely rule out some morphologies as being overly ambiguous or nondenotational-as being outside the system of reference (Goodman 1972, Elgin 1983). But despite LewisWilliams and Dowson's claim to have isolated some basic types (perhaps true as far as it goes), ultimately we have no good idea of what could not count as entoptic or hallucinatory, and therefore as it stands the "decipherment" is impossible to evaluate or refute. A proponent can always say, "Well, perhaps this is just what Paleo-
lithic people experienced entoptically or hallucinatorily."

It is clear, then, that to assess the plausibility of the decipherment (vis-a-vis competitors), we must investigate the possible place of entoptically derived graphics (noniconic or iconic) and of images of entoptics in Upper Paleolithic society. Presumably, using the rich anthropological literature on shamanism, we can do better than the sketchy and by now clich6 invocation of initiation, imprinting, validation, and so on.

All of the "implications" raised by Lewis-Williams and Dowson need close scrutiny. I will take up just one topic close to my own current interests. I do not think that this or any particular iconographic decipherment, whatever the antiquity of the images or their apparent association with "universal" perceptual processes, says anything about the "origin of representational art" as such. It may say something about a historical origin, but there have been many of these. The paper is marked by some uneasiness and even confusion on this point. It is sometimes not clear whether graphic displays morphologically resembling entoptic phenomena are taken by Lewis-Williams and Dowson to be genuinely symbolic (denotational) at all. Insofar as entoptic and hallucinatory phenomena are intrinsic to the hominid nervous system, they are not, strictly speaking, "images" at all, on any developed definition of that term: they are percepts or perceptions. (Oddly, cognitive psychologists like Kosslyn [19831 have been studying pictures to understand the properties of "mental images.") For anthropological or historical purposes, we have to know how perceptions are extrasomatically symbolized (and similarly for nonvisual cognitive phenomena such as propositions, attitudes, "thoughts," or object labels). Although the perceptual and cognitive activities may be intrinsic and universal, the extrasomatic symbolic ones (e.g., depiction or notation) are not, and they cannot be taken for granted. As I have pointed out

elsewhere, that our visual system is operating as it ordinarily does under various stimulations-of light entering the lens of the eye, of mechanical pressure on the cornea, etc.-does not mean that we can design and use an extrasomatic representational system (denotational or symbolic system) preserving any of this information. Further conditions or processes must be specified to take us from perceptual to graphic abilities and experiences. A relation of reference must be forged between graphic marks (or other media) and perceptual experience such that the marks denote or depict experience when this relation holds in a particular way (Davis 1986c:54). As I see it, this is the question of the origins of representation. My answer to it (Davis 1986a, 1987), although criticized by Lewis-Williams and Dowson, does not contradict but crosscuts and in my opinion would actually have to underwrite theirs. They propose that the entoptic percept-often experienced as floating before the observer-and afterimages of it (described in Gombrichean terms as "projections") may have been "traced" by the subject/observer, effecting, of course, our crucial transition from percept to graphic display. This is a highly

specialized suggestion that actually has only a secondary place in their structure of argument; it is one explanation of how the subject/observer could have carried out the project of symbolizing entoptics should he or she have desired to do so. Although it has an honorable place in traditional aesthetics, the projection/tracing theory is, I think, fatally restricted and incomplete. For one thing, tracing is a difficult and unlikely procedure (just try tracing your own afterimages on a wall or shadow on the ground or even the far simpler task, recommended in the Renaissance for studying lines of projection and the vanishing point, of tracing your face in a cloudy mirror). Much more worrying, the theory actually says nothing essentially about symbolization or reference at all. For instance, I can certainly trace a signature to forge it, not to refer to it; in fact, in forging your signature I certainly do not want to refer to it. If and only if the trace in turn stands for or denotes that which it necessarily also resembles does it become an image in the strict sense (Maynard [1986] rightly criticizes Davis [1986a] for inadequately recognizing this, and see Davis [1987: n. 22, 23, 261). Again, this ability or interest, although based on universal perceptual and cognitive processes, is not automatic. It is actually quite difficult to give a nontautologous formal account of it. In a general model of origins, I would not rely on anything so cognitively specialized as an "altered state of consciousness" (for images originate nonconventionally but quite "normally" among children) or anything so technically specialized as tracing projections. In a general model, images originate in the replication of seeing-as as such or for itself (Davis 1987). It would be intriguing to discover that the referent of the images in one such canonical chain of replications was an entoptic, as Lewis-Williams and Dowson might claim for the Paleolithic chain, but the ability to refer to an entoptic pictorially was actually acquired in another way, although no less "intrinsically." Indeed, the cultural expectation or convention to "draw an entoptic," as to "draw a bison," may have crystallized quite late in a replicatory sequence beginning in some simpler and

more common mark-making activity such as "digital fluting" (Bednarik I986a, Davis 1987). In all of this, I am stressing not so much our disagreement as our divergence in asking and answering different questions: whereas Lewis-Williams and Dowson really are asking what Upper Paleolithic graphics might have meant, I ask how they could have meant anything at all.

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In the difficult field of semiological analysis of the parietal and mobiliary art of the Upper Palaeolithic, any attempt at interpretation, however limited, is worthy of consideration. Very prudently, Lewis-Williams and Dowson's work on the origin and description of entoptic phenomena (phosphenes and form constants) and their
possible implications for Palaeolithic symbolism is co: fined to a study of the perception of simple geometr forms, spontaneous or induced (including the very coin mon vision of bodies floating in the vitreous humour),1 the exclusion of the various types of hallucination (ti patient being aware or not of the abnormal character these complex visions that, in contrast to optical ill, sions, have no external object). Nor does it claim to pr4 vide an explanation for the very distinctive sigr (pseudoarrows, claviforms, and tectiforms), to whic should doubtless be added most of Leroi-Gourhan thick and thin signs with probable sexual connotation In fact, with reference to the complexity of the signs Lascaux, Leroi-Gourhan admitted to us shortly befi his death, "At Lascaux I really believed they had com very close to an alphabet."

The present study is an update on the question of tb entoptic origin of the elementary graphic units that ai so frequent in mobiliary art and so often omitted fro the inventories of parietal art. It carries much farther th previous modest attempt by Desban (1976), inspired as was by the work of Max Knoll and G. Oster, whic sought, through the use of phosphenes, to draw a parallt between certain signs in prehistoric art and certain elc ments in contemporary art (particularly in the works c Paul Klee and Joan Miro).'

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The model presented by Lewis-Williams and Dowsoi indicates that scholars are returning to their own neuro psychological structure in trying to uncover the deepe significance of prehistoric signs and symbols. This ap proach is a natural next step in what has proved to be ai increasingly provocative conversation with the past Providing insight into the foundations of symboling ant the meaningfulness of Upper Paleolithic art, the model has far-reaching implications. Excellent examples of iconic/entoptic combination, occur in prehistoric arts throughout the world. Lewis. Williams and Dowson's model could be applied to the X-ray rock art of Arnhem Land, Australia, in which o subject's internal organs and skeletal features are illustrated. It suggests that iconic depictions associated with entoptic forms originated within the third stage of altered states of consciousness. Early X-ray art, which is graphic in form and simple in execution, may have been derived from mental images produced during the final stage of

altered consciousness, in which entoptics may persist during iconic hallucinations. If symbolic associations are unavoidable in representational art, as LewisWilliams and Dowson imply, then a cognitive correlation could have been made between gridlike entoptic forms and skeletal features. Once this connection was
I. Translated by Mary Turton.

made, the art could have developed into the well-known complex representations of humans and animals that incorporate such features as backbones, lungs, and even breast milk. In the final phases of this art, inanimate objects such as rifles are painted with X-ray features. contemporary Arnhem Land bark paintings continue to combine entoptic and iconic forms. Far from being mere filler, the entoptic forms are finely integrated patterns with symbolic meaning. I am not arguing that LewisWilliams and Dowson's model explains the origins of X-ray art; rather I am playing with the applicability of the model to an artistic tradition other than their three examples.

My understanding of Lewis-Williams and Dowson's argument is that art having visual similarities with entoptic phenomena originated through a process of conscious imitation rather than free-flowing, unselfconscious spontaneity. Primal arts in general-not only shamanistic arts-ubiquitously incorporate entoptic forms. It could be that both entoptic phenomena and primal symbols derive directly from the same ordering and pattern-producing neurological function rather than the art's being informed by entoptics. If so, there may have been no need for artists to base their image making on review and imitation of entoptic phenomena. Human image making emerges from complex associations and motivations; to ascribe its origins to entoptic imagery alone may not be adequate. We are a long way from understanding the intricate details of symbolic relationships in the art of contemporary peoples, let alone that of the Upper Paleolithic.

Entoptic patterns have a striking immediacy, both visually and psychologically. As Lewis-Williams and Dowson indicate, however, this does not prevent entoptic forms from being saturated with complex meaning. The human mind strives to process sensory information-to structure it and to shape it into workable, accessible knowledge. The inescapability of symbolic modelling among Homo sapiens sapiens complicates our ability to grasp meaning from prehistoric art, for we are dealing with imagery rich in culturally based associations. All we can hope to produce is realistic and constructive interpretations of interpretations.

In symbolism, a visual similarity allows one image to represent another while transcending itself. Images are not necessarily representative of only one object or concept. Often, there is a continuum of symbolic meaning in which images are multivocal to varying degrees. The patterns integrated into the Coso anthropomorphs, for example, may depict both internal power and ornate garinents, not necessarily one or the other. We should refrain from applying dualistic categories to prehistoric arts-all of which are infused with cultural as well as natural symbols.

Lewis-Williams and Dowson portray Upper Paleolithic and shamanistic art as the result of a controlled and systematic undertaking. They are right in observing that

image making did not necessarily evolve from simple to complex. Complex mental images certainly could have been reduced to schematic form. Thus, a line of
horses' heads may have been reduced to a zigzag just as a zigzag may have been elaborated into a line of horses' heads. It is conceivable that an association between a zigzag line and the heads of galloping horses could be perceived in a single instant. Although its occurrence would be extremely significant, this sort of perceptual quantum leap would be difficult if not impossible to pinpoint in the development of an artistic tradition.

This brings me to a related point: referring to figure 5 b as a "clearly hallucinatory composition" is an overly liberal reading of a complex iconic/entoptic integration. This interpretation is laden with cultural predilections and does not give sufficient credit to the reflexive and interpretive aspects of creativity. Primal arts utilize symbols which operate on both the reflective, intellectual level and the nonreflective, perceptual level. Schematization is a sophisticated cognitive and artistic device for eliminating the inessential and portraying an object diagrammatically.

On a less theoretical note, Lewis-Williams and Dowson present some unsubstantiated suppositions. For example, irrespective of their initial qualifications, they repeatedly refer to Coso petroglyphs as "shamanistic art," a claim for which there is no conclusive ethnographic evidence. In spite of much speculation, we should not prematurely attribute a shamanistic origin to this art. Lewis-Williams and Dowson have shifted away from the usual vehicles of research-ethnography and internal analysis. They present a model which, they believe, objectively reveals Upper Paleolithic art to be the product of identifiable stages of altered consciousness. In spite of my caveats, I am very taken with their model, especially when I read it as exploratory rather than conclusive. Lewis-Williams and Dowson's concept of a "1neurological bridge" which gains us access to Upper Paleolithic imagery is an important contribution to our deepening understanding of prehistoric art.

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This paper offers an extremely interesting and persuasive explanation of those indeed "intractable" figures traditionally called "signs." In fact, it is the first really credible explanation that I have seen. The account of entoptic phenomena and processes is lucid, the main argument cogent, and the heuristic use of ethnography admirable in respect to San and Coso depictions (although I should think Bednarik [i 984b] deserved a good deal more recognition for his explicit identification of phosphene types with Australian petroglyphs).

The authors do avoid "simplistic ethnographic analogy" in the main, but I wonder whether something of the sort has not slipped into the later part of the paper in assumptions made about shamanism and ritual. For example, "because [emphasis added] shamanism is so pervasively associated with foraging societies," the authors

conclude that "in the Upper Palaeolithic this association probably had at least some features in common with what we understand by shamanism." This is surely a shameless appeal to analogy. There are also references to "novices . . . on a vision quest," "elaborate rituals," "spirit helpers from whom shamans obtained power," etc. If everything stated or implied in these passages is perfectly possible, yet the source of such speculation can only be ethnographic analogy; the depictions themselves carry no such implications. It is, after all, equally possible that no ritual of any kind was involved and that these people knew nothing of spirits, vision quests, or shamans. That they did hallucinate is plausible, but the plausibility rests first of all on the fact that hallucinating is a human biological phenomenon (the "neurological bridge"), which need not have been enculturated in any way. Indeed, it may have been a common experience, not something especially to be sought or avoided but just a part of life. Many things can induce visions: the authors mention flickering light, fatigue, sensory deprivation, intense concentration, and rhythmic movement, for example, all of which, one might assume, were not infrequent in the lives of Paleolithic hunter-gatherers. Hence, in the limited sense the authors propose, virtually anyone could have been a "shaman." And if visions were commonplace, why should they be singled out for depiction? It is, I suppose, to answer this implicit question that the authors take doubtful recourse to ethnographic analogy. In this case, the San analogue is precarious enough in itself (Lewis-Williams 1982). I do not mean the trance theory, which seems solidly based, but rather the supposed ritual context, for which the evidence is thin.

The most difficult part of the paper for me is the last section, which sets out to answer the question of how people came to realize that two-dimensional marks could represent three-dimensional objects. So far as I can see, the question is not answered, for unless geometrical entoptics are assumed to be three-dimensional, which seems most unlikely, two-dimensional depictions simply represent two-dimensional mental images. But the real subject seems to be not perception (the capacity in question is probably to a large degree innate in any case) but the origins of depictive activity. And here the authors espouse a bold and controversial projection theory (one quite different from Gombrich's, incidentally). Has anyone actually been known to trace projected images on the surface where the images appear to be? Furthermore, since the projected entoptics are characterized by constant movement and fluctuation from one pattern to another, would not their "fixing" by tracing be virtually impossible? It seems more reasonable to assume that the depictions were based on memory (as is suggested for San painters), which had already "fixed" salient images. Thus there is no need to suppose that "for their makers, the earliest depictions were visual images: hallucinations and depictions were one." If the makers of animal depictions "did not suppose that they stood for 'real' animals any more than the accompanying entoptic depictions represented (iconically) things in the real world," what did they suppose? Surely the implication
is that they knew they were depicting mental images. the case of animals, moreover, there would be no diff ence in memory images between hallucinations

and sual perceptions, and both would "stand for" exten objects. Otherwise put, memory images of real anima would supersede hallucinations in the process of co strual, a supposition supported by the "realism" 1. animal depictions (there are extremely few fantastic i mals in cave art, though these might be expected from hallucinatory source). In short, people probably undej stood quite well that depictions were depictions, repr senting things seen, optically or entoptically, and question of why depictions were made at all remai open.

Up to a point, then, the authors' theory seems th oughly convincing. As an explanation of so-called sig as representations of entoptic phenomena, it offers brilliant solution to what has long seemed a hopele problem. Perhaps it were best left at that. As an accou of the origins of depiction, the theory has too ma difficulties to be persuasive, but it is otherwise a maj achievement.

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Lewis-Williams and Dowson recognize the problem tha Upper Palaeolithic rock art has no exact modem coun terpart and the difficulty this creates for explanation bi ethnographic parallel. But in what way is their use ethnographic analogy less simplistic than Breuil's? Pre sumably in its systematic application of a theory whicl accounts for a variety of motifs rather than the piece meal selection of parallels from diverse cultures. Thei paper usefully broadens the range of possible explan tions of Palaeolithic signs, but how susceptible is theij hypothesis to verification? They are no doubt correc that any explanation of the unique body of materi which Palaeolithic cave art constitutes must begin b) identifying some universal elements in human percep tion, but this is not enough; any adequate theory mud also account for the diversity and uniqueness of differeni cultural traditions. While certain elements of Palaeo lithic culture can be reconstructed beyond reasonablt doubt, others may only be inferred on a balance of proba bilities, and many guesses remain mere possibility. Tc which category does the present hypothesis belong? While altered states of perception may induce universal images, they do not inevitably produce rock art. Is ii not a relevant consideration that not all San rock-an techniques showed the same predilection for depicting allegedly entoptic motifs, despite the artists' possession of apparently similar belief systems? It would be false logic to argue that (a) optic stimulation always inciteE perception of grids; (b) Palaeolithic art motifs include grids; therefore (c) these grids are the product of optic stimulation. The missing step is that which would en able one to weigh the probability of this hypothesis against alternatives (traps, sexual signs, notations, etc.)

What level of proof do Lewis-Williams and Dowson claim? "A single zigzag would not be persuasive evidence"; "presence of all six [entoptic categories] suggests emphasis added] that at least some of the art originated in certain altered states"; "the European example of replication is of a simpler variation"; homed or antlered humans are "better explained [emphasis added] by hallucination... because they.., have clearly non-realistic features" (clarity assessed by what

criteria?); "we expect examples as convincing as the San and Coso one to come to light" (how will degree of conviction be measured?). The authors are probably correct to state that San art is now widely accepted as shamanistic, but what specific evidence is there that San artists intended to depict "entoptic" forms? It is often the most ambiguous motifs, such as "flying bucks," that seem to be used as firm evidence for depiction of trance experience. The security of this particular evidence should be assessed, as it is treated as proven in the remainder of the paper. Other ethnography should perhaps have been drawn from better-known cases of shamanic art, not poorly documented rock art. Does Inuit or Tibetan art embody "entoptic" forms? How probable is it that shamanism inevitably determines the form of art motifs? Are Palaeolithic signs a unitary category in the artists' culture or a residual category of the analyst-those which cannot be construed as animals or anthropomorphs? Lewis-Williams and Dowson maintain that their argument is strengthened by the recognition that not all marks can be construed as entoptic; some "spears" may be realistic depictions of weapons, some claviforms of simplified female forms. But those which do not fit the six entoptic categories are described as residual: what independent means can be used to determine the unity of those construed as entoptic? Do they always occur juxtaposed only to other "entoptic" forms? Are they confined to certain types of location? The authors propose such a hypothesis when they state that the less accessible parts of some caves contain simpler and more fragmented figures but go on to note that similar motifs occur as artefacts. Even the fact that some motifs are entoptic in form does not prove they are entoptic in intent.

It is important not to elevate tendencies into universal principles. Lewis-Williams and Dowson write that shamanism is pervasively associated with foraging societies, but so is totemism. They suggest that shamans often go to remote places such as caves to meditate, but shamans are not the only people who visit caves. Although my remarks are critical, they are not intended to be destructive; rather, they are aimed at suggesting how this interesting hypothesis might be used.

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I agree with Lewis-Williams and Dowson that the "signs" of Upper Paleolithic art may be connected with
or derive from altered states of consciousness. Indeed, it has been argued that the production of virtually all art involves an alteration in consciousness and that traces of this can be detected in its form or content (e.g., Ehrenzweig 1953, Kris 1952, Martindale 1981). However, these altered states of consciousness are not necessarily so extreme as those induced by psychoactive drugs or sensory deprivation. Rather, the inspiration for works of art may derive from mildly altered states such as hypnagogic states, reverie, and fantasy. It does not seem necessary to argue that Upper Paleolithic signs are always due to what Lewis-Williams and Dowson call entoptic phenomena. Visual activity is usually divided into several levels of neural processing: purely sensory activity, detection of elementary features such as lines, slits, and angles (Hubel and Wiesel 1965), and activation of sets of neurons coding "unitary percepts" or recognizable objects

(Konorski 1967). Unitary percepts are presumably constructed from simultaneous activation of neurons coding elementary features (see Martindale 1981 for a review). Visual perception consists of "bottom-up" activation from the sensory level to the level of unitary percepts. Mental images or hallucinations consist of "top-down" activation from the level of unitary percepts to the sensory level. (If hallucinations and mental images did not include activation of neurons on lower levels of analysis, we would not be able to "see" them.) Presumably, phosphenes correspond to activation of neurons only on the sensory level, whereas Kliver's (1966 [1928]) "form constants" correspond to activation of neurons on both featural and sensory levels. Neural activity on the featural level occurs not only in the case of entoptic phenomena but also in the cases of normal perception and organized mental images and hallucinations. It is a common assumption that what Kliver called form constants are the basic building blocks of both veridical and hallucinatory perception. Given this, it makes sense to argue that form constants or "signs" can arise from normal perception if one attends to the featural level rather than to the level of unitary percepts.

Evidence for this contention comes from studies of children's drawings. Five of Lewis-Williams and Dowson's Upper Paleolithic "signs" are included in Kellogg's (I969:15) catalogue of the 20 basic "scribbles" found in the drawings of children from two to four years of age. The sixth (grids, lattices, ladders) is prominent in her listing of common aggregations of scribbles. (Kellogg and others have printed out the similarities between motifs in children's art and Paleolithic art.) To my knowledge, no one has argued that young children are trying to reproduce entoptic experiences in their drawings. It is generally agreed that children are not attempting to produce realistic drawings and failing because of lack of technical skill (Amheim 1967, Harris 1963, Luquet 1927). Rather, as Luquet put it, the child draws "what he knows rather than what he sees" because he attends to different aspects of the optic array than the artist attempting to render what we call a realistic depiction (Gibson 1979). It would seem that the child is attempting to depict concepts or abstract essences rather than raw, specific per-

cepts. Because of this, basic features are attended to and irrelevant or idiosyncratic aspects of the optic array connected with perspective, viewing angle, shadowing, and so on, are ignored. It is notable that some autistic children so retarded that they seem quite literally to lack abstract concepts do produce, at very young ages, quite realistic drawings employing linear perspective, shading, and other devices (Selfe 1983).

It seems plausible that the goal of Upper Paleolithic artists was the same as that of children. That is, they were often attempting to depict either percepts or mental images but their notion of what is important differed markedly from what a modem artist aiming at photographic realism deems to be important. Their attention was drawn to the featural level of perception rather than to the less general level of unitary percepts. It is plausible that some Upper Paleolithic signs arose in precisely the way Lewis-Williams and Dowson say that they did. My

point is that such signs may also have arisen from other causes having as much to do with the goal of the artist as with his or her state of consciousness.

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This paper is certainly a bold one, but the conclusions it draws do not seem convincing. The set of rock depictions the authors choose to analyze and entoptic signs have in common only a rhythmic structure that can in some cases be traced to human physiology. The rhythmic character of entoptic phenomena is, moreover, evidently induced by neurological processes, while the recurrence of simple forms may be kinetic in origin, that is, brought about by monotonous movement, the socalled dance of an arm (Arutunov and Sergeev 1975 :176). They may also be graphic counterparts of oral or musical rhythms (Mirimanov 1973:55-67). In many cases such forms are a simplistic symbolic depiction of an object. A zigzag, for instance, may be the symbolic depiction of a snake, water, and so on. Many signs, including some similar to entoptic ones, that we find in Neolithic art and the Metal Ages have been safely interpreted. Such "understandable" non-figurative depictions occur less often in Palaeolithic art because we know less about it, but they include "macaroni," hand imprints, arrow-like lines, vulvas, etc. There are many Neolithic and Eneolithic depictions that match the entoptics, but one would hardly imagine the stockbreeders, hunters, or cultivators of Eurasia covering the rocks with depictions of anomalous entoptic phenomena. As for the zooanthropomorphic paintings, they are definitely not the result of hallucinations. In the Sahara and South Africa they are in some cases camouflaged hunters and in others ritualistic masked dancers. Furthermore, zooanthropomorphic depictions constitute the basis of all traditional art. Finally, what little we
know about rock art yields no evidence as to a shamanistic origin for these paintings.'

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This essay is exhilarating and disappointing at the sain time. A brilliantly creative application of biological j formation to the archaeological problem of interpretii Paleolithic rock art, the presentation is weakened by ti authors' position that it is "logically impossible to i duce meaning from numerical rock-art data, as it is fro any data." How many times a day does a scientist sa "What these data mean is that.. ."? It is precisely d lack of quantitative information for sample sizes, centi tendencies, associations, and variation that reduces th(proposition to argument rather than hypothesis testin from science to polemics.

What is their proposition? Simply put, they offer th some rock-art designs are mimics of visual artifacts the nervous system, such as simple hallucinationsartifacts said to be documented in laboratory and ca studies, especially involving persons in variously alter(mental states (I tried for a week to induce the effect c myself but got nothing, even in an altered state). Usi an independently derived shape classification of the4 visual artifacts, the authors try

to identify correspondii types in African San, American Coso, and widely di tributed Paleolithic rock art. Simple designs are reasoi ably matched with the visual artifact types. More con plex and naturalistic designs are said to incorpora external nonbiologically derived information (a detail drawing of a horse may incorporate one of the visti artifact types, but the horse form comes from outside tl artisan). Would not simple designs be more like. matched always with the visual artifact types than coD plex ones? Here is where the, issue of quantification ej ters.

In a given culture, who produces the rock art? Tb authors imply that shamans or individuals on visio quests were significantly involved. But no evidence i offered as to the ratio of visual artifact designs produce by nonshamans, particularly children and subadult! whom we could expect to be immature artisans an therefore producers of simpler designs. I rather suspec that the development of drawing in children is strongl correlated with neurological growth and developmeni at least that is my impression of children's drawings i several cultures I have experienced. I doubt very muc that what children draw results from visual artifactv And I know from experience among Hopi, Aleuts, an Russians as well as with my own daughters that childre do practice rock or other surface art. How do we di,

criminate between possible shaman activity and the 0arkings of children?

To begin with, designs need to be analyzed in depth to identify factors of treatment or form that would differentiate the productions of normal adults, altered-state adults, and subadults. There will be variation in the depictions of these three classes, so quantification has to be involved to provide some estimate of error. Context (i.e., deep caves or strange places) cannot be assumed without independent assessment to be a reasonable aid for discriminating between the rock-art productions of children and those influenced by visual artifacts, i.e., shamans'. Preservation needs to be factored in, since weathering could break down a complex design into a remnant simple-appearing one. Placement relative to the ground surface is another obvious variable, and so forth.

Quantitative data are also needed to evaluate the frequencies of the neurologically influenced types within a rock-art panel, between panels, and through time. In the Anasazi culture area where I have had some experience with rock art (Turner 1963, 1971), the earliest style is decidedly simplistic, and therefore all six of the visual artifact types can be recognized, and quite frequently. But these forms are style or tradition characteristics and hardly the result of only shaman activity, heavy drug use, or other determining factors. Coming up in time, Anasazi rock art becomes both more realistic and abstract, and the visual artifact types are much less readily identifiable. My point is that variation in the frequency of visual artifact types occurs through time and space. Consequently, statistical inference is obligatory for factoring out the different causes of convergent forms that must be

considered before it is possible to get at the meaning of Paleolithic rock art. At least it is obligatory if we want to know the probability of discriminating between drawings by shamans and by children or between style and content.

If my comments appear overly critical, they are not intended to be. I applaud this very clever, highly creative, and scholarly effort at constructing a "neurological bridge" to the Paleolithic. I find the idea of visual artifacts' being an element in Paleolithic rock art intuitively satisfying. However, there is a big gap between this idea and a demonstration of its vitality, and this gap is the result of inadequate methodology. Such a demonstration can only be done by statistical inference beginning with some reasonable baseline such as averaged or weighted world or regional ethnographic analogies transformed to some sort of numerical scaling.

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Keeping up with Lewis-Williams's shifting methodologies is no mean task. Within a span of only six years, ethnographic analogy, symbolic analysis, Marxist social theory, and, now, neuropsychology have sequentially informed his interpretations of southern San rock art and, most recently, that of the Upper Palaeolithic. This most recent exercise in the application of experimental psychological data by Lewis-Williams and his colleague Dowson to the problem of prehistoric art interpretation can only be commended. In agreement with Gestalt psychologist Rudolf Arnheim (1974:3), who says that "all seeing is in the realm of the psychologist," I think that insufficient attention has been paid so far to the investigation of actual artistic processes and products by experimental psychologists working not only in neuropsychology but in the various relevant fields of mental imagery, visual perception, dream research, and human response to visual stimuli. While it has not yet been demonstrated to the satisfaction of most art specialists, it is clear that a great deal of visual expression and observer response has a physiological basis, subject to the ever-present conditioning factors of culture and individual personality. Valid interpretation of artistic process in any society of necessity requires the cross-disciplinary cooperation of psychology, anthropology, and the history of art.

Lewis-Williams and Dowson hypothesize for Upper Palaeolithic "signs" what Reichel-Dolmatoff (I978b) had already discovered among the Tukano of Colombia, that drug-induced phosphenes were the visual sources of inspiration for almost their entire design repertoire. It is Reichel-Dolmatoff, too, who seems to have been the first to suggest that "it would not be difficult to find parallels to phosphene-derived design motifs in prehistoric ... petroglyphs and pictographs" (p. 302). Perhaps this precedence should have been more obviously acknowledged by the authors. Their use of this Tukano material to help support the interpretation of Upper Palaeolithic painted "signs" as entoptic representations, it should be noted, contradicts their statement that "simplistic ethnographic analogy" is being avoided. Ethnographic evidence and analogy is in fact essential to their argument, that is, to the postulation that shamanic practices involving altered states prevailed in the Upper Palaeolithic and that the mental images experienced in those states were actually reproduced on cave walls. This comment is not to argue against the

use of ethnographic analogy or to oppose the likelihood of some form of shamanism in the Upper Palaeolithic but merely to point out that ethnographic analogy and internal analysis are difficult to avoid where almost all contextual data are lacking. For any hope of success in understanding prehistoric art, what is needed is not a battle of theories and methodologies but cooperation among them. While I support the use of experimental neurological and other psychological data for the interpretation of prehistoric art and, I might add, for the still undeveloped investigation of aesthetic universals, those data alone do not entirely "explain" the concrete visual images. The prime conditioning factors of culture as well as those of physical format, techniques of execution, and materials employed by the artist largely determine whether and how those ephemeral entoptic phenomena are actually represented on the cave walls.

As the authors state, phosphenes are experienced universally. But they are not universally represented. It is one thing to experience mental images; it is another to reproduce them in material form. It is difficult to accept the authors' suggestion that the Upper Palaeolithic artists may have projected their mental imagery and afterimages like so many slides onto the cave wall and "traced" them, "merely touching and marking what was already there." The passivity of subjects during trance does not allow for active production of art forms. "Recollected mental imagery," on the other hand, must be acknowledged as one of the sources of visual inspiration in prehistoric rock art. But, as in the case of the Tukano, mental image recollections are conditioned by cultural as well as technical and environmental factors. That the cave walls as a physical environmental factor, for example, were not considered by the authors is clear. They seem to agree with Halverson's (1987:67) description of the painted images as "free-floating" and "independent of scene or surface."

Phosphenes may be "free-floating" in the vitreous humour of the eye, but painted images adhere and relate to particular surfaces, which often give evidence of having been deliberately selected, not arbitrarily "traced" upon because they just happened to be there. This selectivity is obvious in the case, for example, of the cluster of red dots on the ceiling at Pech-Merle, located not on the rough side walls but on the relatively smooth surface of the ceiling. This selectivity is even more evident in animal representations. The head of the spotted horse at the same site, for example, is fitted into and conforms to a similarly shaped rock projection (Pfeiffer 1982: pls. 13 and 14), and the plastic volumes of the clay bison at Tuc d'Audoubert conform visually to their rocky matrix in the center of the cave (pl. 12). The visual and evocative context of the site itself cannot be ignored as a source of inspiration. Indeed, in many cases, it is quite likely that the site is iconically prior to and ritually more important than the pictorial images with which it is covered. The visually suggestive crevices and seams of the prehistoric petroglyphs near Peterborough, Ontario, for example, clearly inspired images of female genitalia (Vastokas and Vastokas 1973:79-83).

It is quite likely that phosphenes, even in the Upper Palaeolithic, while passively received, were almost immediately afterward given cultural interpretations.

Meaning would have had to be projected upon these mental phenomena before the artist could have felt any need to "fix" them permanently. Any practising artist can report that the critical step between imagined paintings and their actual execution on canvas or wall is the most crucial, requiring at least the planned presence of appropriate tools and materials, if not (in the case of Westerners) a lengthy sequence of experimentation in preliminary sketches and drawings. The point is that the creative interval lies between passivity ("getting an idea") and the completed action ("getting it down on canvas"), a process that is not automatic (not a case of "tracing" ideas) but subject always to the peculiarities of individual motor habits, background training (read "culture") with all its acquired conventions, and the havioural vagaries of the artist's tools and materials While phosphenes may have served as visual sourc in a number of circumstances throughout human his tory, interpretation of prehistoric art in terms of the neuropsychological phenomena should not be carrj too far, as I am afraid the authors have done in the case the Coso rock-art data. Viewed cross-culturally, t sources for image creation are immensely varied difficult to disentangle when one considers the comple ity of artistic processes. Shamanism and hallucinoge phenomena seem to have been a fad with us in rece years, to the neglect of innumerable other consider tions of equal importance to the interpretation of preh toric and non-Western art forms. One observation that needs making at this juncture the neglect of the potential data that living artists c provide for a kind of "ethnographic analogy." If, indee there are any universals to be discovered in artistic pr cesses and if the route to their determination lies in various branches of experimental psychology, then ps chologists, anthropologists, and prehistoric-art spec&i ists should be doing research among living artists Western as well as non-Western cultural contexts.

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Lewis-Williams and Dowson are to be commended fo an informative cross-disciplinary synthesis of the neurq psychology of entoptic and hallucinatory phenomem with an analysis of the origin and significance Palaeolithic and other cave and rock art. While the ap proach has limitations and shortcomings recognized b the authors, it makes an important contribution to the development of a biopsychological model of shamamc and related altered-state-of-consciousness activities The explanation of these art forms as "products of altered states of consciousness and related neurologically based principles in the formation of mental images, informed by the functioning of the human nervous system," links their research with my work on the psychophysiology of altered states and the origins of shamanism (Winkelman 1986) showing that tranceinduction techniques used cross-culturally include stimulation of aspects of the central nervous system that produce hallucinatory visual activity.

A biopsychological approach is useful not only for explaining the homogeneity of rock art and shamanic practices worldwide but also for addressing particular aspects of the art. The occurrence of Upper Palaeolithic art forms in deep caverns, for example, can be understood in terms of the trance-inducing properties of these locations, including sensory deprivation, temperature extremes, oxygen

deprivation, physical immobility, and emotional manipulation (see Winkelman 1986). The analysis of entoptic forms and the rules for their combination provides a useful alternative to views of

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these art forms as reflecting cognitive deficits of primitive artists. An unaddressed issue is whether participation in the bizarre hallucinatory worlds and their depiction constitutes a parallel, equivalent, or inferior perceptual modality.
I question the usefulness of the notion of "stages in the development of mental imagery," especially since the authors themselves point out that the three stages are to be viewed as "cumulative rather than sequential." Although the model emphasizes a developmental-stage perspective, the discussion shows that this perspective is unnecessary, likely a product of Western evolutionary/developmental tendencies and the effort to order entoptic, iconic, and hallucinatory forms hierarchically. The subsequent analyses suggested by Lewis-Williams and Dowson might more firmly establish the fundamental importance of entoptic forms and indicate the extent to which social and cultural factors affect their manifestations. A formal examination of the incidence of entoptic forms with respect to the entire range of forms presented would be valuable in this connection. Future questions include an assessment of the specific meanings or range of meanings ascribed to entoptic phenomena, sociocultural factors affecting the selection of or emphasis on specific entoptic phenomena, and the ways in which expectations may feed back into altered-stateinduction procedures.

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The main virtue claimed for the "model" of rock art presented here is that it "reduces the inferential component" inherent in both "internal analyses" and analogical interpretation. The suggestion is that the "neurological bridge" makes it possible systematically to exploit external interpretive resources without engaging the unreliability of "simplistic" ethnographic analogy. In what follows, I want to draw attention to analogical elements that remain in the formulation of this model. Far from calling into question claims made for its plausibility or security, my aim is to elaborate the suggestion that reliance on analogical inference should not automatically give way to "ethnographic despair" when no single, complete analog for the subject is available. Sophisticated analogical argument across the sciences exploits a range of sources-the analogs involved are generally "multiply connected" (Harre 197o:49)-and establishes the relevance of these sources to the subject by demonstrating the existence of "determining structures" (Weitzenfeld 1984:143) that ensure, with some specifiable degree of reliability, that the association of compared with iflputed attributes is not purely accidental. I suggest that the strength of the model proposed by LewisWilliams and Dowson derives not so much from an elimination of inference as from an effective use of two quite different, mutually reinforcing sources which underwrite strong claims for the relevance of specific

similarities in visual imagery manifested in diverse contexts.
What "independent neuropsychological research" provides is a model of a cause-a constraining or generating factor-that is capable of producing certain visual imagery, imagery which is also associated, Lewis-Williams and Dowson argue, with the artistic expression of shamanistic traditions. Given the physiology of the human nervous system (or, indeed, that of many mammals), this cause is potentially operative in all human contexts. The power of the neurological link is, then, that it effectively eliminates uncertainty about whether the postulated causal factor could have been present, given its biophysical nature. Two questions remain, however, which are not settled by the neurological model itself: whether the causal factor cited was, in fact, operative in the contexts in question (did people in these contexts enter the altered states of consciousness in which their neurological systems could be expected to produce entoptic images?) and whether it played a role in the artistic tradition (did the rock art result from people's attempting to "fix" these particular images?).
In the San and Coso cases, it is possible to settle these questions ethnographically or ethnohistorically. These are cultural contexts that incorporate shamanistic traditions in which trances played a central role. The trances were valued in part for the visions associated with them; the rock art is known to be associated with shamanism, and there is some direct testimony that it embodies trance-induced visions. The background neurophysiological knowledge cited makes it possible to reconstruct, with a high degree of certainty, what sorts of images these neurologically induced visions would have incorporated. The crucial step in determining the "validity" of the model for Coso and San art is to demonstrate a correlation between these entoptic images and the content of the art; it is a matter of linking the model of images produced "within," as a function of the structure of our nervous system under trancelike conditions, with the images encountered in rock art. The existence of shamanism secures this connection as an enabling condition; it involves practices which ensure that some individuals (those producing the art) entered states of consciousness in which the postulated causal mechanism would have been activated (i.e., states in which they would have experienced the distinctive entoptic images described by the model). The relevance of this to the artistic tradition is then confirmed by demonstrating that the art embodies the same range of images as is distinctive of these altered states of consciousness. When the model is extended to Upper Paleolithic art, I submit, it is by analogy, although not simply "formal" analogy that trades on contingent similarities between source and subject. The neurological source supplies, again, only information about the sorts of images the human nervous system is capable of producing when "altered" by sensory deprivation or drugs. The supposition that the minds of Upper Paleolithic artists were so altered and their art represents a "fixing" of visual sensations so induced is based on analogy to the San and Coso

cases; the "positive" analogy consists of striking similarities in the repertoire of images produced. The conclusion drawn is that they are entoptic images and are therefore further similar in being associated with shamanistic-like practices. The

pivotal argument here is that the same "determining structure," specifically, the neurological structure that produces a delimited range of visual sensations under trancelike conditions, was responsible for the repertoire of images present in Upper Paleolithic art as in artistic traditions known to be shamanistic, those of the Coso and San. This is an argument that the presence of a particular repertoire of images is a "relevant" indicator that the postulated causal factors were present and operative as well. And it depends not solely on the neurophysical information about our capacity to experience entoptic sensations under certain conditions but, given the lack of any collateral evidence of direct connection, on a demonstration of the tightness of the link between the having of such experiences and the production of the associated artistic images.

On this analysis, then, the crucial, inference-securing, element of Lewis-Williams and Dowson's argument consists of the considerations they bring to bear in establishing that the rock art they discuss incorporates a repertoire of images sufficiently like entoptic or entopticiconic mixes of images produced neurologically under trancelike conditions and sufficiently unlike images that are or would be produced by other postulated "determining structures" (e.g., representational interests, the internal dynamic of evolving artistic skills and traditions) to be very likely to be entoptic images-the result of attempts to "fix" trance-induced entoptic images rather than of other conditions, intentions, or activities. The model is properly defended, on this account, as a "best explanation," and its strength derives both from the extensiveness of the "fit" between forms described by neurological research and forms evident in rock art and from its capacity to account for features of the subject which remain puzzling on alternative models (e.g., the juxtaposition of geometric and representational images). The model is "best" to the extent that the cited causes can be shown to be uniquely associated with the effects in question.

When the argument for Lewis-Williams and Dowson's model is considered in this light, a number of possibilities for further investigation suggest themselves. As an argument for a "best explanation," the case for the model is essentially comparative; further exploration of the strengths and limitations of alternative models would seem important for securing and perhaps refining it. Two strategies for strengthening analogical claims of relevance follow from the structure of the inference involved (Wylie 1985), both of which could be relevant in making this central comparative assessment. One is to press the demonstration of tightness of fit between source and subject (showing that it is unique to this model), and the other is to investigate the persistence and uniqueness of the connection between entoptic-like images in art and their experience in trancelike states in a range of source contexts. Both call for broadening tj range of sources on which the analogical portion of t argument is based. The former suggests the value of d vising methods for systematically measuring and cor paring degree of fit to demonstrate that it is not ac(dental. The latter directs attention to cross-context coi parisons designed to determine whether distinctive ej toptic forms and entoptic-iconic mixes of forn routinely (or always) occur in art associated with tranc or altered-state-inducing practices and whether, by w. of seeking counterexamples, they ever occur (or wil what frequency they occur) in artistic

traditions assoc ated with no such experience. Where it is recognic that nonneurological factors play a role in the icoa interpretation of entoptic images in the second and thn stages, and even in the first stage, where "expectation may "sharpen" the perception of some entoptics rathi than others, it would also be useful to determine tb consistency and isolate the degree of plasticity of "for constants," transformation principles, and stage st quence across "altered states of consciousness" induce in different ways, under divergent cultural condition (e.g., associated with cults or religious traditions of d verse content or with secular practices in which the iir ages have no particular conventionally defined signif cance).

All these possibilities for strengthening the argumen take a common question as their point of departurt What would count as disconfirmation of the model More concretely: How clearly diagnostic are the "el fects" of the particular causal factor postulated in present model? What is the likelihood that they could h produced by other causal factors? It will depend on tl circumstances of research in several different fieldsneurophysiology, ethnography, archaeology-whethe any or many of these questions can be fruitfully pursued It is a significant strength of the present model, howevej that it not only provides an initially compelling accoui of puzzling, seemingly "anarchic" phenomena but s clearly opens up new lines of inquiry.

Reply

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As a number of commentators point out, the topic wc address impinges on several specialist fields: psychol. ogy, neurology, archaeology, art history, and philosophy. Vastokas, who is clearly aware of this complexity, remarks on the "shifting methodologies" one of us (JDL-W has employed in the past. The reason for this diversity is that method and theory must be appropriate to the question. This places a burden on rock-art researchers, and we are, therefore, grateful that representatives of various fields have taken the trouble to comment. Their remarks raise three comparatively minor points, some unfortu-

nate misunderstandings, a methodological problem, and two major philosophical issues. In our response, we address these topics in this order. The first minor issue concerns our use of "shaman." consens notes that we use the word to include the "lone visionary of the Siberians and the collective Tukano," and Halverson rightly concludes that, in the limited sense we propose, "virtually anyone could have been a shaman." As we stated, we mean only to imply persons in hunter-gatherer societies who enter altered states of consciousness to perform various curing and supernatural functions. Whether such persons are solitary or common (as with the San) is immaterial to our present argument, though we believe it may be necessary to draw this distinction at a later stage. A second minor point is the place of therianthropes in shamanistic art. Mirimanov claims that they are "definitely not the result of hallucinations" and that "what little we know about rock art yields no evidence as to any shamanistic origin for these paintings." We

cannot speak for the Sahara, but there is now little doubt that the San examples are hallucinatory (see our footnotes 3 and 4). In one of the few direct comments on San rock paintings a 19th-century San informant said, in a series of San metaphors, that they were men in trance (LewisWilliams 198o), and the statement by James's subject about turning into a fox shows that zoomorphic transformation can indeed be part of trance experience. In any event, clearly painted fetlocks and hoofs as well as the fact that some are half-animal and half-human prelude their being human beings in disguise. More interestingly, Balm asks why they are not more abundant in European Upper Palaeolithic art. In fact, a similar position obtains in southern Africa, where, in one area, there are 6,321 human and 3,942 animal depictions but only 88 therianthropes (Pager 1971:321). Although some commentators do not recognise it, we draw attention to the importance of cultural selection in explaining emphases and omissions in various arts. The San, for instance, selected certain animals for frequent depiction and ignored others; similarly, some societies emphasize certain entoptic phenomena and ignore others. The Tukano, in an indisputably shamanistic art, have very few therianthropes. The comparative paucity of therianthropes in a number of shamanistic arts certainly requires more detailed explanation, but it does not count against a shamanistic explanation. The last minor point concerns the origin of certain ideas. Bednarik remarks on "[his] theorem" and "another crucial proposition of [his]," while Halverson thinks we should have accorded Bednarik "a good deal more recognition" and Davis believes we "do not really engage" Bednarik's work. Although debates of this kind can become unseemly, credit must certainly be given where it is due. We merely point out that we did not know of Bednarik's work until the southern African work was far advanced (cf. Thackeray et al. 198I; Maggs and Sealy 1983; Lewis-Williams 1984c, 1985a; see Bedlarik [1986b: I65] himself on this point) and, much more Important, that he makes so little of the formal parallels
he notes that there is very little in his work we wish to "engage" at this juncture. In any event, Eichmeier and H6fer's (1974) more penetrating study preempted him by ten years, and Reichel-Dolmatoff's (1972, 1978a, 1978b) even earlier seminal ethnographic work with the Tukano has not been bettered. Then, just over a decade ago, Blackburn (1977:93), in another paper we cited, observed parallels between Chumash design elements and entoptic forms and urged researchers to "learn more... about the biopsychological aspects of the art and the intervening cultural screen, and about the process of interaction between the two." As far as we know, no one has heeded Blackburn's advice and gone much beyond reporting formal parallels. Thus, as Davis remarks, the idea that entoptic phenomena may be depicted in various arts "has been around for some time now." We acknowledged this by citing a number of papers, some of which Davis cites again. Neither Bednarik nor we can claim precedence for observing isomorphism between entoptic phenomena and certain rock-art depictions, and we were careful to avoid making such a claim. The important point is that the noting of formal parallels between entoptic phenomena and certain graphic images is, in itself, not sufficiently illuminating: it needs to be developed and incorporated into a comprehensive model that can become part of a more complex argument.

Bednarik's failure to develop such a model can perhaps be attributed to his misunderstanding of analogy (see below) and his belief that "semantics are among the trivial aspects of early marking traditions, that derivation is the real issue" (Bednarik 1986b:i63), and that changing social circumstances are a "feeble construct" (see, for example, Conkey 198o, Gamble 1983, and White 1985 on this last point). If Bednarik had not been hampered by these misunderstandings, he would not have found some interpretive aspects of our paper "surprisingly plausible."

There are, in addition to these minor points, two misunderstandings we must rectify. First, Bednarik believes we claim that "entoptic phenomena and iconic hallucinations have always coexisted." In fact, we claim only that their association is remarkably widespread in rock art. Moreover, we adduce evidence that the earliest markings are exclusively entoptic and argue that at "the beginning of the Upper Palaeolithic there was an intensification of production, an apparent increase in the artists' entoptic repertoire, the addition of representational images, and, quite possibly, a new desire for durable depictions."

The second misunderstanding, exemplified by Vastokas, is our fault rather than hers. In a badly phrased sentence we appeared to claim that Upper Palaeolithic depictions are always independent of their support. We intended to say only that many (but not all) iconic images are depicted without ground lines or surroundings and that they are often grouped so that they appear to be quite independent of one another. Certainly, very large numbers of images are associated with the form of the rock wall, and we are grateful to Vastokas for citing examples.

Important methodological issues arise from some commentators' emphasis on traditional strategies for rock-art research. Consens, for instance, believes the establishment of (probably stylistic) sequences and regions and quantitative analyses are "standard procedure." This is a manifestation of the empiricist position that researchers should collect all data, classify them, and then induce explanations from them. Turner also expresses this view when he defends induction of meaning from numerical rock-art data by asking, "How many times a day does a scientist say: 'What these data mean is that . . .'?" Contrary to his expectation, data do not speak, indeed cannot speak, to the researcher in this way. Whatever he may believe he is doing, the researcher formulates hypotheses and applies them to the data; in other words, the ideas come from the researcher, not the data (Chalmers 1978). Still more seriously, which of the multitude of possible observations qualify as data, and how should they be classified or analysed? For data to be collected in the first place they must be deemed relevant to some hypothesis; not even supposed "raw data" can be theory-free. If, as in a gross but not imaginary example, painted "scenes" are categorized as walking, hunting, dancing, fighting, domestic, mythical, and ceremonial groups, the results will show that a certain percentage of the art is secular and a certain percentage "religious." But, because each of the categories is itself an interpretation based on the assumptions that such groups are evident upon inspection and that the art is

partly secular and partly religious, the general result is inevitable. All the accompanying numbers and statistics merely lend a "scientific" flavour to the work. As Shanks and Tilley (1987:59) remark, "For mathematization meaning is a meaning-less question. This is the inevitable conclusion to a belief in the objectivity of precision and calculability." Thus the numerical inventories Turner advocates reflect not "objective" criteria but criteria that the researcher deems potentially significant in terms of his or her (perhaps tacit) hypothesis and that are therefore already skewed. As we ourselves have found, numerical inventories must of necessity omit important criteria of which the researcher is ignorant at the time of collection.

Because of these problems, quantification not surprisingly plays hardly any significant role in Turner's own work. In his comment he says, "Statistical inference is obligatory for factoring out the different causes of convergent forms," but in his study of the Glen Canyon petroglyphs he defines styles subjectively, not statistically (for example, "a poorly-executed outline," "naturalistic designs are poorly done," "falls short of the quality of Style 4 imagery" [Turner 1963:61). Similarly, when he comes to "possible motivations for petroglyphs" he writes, "some individual petroglyphs, and two panels composed of several different designs both representational and non-representational, have 'struck' me the way some abstract paintings have done. Though meaningless, they are to my mind as they should be" (p. 29, emphasis added). He also says, "Interpretation of realistic forms probably will give as close a guess about
actual meaning as is possible" (p. 22, emphasis add He thus shows that the ideas are in fact coming fi himself, not from the data, and he effectively exclu statistical inference from the formulation of expl tions of meaning.

These examples illustrate some of the problems v traditional empiricist rock-art research: it is commii to a false notion of "science" and consequently seld gets beyond descriptive inventories and, in the very ture of its method, cannot produce persuasive results more on empiricism in rock-art research, see Le, Williams and Loubser 1986). Because we do not ad the traditional empiricist approach, the form of our gument is a problem for a number of commentati Consens, for instance, characterises it as "a pseu epistemological approach" comprising "a mixture of ioms, assertions, and beliefs." To show that this travagant charge betrays a tenuous hold on logic general and, in particular, on the progression of our ar ment, we now address the nature of proof and the str ture of our argument.

On the matter of proof, Davis writes of "downri, unproved assertion," and Balm claims that our argum "in no way proves that Palaeolithic meanings fell wit] that range." As philosophers of science have amply de onstrated, this is a grave misunderstanding (see, e Chalmers 1978). Proof is a concept appropriate only mathematics and unimpeachable deductive argumer A call for proof is therefore inappropriate in rock-art search, and researchers must use forms of argument propriate to the human sciences.

A number of commentators raise the converse pri lem of disconfirmation. Davis, for instance, says ti without an element of disconfirmation our explanati is "impossible to evaluate." What element in an could be shown to preclude an

explanation derived fr(altered states of consciousness (ASC)? Such an argumt would run:
If x, then not ASC,
where x is a feature of the content, or perhaps context, an art. Although we note that our model does not elu date all Upper Palaeolithic signs, the difficulty here is, course, defining x. At present part of our argument rux
If yi, y2, Y3 .. . , then ASC.
But, because we do not yet know the complete range y's, it is hard to be sure that a supposed x will not, upi further research, turn out to be a y or, at any rate, a no restricting factor. This has in fact been our experien with southern African rock art. At one time some wr ers thought that the so-called narrative scenes app, ently depicting fights, hunts, and so forth, could not derived from trance experience. Since then it has bei shown that such events are also part of trance expe: ence, and, as other painted features often confirm, the is every reason to believe that the supposed x in this ca is not anx at all (Lewis-Williams 1984c; Campbell 198 1987). In any event, the observation statements that co stitute supposed x's are themselves theory-laden. Th(

have to be made in the language of some theory and are therefore as fallible as the theories they presuppose; they are not "given" and not as secure as they are popularly believed to be (Chalmers 1976:25-3o; Hempel 1966:12). Because observation statements are fallible, they cannot conclusively falsify a hypothesis. As long as there is uncertainty about establishing unequivocal x's we shall not be able to formulate disconfirmations. This, however, is not the end of research; incontrovertible disconfirmations are difficult to formulate in many archaeological areas, but that does not inhibit research. Indeed, rock-art research is in good company; many scientific disciplines operate outside the rigidly demarcated areas of proof and disconfirmation. As in similarly placed disciplines, we shall have to work with "best-fit" hypotheses. Philosophers of science have proposed criteria whereby hypotheses may be judged (e.g., Copi 1968, Hempel 1966), and these have been used in rock-art research (Lewis-Williams 1983a, Lewis-Williams and Loubser 1986). They include quantity of data explained, diversity of data explained, testability, heuristic and predictive potential, and compatibility with wellestablished research.
The evaluation of hypotheses in the absence of "proof" is a major feature of our argument. To show where it fits in we now adumbrate the principal stages of our argument, at the same time addressing other comments relevant to these stages. Our argument begins with the construction of a neuropsychological (rather than "neurophysiological") model of mental imagery in altered states of consciousness. This model is derived entirely from neuropsychological research, not from rock art; its validity can be questioned only by neuropsychological research. We do not see in what way it is "tendentious" (Davis), and we certainly do not, as Bednarik claims, use "0.03% of the world's surviving rock art" as a "basis for identifying universal trends." A misunderstanding of this magnitude explains why, for Bednarik, our argument "becomes progressively less convincing as [our] model is

developed." The kind of universality we propose derives not from Upper Palaeolithic art but from neuropsychological research alone (cf. Winkelman's [1986] important work on the neuropsychological basis of shamanism). There is thus no tautology as Bahn charges. The structure of the human nervous system establishes a potential for entoptic phenomena that is universal. Examination of Upper Palaeolithic art reveals similar forms, and this, together with other points, suggests strongly that these forms are entoptic in origin. We certainly do not, as Bahn claims, start our argument by assuming that Palaeolithic signs are entoptic images.

The usefulness of our model, especially the notion of stages in the development of mental imagery, is questioned by Winkelman. However, the fact that the Tukano recognise comparable stages in their own experience shows that the model is not entirely "a product of Western evolutionary/developmental tendencies and the effort to order entoptic, iconic, and hallucinatory forms hierarchically." Moreover, the model elucidates
the hitherto inexplicable relationship between iconic and geometric rock-art images. This alone establishes its explanatory power.

Having constructed the model, we assess its utility by applying it to two known shamanistic rock arts. At this point Layton expresses the view that our two shamanistic rock arts (we resolved to stay with rock art and to ignore other shamanistic art forms) are "poorly documented," and Vastokas, Faulstich, and Consens, in contrast to Bahn, question whether there is sufficient evidence to accept Coso rock art as shamanistic. In the first place, we believe that San rock art is adequately documented; our footnote 3 provides references to a wealth of evidence and also answers Consens's misapprehension that we "disregard previous criticism." Secondly, we turned to Coso rock art because it was from a different continent and because there is evidence that it too is shamanistic. To allay misgivings on this point we have asked Whitley to outline some important new evidence (see below).

When we apply our model to these two arts, we avoid the obvious pitfall of identifying any squiggle as an entoptic image; we do not "come close to admitting" (Davis) that any mark can be interpreted as entoptic. Application of our complete model to drawings made by chimpanzees (Morris 1962:figs. 6-9, 48, 49, reproduced by Davis 1986a:fig. 7) shows quite clearly that the model does exclude some "arts." We point not just to the six entoptic forms we selected but also to combinations and transformations of these forms by definable principles (also derived from neuropsychology, not from the art itself) and to the juxtapositioning, superpositioning, and combination of entoptic and iconic images (as the neuropsychological model predicts). Because our model in this way makes sense of images in San and Coso art, our confidence in its utility increases (note that we do not claim to have "proved" the model in any sense), and we are encouraged to apply it to Upper Palaeolithic art.

It is at this point, Wylie contends, that we proceed analogically. Bednarik castigates us because we "fail to jettison ethnographic analogy... at the right moment" (whenever that might be), and Halverson writes of "a shameless appeal to analogy" (cf. Vastokas on our use of Tukano material). Because these and

similar comments reflect a general and serious misunderstanding in rockart research, they deserve close consideration. Near the beginning of our paper we express the belief that our argument reduces the inferential element that looms so large in arguments from internal analyses and, at the same time, avoids simplistic ethnographic analogy (see also Lewis-Williams and Loubser 1986:262-64). We do not claim to be eliminating inference or analogy. We are, therefore, especially grateful to Wylie, a philosopher of science, for her thoughtful and detailed examination of our use of analogy. Unlike other commentators, she does not reject analogy out of hand. Instead she elaborates "the suggestion that reliance on analogical inference should not automatically give way to 'ethnographic despair' when no single, complete analog for the subject is

available." We take her acceptance of our argument a!
vindication in the face of the criticism to which we nox
turn.
Layton asks if our use of analogy is any less simplistic
than Breuil's. To answer this question we must first con.
sider the kind of simplistic analogy one of us has criticised elsewhere (Lewis-Williams and Loubser 1986).
In such an analogy, Pager (1975 b:8o) cites an Australian Aboriginal ritual using a rope fringed with white feathers to explain the sinuous red line fringed with white dots that sometimes links depictions in San rock art. He concludes, "Without asking for possible reasons for such a striking parallel one might just accept that the same explanation fits the extraordinary rock art scenes." This is the kind of (false) analogy employed by Breuil and others. In contrast to it, Wylie (1985; see also Salmon 1982:62-63) describes a form of analogy that depends on relations of relevance. The concept of relevance implies a causal or determining effect between properties in the source of an analogy. In other words, the source exhibits two properties, A and B, and it can be shown that causal, functional, or some other close connection exists between them. It follows that, if the subject of the analogy also exhibits A, it is reasonable to accept that the same relational mechanism exists in the subject and that, consequently, B is also present. In archaeological research it is difficult in practice to establish strong relations of relevance that are not trivial. Archaeological analogy extends an argument from the ethnographic present into a new domain, the distant past, in which we cannot always be sure that the same mechanisms existed. In other words, Upper Palaeolithic social formations may have been so different from any of those observed ethnographically or historically that we cannot consider them to exhibit the same principles of relevance. We believe that our argument at least partially overcomes this objection and comes close to establishing strong relations of relevance. In the first place, a review of these comments shows that our proposition that the nervous system of Upper Palaeolithic people responded in certain altered states in ways closely similar to modem people's seems not to be generally or seriously disputed. There is, moreover, a relation of relevance between activation of the nervous system in altered states and entoptic

phenomena. The presence in Upper Palaeolithic art of geometric forms very similar to entoptic phenomena, combinations of entoptic and iconic forms, and a range of predictable transformations imply, through this relation of relevance, altered states of consciousness comparable with the shamanistic San and Coso ones that produced geometric rock art. This brief analysis shows that our argument is demonstrably "less simplistic than Breuil's" and supplies what Layton calls the "missing step" that enables us to assess the strength of our analogy against others'.

From here on our argument develops as a "best-fit" hypothesis. Although we headed the final section "Implications," it is more than that. We actually provide additional argument for our explanation by showing that it makes sense of other puzzling features of rock art,

; such as the widespread association of geometric . r iconic depictions and the origins of art. In achiev:

these further explanations of data, we believe our mo

is more empirically adequate.

It is in the light of "best-fit" considerations that

alternative explanations some commentators advar must be assessed. The one we find most thoug provoking and best-argued (though ultimately ina(quate) is Martindale's. We do, of course, allow that may derive from "mildly altered states such as h3 nagogic states, reverie, and fantasy," but we part co pany with him when he goes on to argue that "'sigi can arise from normal perception if one attends to t featural level rather than to the level of unitary p(cepts" and that this would account for Upper Palac lithic art if the artists' goal was the same as that of ch dren, who attend to only "basic features" of the "opt array." Acceptance of Martindale's hypothesis wou entail, in part, showing how and why they derived the particular "building blocks" from their veridical perce tions. Further, we believe that the long association entoptic forms with often remarkably "realistic" icon depictions, various kinds of combinations of entopt and iconic forms, and combinations of iconic imag, (therianthropes), together with evidence for compl Upper Palaeolithic social forms, are better explained I the more extreme varieties of altered consciousness a sociated with shamanism than by infantile perceptioi Interesting as Martindale's hypothesis is, we conside less successful as a "best-fit" hypothesis; it does not, % submit, cover as many data as ours. Mirimanov's sugge tion that "the recurrence of simple forms may be kineti in origin, that is, brought about by monotonous movt ment" and the suggestion of a number of commentatoi that entoptic forms may have been the work of childri must both be rejected for the same reasons. In contrast to these alternative hypotheses, Davis bt lieves that his explanation for the origin of art "mus underwrite" ours. Simply put, Davis's argument begin with the proposition that natural and human-mad marks are sometimes perceptually ambiguous or, mor broadly, have the capacity to be optical illusions. linear shadow or black mark, for instance, may be ms taken for a deep groove, and the duality of the perceptiol it affords would have been empirically ascertainable t(early people. From this fundamental proposition Davii argues that it was inevitable that humankind wouh eventually tumble to iconicity and the representation o three dimensions on plane surfaces: "The more yOi mark,

the more likely you will be to produce at som(point a mark which potentially will be seen, by you or someone else, as a thing" (Davis 1986a:2oo). This poteDtial becomes, with the increasing sum of marks, sc strong that representational marking is predictable (p. .201).
Whilst it is, as we have shown, difficult to disconfirm such a hypothesis, its inadequacies are demonstrable. In the first place, we are uneasy about inevitablist arguments. Davis's hypothesis recalls monkeys, typewriters, and Shakespeare sonnets. It seems from the Mousterian

evidence that early people were making (entoptic) marks before the Upper Palaeolithic (for a recent review of Middle palaeolithic symbolism, see Chase and Dibble 1987). it also seems inescapable that social forms must have developed at the beginning of the Upper Palaeolithic that provided a niche for the practice, for, without an appropriate social framework, representation would not have "taken off" as it did at that time. Thus, while it aay be true that some marks are intrinsically perceptually ambiguous, there was nothing inevitable about the "discovery" of representation. At this point Davis's hypothesis could be saved by dropping the inevitablist component and substituting a social explanation to explain the increased value of exploiting perceptual ambiguity at the beginning of the Upper Palaeolithic were it not for the fundamental problem that his explanation is very close to the old idea that early people perceived iconicity in random marks and patches on a wall (Gombrich I96I). Even if some of those marks were ambiguous, it does not explain why or how that ambiguity came to be seen, by a major extension, to represent, say, an animal. The illusion of depth that a dark black line may give would not, we believe, have "predictably resulted in the emergence of the specifically representational mark through seeing marks as things" (Davis 1986a:2oi). Davis's hypothesis has an even more serious limitation. Although he refers to Aurignacian markings, they do not play a major part in his argument. He likens them to "modem telephone-pad doodling" that does not "initially or necessarily possess but may quickly acquire meanings" (Davis 1986a:I97). The fact that these early people made marks is more important to him than their form. But, as we have shown, these marks are less random than Davis allows; they can readily be seen as part of a long entoptic tradition. As his argument proceeds, Davis concentrates on representations of three-dimensional items in two dimensions and ignores the signs that accompany (in some sites exceed) iconic depictions throughout the Upper Palaeolithic. The intimate and long-lived relationship between these two apparently different kinds of depiction cannot be ignored. By dropping consideration of signs once representation is established Davis turns his back on a crucial feature of Upper Palaeolithic art and, in effect, relegates the signs to their old position as precursors of iconicity, even though they persisted throughout the Upper Palaeolithic. Clearly, in terms of the criteria for hypothesis evaluation, an explanation that covers signs and representations will be preferable to one that explains just one or the other. We argue that our hypothesis does this (i) by at one level combining the two classes of depiction (both derive from mental imagery), (2) by explaining the forms the

signs take, and (3) by explaining why and how sikns and representations are associated throughout the Upper Palaeolithic. Our hypothesis is thus more comprehensive than Davis's; acceptance of ours makes his redundant. More specifically, Davis sees his explanation as underwriting ours in offering a better explanation for the origin of image making than our notion of fixing projected mental images (see also Halverson and Vastokas).

Davis's use of "projection" here seems to differ from his use of it elsewhere (Davis 1986a:i99). As Halverson recognises, "projection" can refer either to the projection of meaning onto natural marks like cracks or stains on a wall (Gombrich 1961) or to the visual projection of the image itself. We propose visual projection, not semantic projection onto preexisting marks, natural or human-made. We cannot be sure at present if projected iconic and entoptic mental images traced on a wall or floor were, for Upper Palaeolithic people, those images or whether they were intended to remind people of them, that is, accepted as references to mental imagery. We suspect that, initially, they were mental images and that reference developed along with socially produced images.

Either way, "the implication is that they knew they were depicting mental images" (Halverson). Present uncertainty on this point does not, however, seem to be as serious as Davis believes; it is a secondary question. Similarly, the action of fixing projected images was probably also less complex than Davis allows. He recommends trying to trace one's face in a cloudy mirror. The three-dimensionality of the mirror, of course, makes this a tricky task. But tracing a projected colour slide is comparatively easy, and it is to this that laboratory subjects liken projected mental imagery (Siegel and Jarvik 1975:109; Siegel 1977:134). We do not suggest that the act of tracing was "automatic." On the contrary, we believe that projected entoptic and iconic mental imagery, like that of the Tukano (Reichel-Dolmatoff 1978a:8), was a "natural" part of early people's experience. Then, with the development of certain kinds of social relations (still to be elucidated), these images became more significant, as they have for the Tukano, and there was a growing desire to touch and fix them. As the fragmentary evidence shows, some fixing did take place before the Upper Palaeolithic. Although, as other commentators point out, this process requires more explication, it seems to us to explain early marking better than Davis's account because it explains the forms of early images and shows the origin of signs and representations to have been in a single experience. We therefore do not believe that his explanation necessarily underwrites ours.

This kind of evaluation is the final part of an argument that proceeds by clear stages: construction of a model, assessment of its utility, application of the model to Upper Palaeolithic art, and, finally, evaluation of alternative hypotheses. We do not claim to prove anything; we merely offer a hypothesis that we believe explains more, and more varied, data than competing hypotheses, is compatible with well-established research, and has predictive and heuristic potential. It awaits modification, refinement, or rejection when it fails to fulfil these criteria. As numerous commentators including Clegg and Faulstich note, our model's explanatory potential must be assessed against other rock arts, and the points that it raises but does not fully resolve must be followed up. Winkelman and Davis,

for instance, rightly recommend an assessment of the sociocultural factors affecting the

selection of or emphasis on specific entoptic phenomena, while Vastokas urges research among living Western and non-Western artists. An important point here is that a hypothesis does not have to explain all data instantly before it can be adopted; in the absence of the misleading notion of proof, it has only to explain more data better than competing hypotheses. It then provides a platform for addressing outstanding issues. We argue that our explanation for the signs and other features of Upper Palaeolithic art is, at the present stage of research, the "best fit," and this seems to be accepted by many commentators. We extend our thanks to them, for their often very generously phrased remarks, and no less to our critics, who have pointed to numerous promising avenues for further research.

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A number of commentators have questioned LewisWilliams and Dowson's use of the Coso rock engravings as an example of shamanic art, arguing that this has not been established. Because this contention is based on my as yet unpublished work (Whitley n.d.c), the authors have asked me to respond directly to this concern. I oblige by briefly summarizing here conclusions I have reached concerning the rock art of the Coso region and environs.

Although not widely recognized as such, there are numerous ethnographic references to rock-art production in the western Great Basin. These provide a clear and coherent indication of the creators of the art. Historically, however, rock-art researchers (and some ethnographers) have overlooked these references or have undertaken only a superficial examination of the linguistic glosses attached to them. For example, Voegelin (1938:61) dismissed the purported creators of Tubatulabal rock art, the yahi iwal, "water babies," as "brownies." Yet she subsequently noted yahi iwal as sometimes seen in jimsonweed (Datura spp.) trances and reported that they were a shaman's dream helpers and had a predilection for tobacco. Similarly, Zigmond (1977:7i) recorded the Puwan 2azi, "rock babies," as responsible for Kawaiisu rock art and noted that a hearing or sighting of one of these supernatural beings was an "omen of death" (a metaphor for trance in the region [cf. Zigmond 198o:33, n. i]). Rock or water babies, in other words, were not considered inconsequential dwarfish "brownies" or "hobgoblins" in western Great Basin culture. Rather, they were supernatural beings imbued with power and closely tied to shamanism. Indeed, throughout the western Great Basin the "water baby" served as one of the most important and potent of the shaman's spirit or dream helpers (cf. Park 1938:15, 76-79; Downs 1961:366-67; Siskin 1983:23; Miller 1983:75). Thus, among the Uto-Aztecan-speaking Tubatulabal (Voegelin 1938:61), Kawaiisu (Driver 1937:86; Zigmond 1977:68,

71; Sutton 1982:151), Chemehuevi (Laird 1976:103, 1i 1984:302), and Coso Shoshone (Driver 1937:86, 126; win 198o:32), ethnographic informants consistently a unanimously referred to rock art as made by shama spirit helpers. Shamanism in the western Great Basin was close tied to the ingestion of psychotomimetic plants, esp cially native tobacco; supernatural power for the pr cipal shamanic function, curing, was derived fro "dreaming" related to the ingestion of the psychoto metics; and this power was manifest or embodied in t spirit or dream helper (cf. Steward 1933, Driver I93 Park 1938, Voegelin 1938, Kelly 1939, Laird 1976, Z mond 1977, Siskin 1983). Why did ethnographic info mants consistently refer to the creators of the rock art spirit/dream helpers? Two reasons can be suggeste First, the actions of this helper were inseparable fro those of the shaman (and vice versa); dream, sham and helper were semantically, metonymically, and epi temologically equivalent (cf. Applegate 1978:27, 91; Si kin 1983:22). Second, as is suggested by Laird (1984.302 mentioning the names of the dead was generally pr scribed, and it may well have been convenient (and cu turally preferable) for informants to refer to the artists terms of their spirit helpers rather than to specify th dead shamans themselves. The ethnographic reference thus, are not opaque in their attributions of the art; the must simply be interpreted within their cultural con texts, and they are unqualified and uncontradicting i linking the art to shamans. A deeper examination of western Great Basin lingui tics provides a second confirmation of the link betwee the rock art and shamanism. This is found in John Wes ley Powell's Numic (Uto-Aztecan) texts and word lisit recorded between 1868 and 188o. Powell listed the won for "shaman" (derived throughout the region from th cognate for supernatural power, poa; cf. Miller 1972:13 in his orthography as poagunt. Significantly, he trans lated this as both "medicine man" and "a man wh writes" (Fowler and Fowler 1971:144-45), that is, a mai who writes on rocks (cf. Kerr's Coso Shoshone infor mant, Charlie Wrinkle, who consistently referred t rock engravings as "rock writings" [Irwin I98O:32]), emphasizing the importance in rock-art research, once again, of going beyond the superficial linguistic glossed of the existing ethnographies. Given the increasing evidence for historic rock engrav. ings in the Coso Range and western Great Basin (Whitley and Dom 1987), we have a firm link between the ethnographies and the makers of the art. Because this ethnography provides a clear indication of the shamanic origins of the art and the relationship of shamanism to dreaming and the ingestion of hallucinogens, LewisWilliams and Dowson's argument for entoptic phenom ena within the Coso corpus rests on firm ground. Further, the situation in this region illustrates that there i5 much to be gained from a reexamination of ethnography vis-A-vis rock art (cf. Whitley 1982), even in a region (like eastern California) argued by many to be devoid of relevant or useful ethnographic references.

References Cited

ANASTASI, ANNE, AND JOHN P. FOLEY, JR. 1940. The study of "populistic painters" as an approach to the psychology of art. Journal of Social Psychology 11:353-68. [jci]

ANATI, E. 1981. The origins of art. Museum 33:200210.
_--. 1986. Comment on: The origins of image making, by W. Davis. CURRENT ANTHROPOLOGY 27:202. [RGB]
ANDERSON, R. H. 1975. Fetal phosphenes and newborn pattern preferences. Developmental Psychobiology 8:571-72. [WD]
APPLEGATE, R. B. 1975. The Datura cult among the Chumash. Journal of California and Great Basin Anthropology 2:7-17.
- . 1978. ;Atishwin: The dream helper in southcentral California. Ballena Press Anthropological Papers 13. [DSW]
ARNHEIM, R. 1974. Art and visual perception: A psychology of the creative eye. Berkeley and Los Angeles: University of California Press. [CM, JMV]
ARUTUNOV, S. A., AND B. A. SERGEEV. 1975. Problems of the ethnic history of the Bering Sea coast peoples (in Russian). Moscow: Nauka. [VBM] ASAAD, G., AND B. SHAPIRO. 1986. Hallucinations: Theoretical and clinical overview. American Journal of Psychiatry 143:IO88-97. BAHN, P. G. 1978. Water mythology and the distribution of Palaeolithic parietal art. Proceedings of the Prehistoric Society 44:125 -34.
_. 1986a. Comment on: Parietal finger markings in Europe and Australia, by R. G. Bednarik. Rock Art Research 3:54-55.
_. 1986b. No sex, please, we're Aurignacians. Rock Art Research 3:99-120.
BANDI, H.-G., W. HUBER, M.-R. SAUTER, AND B. SITTER. Editors. 1979. La contribution de la zoologie et de l'dthologie i l'interprdtation de l'art peuples chasseurs prdhistoriques. Fribourg. [HGB] BARDILL, PATRICIA N. 1982. Comment on: The economic and social context of southern San rock art, by J. D. Lewis-Williams. CURRENT ANTHROPOLOGY 23:438-39. [MC]
BEDNARIK, R. G. 1979. The potential of rock patination analysis in Australian archaeology. Pt. I. The Artefact 4:14-38.
_. 1984a. Die Bedeutung der Palaolithischen Fingerlinientradition. Anthropologie 22:73-79.
- . I984b. On the nature of psychograms. The Artefact 8:27-32.
-. 1986a. Parietal finger markings in Europe and Australia. Rock Art Research 3:3o-6 i.
------. I986b. Reply to comments on: Parietal finger markings in Europe and Australia. Rock Art Research 3:162-70. [RGB]
- . 1986c. Cave use by Australian Pleistocene man.
Proceedings of the University of Bristol Spelaeological Society 17:227-45. [RGB]
* n.d. "Finger lines, their medium and their dating," in The Australian meander tradition. Edited by K. J. Sharpe. Forthcoming. [WD] BIESELE, M. 1980. "Old K"xau," in Shamanic voices. Edited by J. Halifax, pp. 54-62. Harmondsworth: Penguin.
BLACKBURN, T. 1977. Biopsychological aspects of Chumash rock art. Journal of California and Great Basin Anthropology 4:88-94. BOOTZIN, R. R. 1980. Abnormal psychology. Toronto: Random House.
BORDES, F. 1969. Os perc6 moust~rien et os grav6 acheul6en du Pech de l'Az6 II. Quaternaria 2:1-6. BREUIL, A. 1952. Four hundred centuries of cave art. Montignac: Centre d'Etude et de Documentation Pr6historiques.

BRINDLEY, G. S. 1973. "Sensory effects of electrical stimulation of the visual and paravisual cortex in man," in Handbook of sensory physiology, vol. 7, pt. 3B. Edited by R. Jung, pp. 583-94. New York: Springer-Verlag.
CAMPBELL, C. 1986. Images of war: A problem in San rock art research. World Archaeology 18:2 55 -68.
* 1987. Contact period rock art of the south-eastern mountains. M.Sc. thesis, University of the Witwatersrand, Johannesburg, South Africa. CHALMERS, A. F. 1978. What is this thing called science? Milton Keynes: Open University Press.
CHASE, P. G., AND H. L. DIBBLE. 1987. Middle Palaeolithic symbolism: A review of current evidence and interpretations. Journal of Anthropological Archaeology 6:263-96.
CHRISTIE-MURRAY, D. 1978. Voices from the gods. London: Routledge and Kegan Paul. CLEGG, JOHN. 1979. "A possibly universal tendency in art composition." Prehistoric art and religion (Valcamonica Symposium 1979), PP. 467-81. [ic]
-. 1982. Comment on: The economic and social context of southern San rock art, by J. D. Lewis-Williams. CURRENT ANTHROPOLOGY 23:439-40. [MC]
--. 1984. Enqutes pr6liminaires Sturt's Meadows: Un gisement australien de p6troglyphes du style panaramit6e. L'Anthropologie 88:595-611. [iC] . 1987a. Human picturing behaviour and the study of prehistoric pictures. Rock Art Research 4:29-35. [jc]
_. 1987 b. Style and tradition at Sturt's Meadows.
World Archaeology I9(2). In press. [Jc]
CLOTTES, J. 1986. Comment on: Theoretical concepts that lead to new analytic methods, modes of enquiry, and classes of data, by A. Marshack. Rock Art Research 3:175-76. [RGB]
CONKEY, M. W. 1980. The identification of prehistoric hunter-gatherer aggregation sites: The case of Altamira. CURRENT ANTHROPOLOGY 21:609-30.
* 1983. "On the origin of Paleolithic art: A review and some critical thoughts," in The Mousterian legacy: Human biocultural change in the Upper
Pleistocene. Edited by E. Trinkaus, pp. 201-27. British Archaeological Reports International Series 164.

* 1984. "To find ourselves: Art and social geography of prehistoric hunter-gatherers," in Past and
present in hunter-gatherer studies. Edited by C.
Schrire, pp. 253-76. New York: Academic Press.
. n.d. New approaches in the search for meaning?
A review of research in "Palaeolithic art." MS.
CONSENS, MARIO. 1986. El arte rupestre de San Luis. San Luis: Direcci6n de Cultura. [MC]
COOKE, C. K. 1983. More on San rock art. CURRENT ANTHROPOLOGY 24:5 38.
coPi, I. M. 1968. Introduction to logic. New York:

Macmillan.
DAVIS, W. 1982. Comment on: The economic and social context of southern San rock art, by J. D. LewisWilliams. CURRENT ANTHROPOLOGY 23:440-41.
. 1986a. The origins of image making. CURRENT ANTHROPOLOGY 27:193-215.
. 1986b. Reply [to B. Delluc and G. Delluc]. CURRENT ANTHROPOLOGY 27:515-16.
. 1986c. Comment on: Parietal finger markings in Europe and Australia, by R. G. Bednarik. Rock Art Research 3:51-54. [RGB, WD]
* 1987. Replication and depiction in Paleolithic art. Representations 19: 111-47. [WD]
. n.d. Seeing through culture: The possibility of the history of art. MS. [wD]
DAVSON, HUGH. 1963. The physiology of the eye. Boston: Little, Brown. [MC]
DELLUC, B., AND G. DELLUC. 1978. Les manifestations graphiques aurignaciennes sur support rocheux des environs des Eyzies (Dordognes). Gallia Pr6histoire 21:213-438.
. 1985. De l'empreinte au signe. Dossiers Histoire et Arch~ologie 90:56-62.
* 1986. Comment on: The origins of image making, by W. Davis. CURRENT ANTHROPOLOGY 27:371. DESBAN, M. C. 1976. Symboles pr6historiques et 616ments de Part contemporain: Contribution A l'6tude de quelques identit6s avec les "phosphhnes." Reprint in the library of A. Leroi-Gourhan, Prigueux, Dordogne, France. [BD, GD]
DOBKIN DE RIOS, M. 1986. Enigma of drug-induced altered states of consciousness among the !Kung Bushmen of the Kalahari Desert. Journal of Ethnopharmacology 15:297-304.
DOWNS, J. F. 1961. Washo religion. Anthropological Records 16:363-85. [DSW]
DRIVER, H. E. 1937. Cultural element distributions. 6. Southern Sierra Nevada. Anthropological Records 1:35-154.
EHRENZWEIG, A. 1953. The psycho-analysis of artistic vision and hearing. New York: Braziller. [CM]
EICHMEIER, J., AND 0. H6FER. 1974. Endogene Bildmuster. Munich: Urban and Schwarzenberg. ELGIN, C. Z. 1983. With reference to reference. Indianapolis: Hackett. [wD] ELIADE, M. 1972. Shamanism: Archaic techniques of ecstasy. New York: Routledge and Kegan Paul. EMBODEN, W. 1979. Narcotic plants. New York: Macmillan.
FARIS, j. C. 1983. "From form to content in the str tural study of aesthetic systems," in Structure an cognition in art. Edited by D. K. Washburn, pp. 9, I 12. Cambridge: Cambridge University Press.
FAULSTICH, P. 1986. Comment on: Parietal finger markings in Europe and Australia, by R. G. Bedn,

Rock Art Research 3:161-62. [RGB]
. n.d. Massaging the earth: A psychoarchaeol
ical interpretation of Pleistocene parietal art. Pap, be presented in Symposium K of the First Austral Rock Art Research Association Congress, Darwin August/September 1988. [RGB]
FISCHER, R. 1975. "Cartography of inner space," in
Hallucinations: Behaviour, experience, and theoi
Edited by R. K. Siegel and L. J. West, pp. 197-239
New York: Wiley.
FOCK, G. J. 1979. Felsbilder in Sildafrika. Vol. I. D
gravierungen auf Klipfontein, Kapprovinz. K61n:
Bohlau Verlag.
FOCK, G. J., AND D. FOCK. 1984. Felsbilderin Sfld
rika. Vol. 2. Die gravierungen auf Kinderdam unc
Kalahari. K61n: Bohlau Verlag.
FOWLER, D. D., AND C. S. FOWLER. Editors. 1971.
Anthropology of the Numa: John Wesley Powell'i manuscripts on the Numic peoples of western Nc America, 1868-i88o. Smithsonian Contributions Anthropology 14. [DSW]
FURST, P. T. 1976. Hallucinogens and culture. Nov
Calif.: Chandler and Sharp.
GAMBLE, C. I980. Information exchange in the Pal.
lithic. Nature 283:522-23.
* 1982. Interaction and alliance in Palaeolithi,
ciety. Man 17:92-107.
* 1983. "Culture and society in the Upper
Palaeolithic of Europe," in Hunter-gatherer econo and prehistory: A European perspective. Edited b) Bailey, pp. 20 i-11. Cambridge: Cambridge Unive
sity Press.
GARVIN, G. 1978. "Shamans and rock art symbols,
Four rock art studies. Edited by C. W. Clewlow, J pp. 65-87. Ramona, Calif.: Ballena Press. GIBSON, J. J. 1979. The ecological approach to visu perception. Boston: Houghton Mifflin. [CM) GILMAN, A. 1984. "Explaining the Upper Palaeolit revolution," in Marxist perspectives in archaeolo Edited by M. Spriggs, pp. 115-26. Cambridge: Car bridge University Press.
GOMBRICH, E. H. 1961. Art and illusion. Princeton Bollingen Series.
GOODMAN, N. 1972. Languages of art: An approaco the theory of symbols. Indianapolis: Bobbs-Merril. [WD]
GRANT, C. 1965. The rock paintings of the Chumas A study of a California Indian culture. Berkeley: University of California Press.
1 1968. Rock drawings of the Coso Range. Cl Lake, Calif.: Maturango Press.
GRAZIOSI, P. I960. Palaeolithic art. London: Faber Faber.
GROENFELDT, DAVID. 1982. Comment on: The e

nomic and social context of southern San rock art, by J. D. Lewis-Williams. CURRENT ANTHROPOLOGY 23:441. [MCI
HALIFAX, j. 1980. Shamanic voices. Harmondsworth: Penguin Books.
,-. 1982. Shaman: The wounded healer. New York: Crossroad.
HALVERSON, j. 1987. Art for art's sake in the palaeolithic. CURRENT ANTHROPOLOGY 28:63-89. HAMILTON-SMITH, E. 1986. Comment on: Parietal finger markings in Europe and Australia, by R. G. Bednarik. Rock Art Research 3:15 9-60. [RGB] HAMMOND-TOOKE, W. D. 1983. Reply to A. R. Willcox. South African Archaeological Bulletin 38:5-6. HARNER, M. J. 1973. Hallucinogens and shamanism. New York: Oxford University Press. HARRE, ROM. 1970. The principles of scientific thinking. Chicago: University of Chicago Press. [Awl HARRIS, D. B. 1963. Children's drawings as measures of intellectual maturity. New York: Harcourt, Brace and World. [CM]
HAWKES, C. 1954. Archaeological theory and method: Some suggestions from the Old World. American Anthropologist 56:155-68. [CI] HEDGES, K. 1973. Rock art in southern California. Pacific Coast Archaeological Society Quarterly 9: 1-28.
-. 1976. "Southern California rock art as shamanistic art," in American Indian rock art, vol. 2. Edited by K. Sutherland, pp. 126-38. El Paso: El Paso Archaeological Society.
- 1982. "Phosphenes in the context of Native American rock art," in American Indian rock art, vols. 7 and 8. Edited by F. G. Bock, pp. i-io. El Toro: American Rock Art Research Association.
--. 1983. "The shamanic origins of rock art," in
Ancient images on stone: Rock art in the Californias.
Edited by J. A. Van Tilburg, pp. 46-59. Los Angeles:
Rock Art Archive, UCLA.
HEINZE, R-I. 1986. More on mental imagery and
shamanism. CURRENT ANTHROPOLOGY 27: 154.
HEIZER, R. F., AND M. A. BAUMHOFF. 1959. Great Basin petroglyphs and game trails. Science 129:1904-5.
* 1962. Prehistoric rock art of Nevada and eastern California. Berkeley: University of California
Press.
HEMPEL, C. G. 1966. Philosophy of natural science. Englewood Cliffs: Prentice-Hall.
HOROWITZ, M. 1. 1964. The imagery of visual hallucinations. Journal of Nervous and Mental Disease
138:513-23.
_- 1975. "Hallucinations: An information-processing approach," in
Hallucinations: Behaviour, experience, and theory. Edited by R. K. Siegel and L. J.
West, pp. 163-95. New York: Wiley.
HUBEL, D. H., AND T. N. WIESEL. 1965. Receptive
fields and functional architecture of two nonstriate
visual areas (18 and I9) of the cats. Journal of

Neurophysiology 28:229-89. [CM]
HUDSON, T., AND G. LEE. 1984. Function and symbolism in Chumash rock art. Journal of New World Archaeology 6:26-47.
HUFFMAN, T. N. 1983. The trance hypothesis and the rock art of Zimbabwe. South African Archaeological Society, Goodwin Series 4:49-53. HULTKRANTZ, A. 1981. Accommodation and persistence: Ecological analysis of the religion of the Sheepeater Indians in Wyoming, U.S.A. Temenos 17:35-44.
HUNCHAK, J. F. 1980. Hypnotic induction by entoptic phenomena. American Journal of Clinical Hypnosis 22:223-24.
INSKEEP, R. R. 1982. Comment on: The economic and social context of southern San rock art, by J. D. Lewis-Williams. CURRENT ANTHROPOLOGY 23:441-42. IRWIN, C. N. Editor. 198o. The Shoshoni Indians of Inyo County, California: The Kerr manuscript. Ballena Press Publications in Archaeology, Ethnology, and History 15. [DSW]
JOCHIM, M. A. 1983. "Palaeolithic cave art in ecological perspective," in Hunter-gatherer economy and prehistory: A European perspective. Edited by G. Bailey, pp. 212-19. Cambridge: Cambridge University Press.
JOHNSON, T., AND T. M. O'C. MAGGS. 1979. Major rock paintings of southern Africa. Cape Town: David Philip.
JOLLY, P. 1986. A first-generation descendant of the Transkei San. South African Archaeological Bulletin 41:6-9.
JONES, T. 1982. Comment on: The economic and social context of southern San rock art, by J. D. Lewis-Williams. CURRENT ANTHROPOLOGY 23:442-43. KALOW, WERNER, H. WERNER GOEDDE, AND DHARAM P. AGARWAL. 1986. Ethnic differences in reaction to drugs and xenobiotics. New York: Alan R. Liss. [MC]
KATZ, R. 1982. Boiling energy: Community healing among the Kalahari Kung. Cambridge: Harvard University Press.
KELLOGG, R. 1969. Analyzing children's art. Palo Alto, Calif.: National Press Books. [CM]
KELLOGG, R. M., M. KNOLL, AND J. KUGLER. Formsimilarity between phosphenes of adults and preschool children's scribblings. Nature 208:1129-30. [WD]
KELLY, I. T. 1939. Southern Paiute shamanism. Anthropological Records 2: 151-67. [DSW]
KIRKLAND, F., AND W. W. NEWCOMB. 1967. The rock art of the Texas Indians. Austin: University of Texas Press.
KLtVER, H. 1926. Mescal visions and eidetic vision. American Journal of Psychology 37:502-15.

. 1942. "Mechanisms of hallucinations," in Studies in personality. Edited by Q. McNemar and M. A.
Merrill, pp. 175-207. New York: McGraw-Hill.
_. 1966 (1928). Mescal and the mechanisms of
hallucinations. Chicago: University of Chicago Press.
[CM]
KNOLL, M. 1958. Anregung geometrischer Figuren und

anderer subjektiver Lichtmuster in elektrischen Feldem. Zeitschrift fir Psychologie 17:110-26.
KNOLL, M., AND J. KUGLER. 1959. Subjective light pattern spectroscopy in the encephalographic frequency
range. Nature 184:1823-24.
KNOLL, M., J. KUGLER, 0. HOFER, AND S. D. LAWDER. 1963. Effects of chemical stimulation of electrically
induced phosphenes on their bandwidth, shape, number, and intensity. Confinia Neurologica 23:201-26. KONORSKI, 1. 1967. Integrative activity of the brain. Chicago: University of Chicago Press. [CM]
KOSSLYN, s. 1983. Ghosts in the mind's machine: Creating and using images in the brain. New York:
Norton. [WD]
KRIS, E. 1952. Psychoanalytic explorations in art. New York: International Universities Press. [CM]
KROEBER, A. L. 1925. Handbook of the Indians of California. Bureau of American Ethnology Bulletin
78.
KUBLER, G. 1985. Eidetic imagery and Palaeolithic art. Journal of Psychology 119:557-65.
LA BARRE, W. 1970. The Ghost Dance: Origins of religion. Garden City: Doubleday.
_. 1972. "Hallucinogens and the shamanistic origins of religion," in Flesh of the gods: The ritual use
of hallucinogens. Edited by P. T. Furst, pp. 261-78.
London: Allen and Unwin.
* 1975. "Anthropological perspectives on hallucination and hallucinogens," in Hallucinations: Behaviour, experience, and theory. Edited by R. K.
Siegel and L. J. West, pp. 9-52. New York: Wiley. LAIRD, C. 1976. The Chemehuevis. Banning: Malki Museum. [DSW]
_. 1984. Mirror and pattern: George Laird's world
of Chemehuevi mythology. Banning: Malki Museum.
[DSW]
LAMING, A. 1962. La signification de l'art rupestre
pal~olithique. Paris: Picard.
LEE, R. 1968. "The sociology of !Kung Bushman trance
performance," in Trance and possession states.

Edited by R. Prince, pp. 35-54. Montreal: R. M.
Bucke Memorial Society.
LEE, G. I977. Chumash mythology in paint and stone.
Pacific Coast Archaeological Society Quarterly
13(3):I-14.
LEROI-GOURHAN, A. 1968a. The art of prehistoric
man in western Europe. London: Thames and Hudson.
* 1968b. "Les signes parietaux du Pal~olithique
sup~rieur franco-cantabrique," in Simposia intemacional de arte rupestre, pp. 67-77. Barcelona: Instituto de Prehistoria y Arqueologia.
_. 1968c. Treasures of prehistoric art. Translated by N. Guterman. New York: Abrams. [WDJ
_. 1980. "Les signes pari~taux comme 'marqueurs' ethniques." Altamira Symposium, pp. 289-94. Madrid: Ministerio de Cultura. [PGB] * 1982. The dawn of European art: An introduction to Palaeolithic cave painting. Cambridge: Cambridge University Press.
-. 1983. "Les entit6s imaginaires: Esquisse d'u recherche sur les monstres paridtaux palolithiqu in Homenaje al Prof. M. Almagro Basch, vol. i, p 251-63. Madrid: Ministerio de Cultura. [PGB]
LEROI-GOURHAN, A., AND J. ALLAIN. 1979. Las, inconnu. Paris: Centre National de la Recherche
Scientifique.
LEWIS-WILLIAMS, J. D. 1972. The syntax and func of the Giant's Castle rock paintings. South Africa
Archaeological Bulletin 27:49-65.
* 1974. Superpositioning in a sample of rock
paintings in the Barkly East district. South Africa,
Archaeological Bulletin 29:93-103.
* 198o. Ethnography and iconography: Aspect
southern San thought and art. Man 15:467-82.
. 1981a. Believing and seeing: Symbolic meaj
ings in southern San rock paintings. London: Aca.
demic Press.
. 1981b. The thin red line: Southern San noti(
and rock paintings of supernatural potency. South
rican Archaeological Society 36:5-13.
*. 1982. The economic and social context of
southern San rock art. CURRENT ANTHROPOLOGY
23:429-49.
* 1983 a. Introductory essay: Science and rock
South African Archaeological Society, Goodwin
Series 4:3-13.
_. 1983b. Reply [to C. K. Cooke and A. R. WillCOX]. CURRENT ANTHROPOLOGY 24:540-45.
* 1983C. The rock art of southern Africa. Cam
bridge: Cambridge University Press.

* 1983d. Review of: Rock art of the Spanish LE
vant, by A. Beltran (Cambridge: Cambridge Univei sity Press, 1982) and The dawn of European art: A
introduction to Palaeolithic cave painting, by A.
Leroi-Gourhan (Cambridge: Cambridge University Press, 1982). South African Archaeological Bulled
38:1OO-l1.
* 1984a. Reply [to H. C. Woodhouse]. CURRENI
ANTHROPOLOGY 25:246-48.
* 1984b. The empiricist impasse in southern A
rican rock art studies. South African Archaeologic,
Bulletin 39:58-66.
.. 1984c. "The rock art workshop: Narrative or
metaphor?" in Frontiers: Southern African archae(ogy today. Edited by M. Hall, G. Avery, D. M. Avei M. L. Wilson, and A. J. B. Humphreys, pp. 323-27. British Archaeological Reports International Series
207.
* 1985 a. The San artistic achievement. African
Arts 18(3):54-59.
. 1985 b. Testing the trance explanation of soul
em African rock art: Depictions of felines. Bolletin del Centro Camuno di Studi Preistorici 22:47-62.
_. 1986a. Cognitive and optical illusions in San
rock art research. CURRENT ANTHROPOLOGY 27:1778.
_. I986b. The last testament of the southern Sa South African Archaeological Bulletin 41:10-ii.
- 1987 a. "Paintings of power: Ethnography and

LEWIS-WILLIAMS AND DOWSON Signs of All Times 1 243
rock art in southern Africa," in Past and future of
!Kung ethnography: Critical reflections and symbolic perspectives. Edited by M. Biesele and R. Gordon, pp.
.231-73. Hamburg: Buske Verlag.
,-. 1987b. The San rock art debate. Man 22:17375.
---. n.d.a. A dream of eland: An unexplored component of San shamanism and rock art. World Archaeology. In press.
-. n.d.b. Seeing and construing: A neurological
constant in San rock art. MS.
LEWIS-WILLIAMS, J. D., AND M. BIESELE. 1978.
Eland hunting rituals among northern and southern San groups: Striking similarities. Africa 48: 117-34. LEWIS-WILLIAMS, J. D., AND J. H. N. LOUBSER. 1986.
"Deceptive appearances: A critique of southern African rock art studies," in Advances in world archaeology, vol. s. Edited by F. Wendorf and A. E. Close, pp. 253-89. New York: Academic Press.
LOMMEL, A. 1967. Shamanism: The beginnings of art.

New York: McGraw-Hill.
LORBLANCHET, M. 1977. "From naturalism to abstraction in European prehistoric rock art," in Form in indigenous art: Schematisation in the art of Aboriginal
Australia and prehistoric Europe. Edited by P. J.
Ucko, pp. 44-56. Canberra: Australian Institute of
Aboriginal Studies.
LUQUET, G. 1927. Le dessin enfantin. Paris: Alcan.
[CM].
MAGGS, T. M. O'C. 1967. A quantitative analysis of the
rock art from a sample area in the western Cape.
South African Journal of Science 63:100-104.
MAGGS, T. M. O'C., AND J. SEALY. 1983. Elephants in
boxes. South African Archaeological Society, Goodwin Series 4:44-48.
MANHIRE, A. H., J. PARKINGTON, AND R. YATES.
1985. Nets and fully recurved bows: Rock paintings
and hunting methods in the Western Cape, South Africa. World Archaeology 17:161-74.
MANHIRE, A. H., J. E. PARKINGTON, A. D. MAZEL, AND T. M. O'C. MAGGS. 1986. Cattle, sheep, and horses: A review of domestic animals in the rock art of southern Africa. South African Archaeological Society, Goodwin Series 5:22-30. MARSHACK, A. 1969. Polesini: A reexamination of the engraved Upper Palaeolithic mobiliary materials of Italy by a new methodology. Revista di Scienze Preistoriche 24:219-81.
-. 1972. The roots of civilization. London: Weidenfeld and Nicolson/New York: McGraw-Hill.
--. 1976. Some implications of the Palaeolithic symbolic evidence for the origin of language. CURRENT ANTHROPOLOGY 17:274-82.
- . 1977. "The meander as a system: The analysis and recognition of iconographic units in Upper Palaeolithic compositions," in Form in indigenous art: Schematisation in the art of Aboriginal Australia and prehistoric Europe. Edited by P. J. Ucko, PP. 285-317. Canberra: Australian Institute of Aboriginal Studies.
_. 1979. Upper Palaeolithic symbol systems of the Russian Plain: Cognitive and comparative analysis.
CURRENT ANTHROPOLOGY 20:271-3 I.
-. 1985. Theoretical concepts that lead to new analytic methods, modes of inquiry, and classes of data.
Rock Art Research 2:95-11I'.
* 1986. Reply to comments. Rock Art Research
3:67-82.
MARSHALL, L. 1969. The medicine dance of the !Kung Bushmen. Africa
39:347-81.
MARTINDALE, C. 1981. Cognition and consciousness. Homewood, Ill.: Dorsey.
[CM]

MAYNARD, P. 1986. Comment on: The origins of image making, by Whitney Davis. CURRENT ANTHROPOLOGY 27:206-7. !WDJ
MILLER, J. 1983. Basin religion and theology: A comparative study of power (puha). Journal of California
and Great Basin Anthropology 5:66-86. [DSW]
MILLER, W., COMPILER. 1972. Newe Natekwinappeh:
Shoshoni stories and dictionary. University of Utah
Anthropological Papers 94.
MIRIMANOV, V. B. 1973. Kunst der Urgesellschaft.
Dresden and Moscow: Kunst/Iskusstvo. [VBMJ
MUNN, H. 1973. "The mushrooms of language," in Hallucinogens and shamanism. Edited by M. J. Harner,
pp. 86-122. New York: Oxford University Press. NETTLETON, A. 1984. San rock art: Image, function,
and meaning (A reply to A. R. Willcox). South African Archaeological Bulletin 39:67-68.
NOLL, R. 1985. Mental imagery cultivation as a cultural
phenomenon: The role of visions in shamanism. CURRENT ANTHROPOLOGY 26:443-6 I.
OSTER, G. 1970. Phosphenes. Scientific American
222(2):83-87.
PAGER, H. 1971. Ndedema. Graz: Akademische.
* 1975 a. "The antelope cult of prehistoric hunters of South Africa," in Les religions de la pr~histoire.
Edited by E. Anati, pp. 401-11. Capo di Ponte: Centro Camuno di Studi Preistorici.
_. 1975 b. Stone Age myth and magic. Graz:
Akademische.
PARK, W. Z. 1938. Shamanism in western North America. Northwestern University Studies in the Social Sciences 2. [DSW]
PARKINGTON, j. 1969. Symbolism in Palaeolithic
cave art. South African Archaeological Bulletin 24:3-13.
PARKINGTON, J., R. YATES, A. MANHIRE, AND D. HALKETT. 1986. The social impact of pastoralism in the southwestern Cape. Journal of Anthropological Archaeology 5:313-29.
PFEIFFER, J. E. 1982. The creative explosion: An enquiry into the origins of art and religion. New York: Harper and Row.
REICHEL-DOLMATOFF, G. 1972. "The cultural context of an aboriginal hallucinogen: Banisteriopsis caapi," in Flesh of the gods: The ritual use of hallucinogens. Edited by P. T. Furst, pp. 84-1113. London: Allen and Unwin.
1 1978a. Beyond the Milky Way: Hallucinatory

imagery of the Tukano Indians. Los Angeles: UCLA
Latin American Center.
. 1978b. "Drug-induced optical sensations and

their relationship to applied art among some Colombian Indians," in Art in society. Edited by M. Greenhalgh and V. Megaw, pp. 289-304. London: Duckworth.
1 I985. "Aspectos chamanisticos y neurofisiol6gicos del arte indigena," in Estudios en arte rupestre.
Edited by C. Aldunate del S., J. Berenguer R., and V.
Castro R. Santiago: Museo Chileno de Arte Precolombino. [MC]
RICHARDS, W. 1971. The fortification illusions of migraines. Scientific American 224:89-94.
RITTER, D. 1970. "Sympathetic magic of the hunt as suggested by petroglyphs of the western United
States." Actes du Symposium International d'Art
Pr6historique. Edited by E. Anati, pp. 397-421. Valcamonica: Centro Camuno di Studi Preistorici.
RITTER, D. W., AND E. W. RITTER. 1972a. "Medicine men and spirit animals in rock art of western North America." Acts of the International Symposium on Rock Art at Hanko, pp. 97-125.
' I 972b. "Prehistoric pictography in North
America of medical significance," in Medical anthropology. Edited by F. X. Grollig, S. J. Haley, and
H. B. Haley, pp. 137-228. The Hague: Mouton.
ROSENFELD, A. 1971. Review of: Notation dans les gravures du Paldolithique superieur, by A. Marshack.
Antiquity 45:317-19.
RUSPOLI, M. 1987. The cave of Lascaux: The final photographic record. London: Thames and Hudson.
SACKS, O. W. 1970. Migraine: The evolution of a common disorder. London: Faber.
SALMON, M. H. 1982. Philosophy and archaeology. New York: Academic Press.
SAUVET, G. 1982. Comment on: The economic and social context of southern San rock art, by J. D. LewisWilliams. CURRENT ANTHROPOLOGY 23:443-44. SAUVET, G., AND S. SAUVET. 1979. Fonction
sdmiologique de Part parietal animalier franco-cantabrique. Bulletin de la Soci~t6 Pr~historique Frangaise 76:340-54.
SAUVET, G., S. SAUVET, AND A. WLODARCZYK. 1977.
Essai de s~miologie prdhistorique. Bulletin de la
Soci 6t Pr6historique Francgise 74:545-58.
SCHAAFSMA, P. 1980. Indian rock art of the Southwest. Albuquerque: University of New Mexico Press. SCHAFER, HEINRICH. 1974. Principles of Egyptian art.
Oxford: Clarendon Press. [Jc]
SELFE, L. 1983. Normal and anomalous representational drawing ability in children. London: Academic Press. [CM]
SHANKS, M., AND C. TILLEY. 1987. Re-constructingarchaeology: Theory and practice. Cambridge: Cambridge University Press.

SIEGEL, R. K. 1977. Hallucinations. Scientific American 237:13 2-40.
_-. 1978. Cocaine hallucinations. American Journal of Psychiatry 135:309-14.
_. 1984. Hostage hallucinations: Visual imagery induced by isolation and life-threatening stress. Jour
nal of Nervous and Mental Disease 172:264-72.
SIEGEL, R. K., AND M. E. JARVIK. 1975. "Drug-induce hallucinations in animals and man," in Hallucinations: Behaviour, experience, and theory. Edited by
R. K. Siegel and L. J. West, pp. 81-161. New York:
Wiley.
SIEVEKING, A. 1979. The cave artists. London: Th and Hudson.
SIIKALA, A. 1985. Comment on: Mental imagery culI vation as a cultural phenomenon: The role of visions in shamanism, by R. Noll. CURRENT ANTHROPOLOGY
26:455-56.
SISKIN, E. E. 1983. Washo shamans andpeyotists: R ligious conflict in an American Indian tribe. Salt
Lake City: University of Utah. [DSW]
SNOW, D. R. Rock art and the power of shamans. Nat ral History 86(2):42-49.
STEVENS, A. 1975. Animals in Palaeolithic cave art: Leroi-Gourhan's hypothesis. Antiquity 49:54-57. STEWARD, J. H. 1933. Ethnography of the Owens Val ley Paiute. University of California Publications in American Archaeology and Ethnology 33(3). [DSW] SUTTON, M. Q. 1982. Kawaiisu mythology and rock art: One example. Journal of California and Great
Basin Anthropology 4: 148-54. [DSW]
THACKERAY, A. I., J. F. THACKERAY, P. B. BEAUMONT, AND J. C. VOGEL. 1981. Dated rock engravings from Wonderwerk Cave, South Africa. Science
214:64-67.
TURNER, C. G., II. 1963. Petrographs of the Glen Ca
yon region: Styles, chronology, distribution, and rea tionships from Basketmaker to Navajo. Museum of Northern Arizona Bulletin 38 (Glen Canyon Series
[CGT].
--. 1971. Revised dating for early rock art of the
Glen Canyon region. American Antiquity 36:469-7
[CGT]
TYLER, C. W. 1978. Some new entoptic phenomena. V
sion Research 18:1633-39.
UCKO, P. J., AND A. ROSENFELD. 1967. Palaeolithi
cave art. London: Weidenfeld and Nicolson.
VAN RIET LOWE, C. 1956. The distribution ofprehistoric rock engravings and paintings in South Africa
(Archaeological Series 7.) Pretoria: Archaeological
Survey.
VASTOKAS, JOAN M. 1982. Comment on: The economic and social context of southern San rock art, b

J. D. Lewis-Williams. CURRENT ANTHROPOLOGY
23:444-45. [MC]
VASTOKAS, J. M., AND R. K. VASTOKAS. 1973. Sacr
art of the Algonkians: A study of the Peterborough petroglyphs. Peterborough: Mansard. VINNICOMBE, P. 1972. Myth, motive, and selection southern African rock art. Africa 42:192-204.
1976. People of the eland. Pietermaritzburg: Natal University Press.
VOEGELIN, E. W. 1938. Tubatulabal ethnography. An thropological Records 2(1):I-9o.

WALKER, j. 1981. The amateur scientist: About phosphenes. Scientific American 244(5):1 42-52. WEITZENFELD, JULIAN S. 1984. Valid reasoning by analogy. Philosophy of Science 51:137-49. [AW] WELLMANN, K. F. 1978. North American Indian rock art and hallucinogenic drugs. Journal of the American Medical Association 239:1524-27.
-- . 1979a. A survey of North American Indian rock art. Graz: Akademische.
-. I979b. North American rock art: Medical connotations. New York State Journal of Medicine 79:1094-1105.
WHITE, R. 1985. Thoughts on social relationships and language in hominid evolution. Journal of Social and Personal Relationships 2:95-115. WHITLEY, D. s. 1982. Notes on the Coso petroglyphs, the etiological mythology of the Western Shoshone, and the interpretation of rock art. Journal of California and Great Basin Anthropology 4:262-72.
-. n.d.a. Function and meaning in southern Sierra Nevada rock art. MS.
-. n.d. b. Ethnography of communication and rock art study in the active voice. Paper presented at the annual meetings of the Society for American Archaeology, Toronto, Canada.
-. n.d.c. Context, symbol, and meaning in North American archaeology: A study of southern Sierra Nevada rock art. MS. [DswI WHITLEY, D. S., AND R. I. DORN. 1987. Rock art
chronology in eastern California. World Archaeology
19. In press. IDSW].
WILLCOX, A. R. 1983. More on San rock art. CURRENT ANTHROPOLOGY 24:538-40. [MC]
* 1984. Meanings and motives in San rock art:
The views of W. D. Hammond-Tooke and J. D. LewisWilliams considered. South African Archaeological Bulletin 39:53-57.
_. 1987. The cultural context of hunter-gatherer rock art. Man 22:171-72.
WILMAN, m. 1968. The rock engravings of Griqualand
West and Bechuanaland, South Africa. Cape Town: Balkema.
WINKELMAN, MICHAEL. 1986. Trance states: A theoretical model and cross-cultural analysis. Ethos 14:174-203. [MW]
WOODHOUSE, H. C. 1984. On the social context of
southern African rock art. CURRENT ANTHROPOLOGY
25:244-46.

WYLIE, A. 1985. The reaction against analogy. Advances in Archaeological Method and Theory 8:63III.
YATES, R., J. GOLSON, AND M. HALL. 1985. Trance performance: The rock art of Boontjieskloof and Sevilla. South African Archaeological Bulletin 40:70-80.
YOUNG, R. S. L., R. E. COLE, M. GAMBLE, AND M. D. RAYNER. 1975. Subjective patterns elicited by light flicker. Vision Research 15:1289-9o.
ZIGMOND, M. 1977. "The supernatural world of the Kawaiisu," in Flowers of the wind: Papers on ritual, myth, and symbolism in California and the Southwest. Edited by T. C. Blackburn, pp. 5 9-95. Socorro: Ballena Press. [DSW]
* 1980. Kawaiisu mythology: An oral tradition of south-central California. Ballena Press Anthropological Papers 18. [DSW]

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