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ROCK ART RESEARCH

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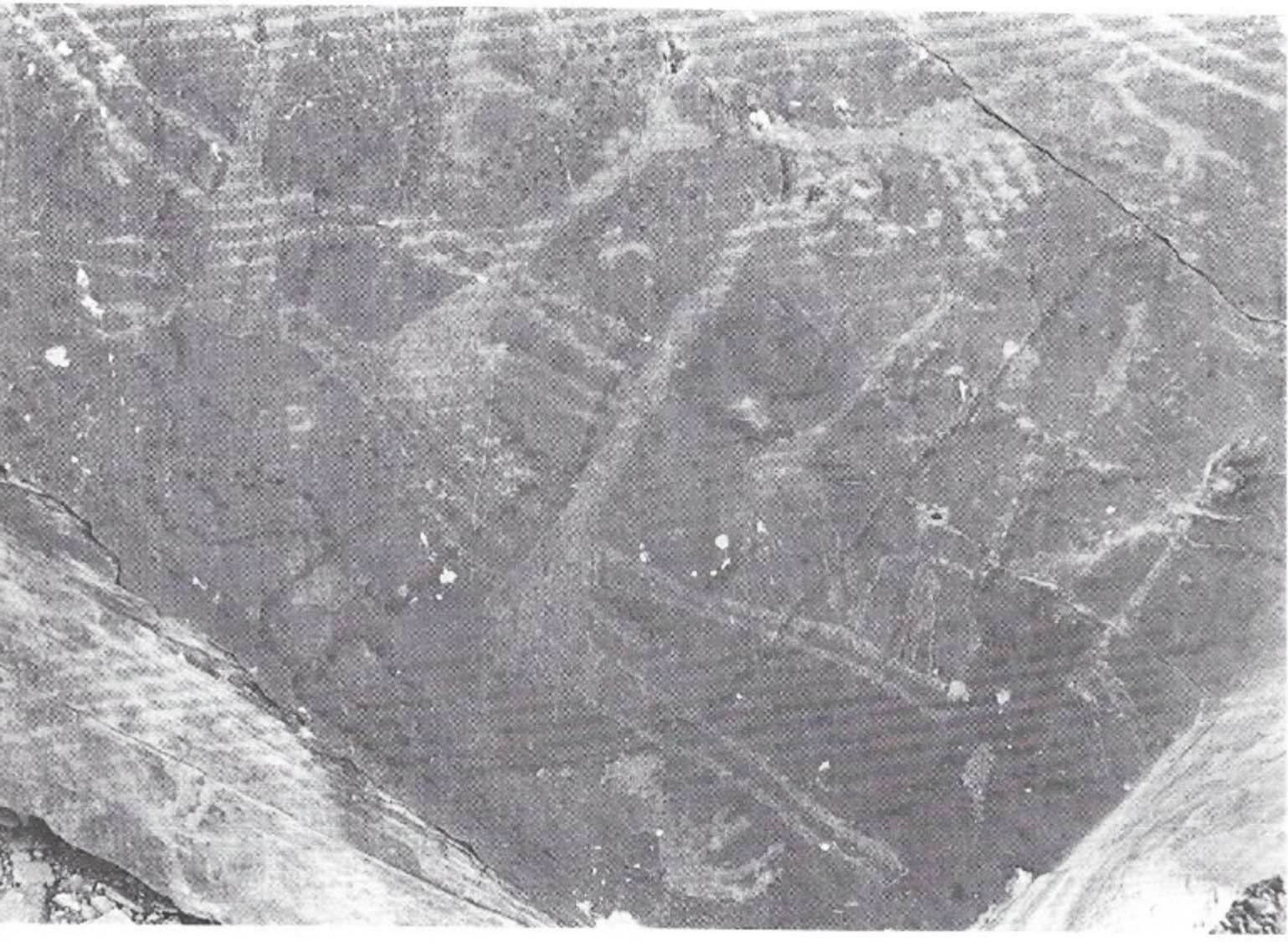

Giraffe drawings superimposed over curvilinear designs on boulder A of Figure 2, article by Dirk Huyge, pages 3-11. Gebel Youssef, El-Hosh, Upper Egypt.

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ROCK ART RESEARCH

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The principal objectives of the Australian Rock Art Research Association are to provide a forum for the dissemination of research findings; to promote Aboriginal custodianship of sites externalising traditional Australian culture; to co-ordinate studies concerning the significance, distribution and conservation of rock art, both nationally and with individuals and organisations abroad; and to generally promote awareness and appreciation of Australia's prehistoric cultural heritage.

Archaeological Publications, Melbourne

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CONTENTS

The contents of this journal are listed in the *International Current Awareness Services* and in the *International Bibliography of Social Science*.
Major papers are abstracted by international abstracting services.

KEYWORDS: ***Petroglyph - Palaeolithic - Fish-trap - Egypt***

POSSIBLE REPRESENTATIONS OF PALAEOLITHIC FISH-TRAPS IN UPPER EGYPTIAN ROCK ART

Dirk Huyge

Abstract. On the basis of its principal subject matter (boats, anthropomorphous figures and animals), the bulk of the Upper Egyptian Nile Valley rock art is manifestly late pre-Historic (Predynastic) or Early Dynastic in age (c. 4400-2650 B.C.). Although several claims have been made, few arguments have been put forward to support a possible Palaeolithic genesis of a part of the rock drawings. On the basis of field observations at the Upper Egyptian site of El-Hosh, this contribution suggests a late Palaeolithic age for intensively patinated, curvilinear designs, which can tentatively be identified as labyrinth fish-traps.

Introduction

The site of El-Hosh is situated on the west bank of the Nile, about 30 kilometres south of the Upper Egyptian town of Edfu (Figure 1). The presence of figurative petroglyphs in this area has been recorded for over a century (see e.g. Chester 1892). In 1926 the rock art localities at El-Hosh were visited by the *VIII. Deutsche Inner-Afrikanische Forschungsexpedition* (*DIAFE*), which was directed by Leo Frobenius. Only seventeen drawings and 'scenes', mostly animal representations, were copied on that occasion (see Červíček 1974: 37-9, Figs 139-54). In March 1937, the German ethnographer Hans A. Winkler surveyed the environs north and south of El-Hosh. In his masterly account, *Rock-drawings of southern Upper Egypt*, issued in two volumes by the Egypt Exploration Society in 1938-1939, El-Hosh bears the site number 35. Altogether sixteen photographs were published in order to highlight the rock art (Winkler 1938: 9, Pls VII, 1; IX, 1; XX, 1-2; XXI, 1-2; XXVII, 2; XXVIII, 1-2; XXIX, 1-2; XXXII, 1-2; 1939: 5, Pls VII, 2; XV, 1; LI, 1).

The rock art site of particular interest here is an isolated late Cretaceous Nubian sandstone hill situated immediately to the south of the village of El-Hosh, along the Nile riverside (Figure 2). Known to the locals as Gebel Jussef, it has been named 'Subsite B' in Červíček's review of Winkler's material at El-Hosh (1980: 33-7). Several rock drawings at this location have been published by Winkler (1938: Pls XXVII, 2; XXIX, 2; XXXII, 1-2) and Červíček (1974: Figs 148-51; 1980: Pl. 28). In January 1997 I had the opportunity to visit the site and was able to relocate several of the previously published figures. In addition, a number of unknown rock art localities were recovered, and it is now evident that the area of El-Hosh presents one of the densest concentrations of petroglyphs in Egypt.

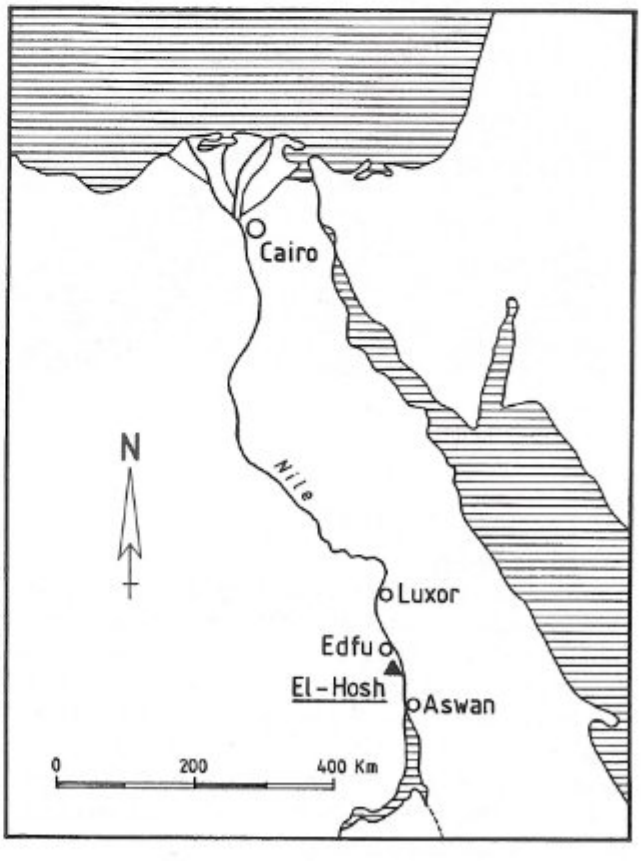

Figure 1. *Map of the Egyptian Nile Valley, showing the location of El-Hosh.*

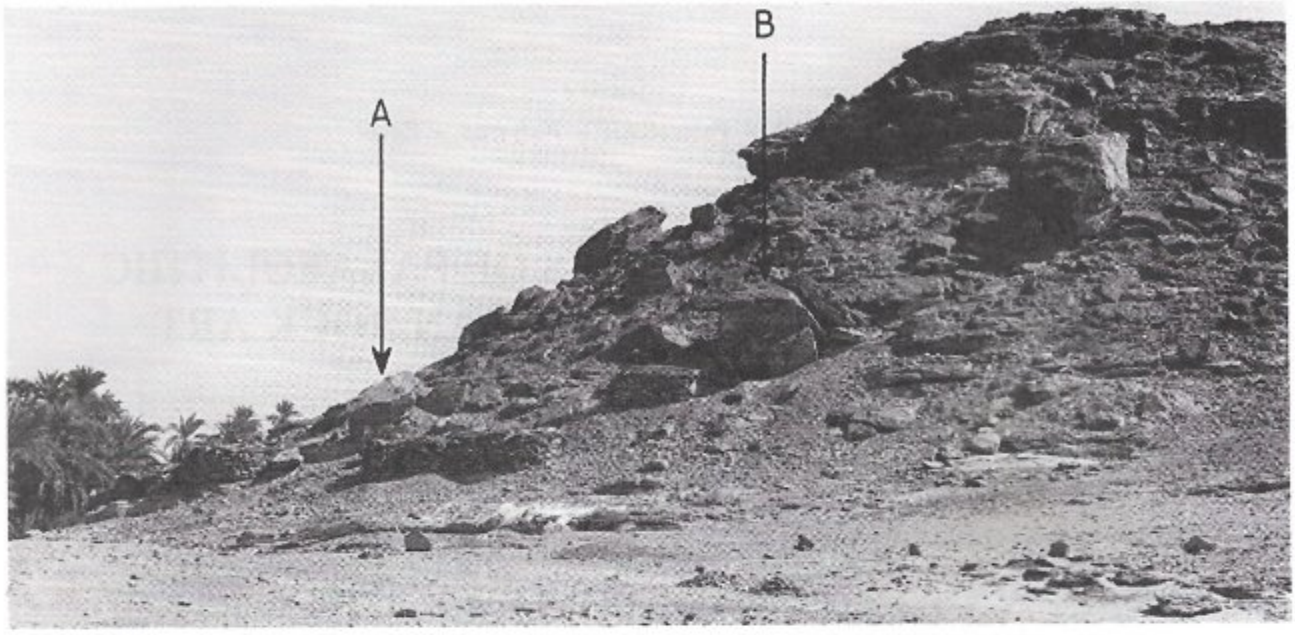

Figure 2. Gebel Yussef seen from the north. The curvilinear designs are on boulders A and B.

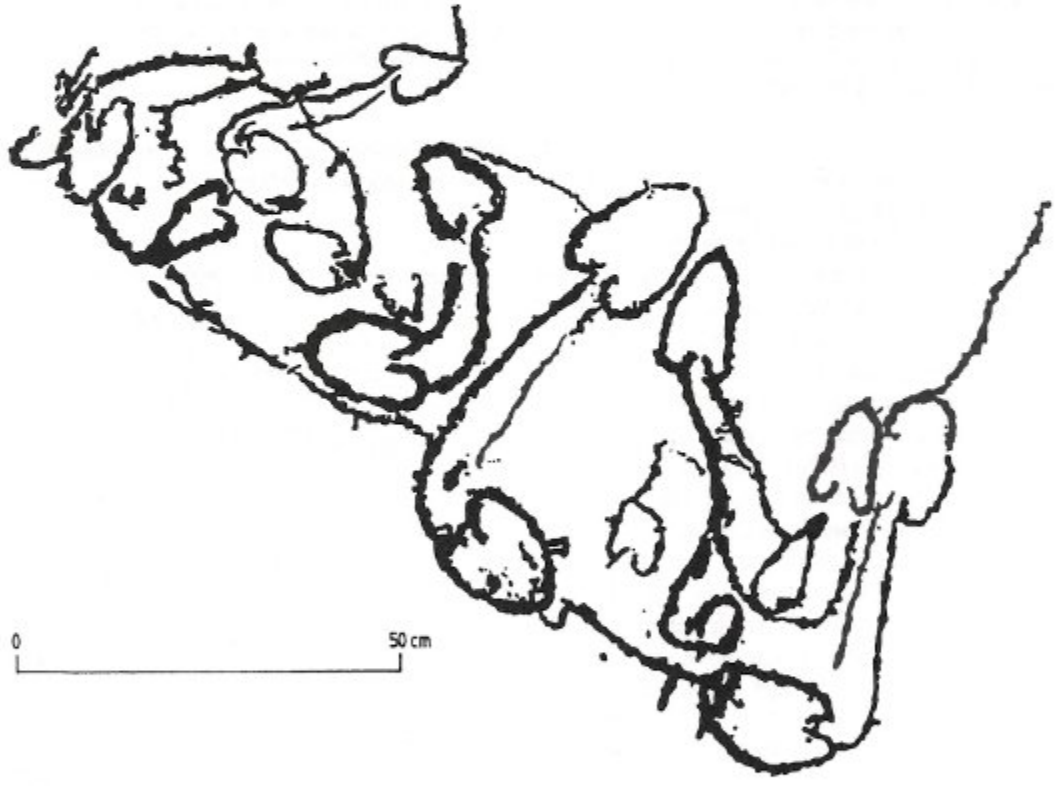

Figure 3. Curvilinear designs on boulder B of Figure 2 (drawn after Winkler 1938: Pl. XXXII, 2).

Curvilinear designs

Among the re-located rock drawings are a number of curious curvilinear, heart-shaped designs. These intensively patinated, hammered motifs, which are confined to the northern part of the hill, appear on two large, free-lying sandstone boulders (A and B of Figure 2). Winkler, who published some of these petroglyphs (Figure 3), considered them to be representations of fish-traps (1938: 31). This interpretation, which is also favoured here, will be advocated further below.

Whereas the majority of the rock art motifs at El-Hosh appears to belong to the Predynastic and Early Dynastic periods (c. 4400-2650 B.C.), and can closely be related to the iconographic repertoire of the early Nilotic pastoral-agricultural civilisations, the curvilinear designs seem to date from another epoch. What is particularly noteworthy about these drawings are the remarkable cases of superimposition, which were not mentioned or illustrated by Winkler. These cases seem to offer firm evidence for a very early date of the drawings. Figure 4 (located on front cover of this issue), for instance, illustrates a panel (on boulder A of Figure 2) in which a series of magnificently executed giraffe drawings are superimposed over the curvilinear, heart-shaped designs.

In Predynastic iconography, stylised representations of giraffe are a common subject on middle Predynastic (Naqada I or Amratian) white cross-lined ware (Keimer 1935: 167-9) (see Figure 5). They are virtually absent on late Predynastic (Naqada II or Gerzean) decorated ware, but reappear on terminal Predynastic (Naqada III) and Early Dynastic elitist artefacts (especially slate ceremonial palettes and ivory knife handles). On the latter documents, however, they are almost exclusively drawn in a naturalistic fashion (see e.g. Ciałowicz 1992). For the stylised El-Hosh giraffes, a middle Predynastic (or possibly earlier) date can therefore be accepted with confidence.

Moreover, as can be inferred from Figure 3, there is a substantial difference in degree of patination between the curvilinear designs and the giraffe drawings: complete *versus* advanced patination respectively, according to Hellström's patina classification (1970: 60). Dynastic (New Kingdom) rock drawings, on the other hand, show little or no variation in degree of patination from the Predynastic giraffes. This evidently points to a considerable difference in age between the curvilinear designs and the giraffe figures, amounting probably to several thousands of years. In my opinion there can be little doubt that the completely patinated curvilinear designs predate the beginning of the Predynastic period. Their overall resemblance, both in 'genre' and manner of execution, to (non-representational?) geometric and polymorphic figurations and line-markings at Lower Nubian (Sudanese) sites, dated on the basis of stratigraphical evidence and absolute dating to the 8th or 7th millennium B.C. (see Davis 1984: 85-7), seems to validate an attribution to the late Palaeolithic (for a critical appraisal of these early datings, however, see Le Quellec 1997). Hopefully, AMS radiocarbon analysis of organics in the rock varnish, which is currently being considered, may help in testing this age claim.

Labyrinth traps

As stated above, Winkler (1938: 31) considered the El-Hosh curvilinear heart-shaped designs to be the representations of pre-Historic fish-traps. According to the discoverer, each one of these designs shows a 'gate' which opens on to a 'corridor' that in turn leads to the opening of the 'heart'. He concludes: 'possibly these are designs of traps put in the current of the river as a primitive labyrinth in which to catch fish or other creatures'. Indeed, these sophisticated devices, capped with mushroom-shaped or cordiform protuberances, bear a great likeness to the ground-plan of a universally known fish-trapping arrangement, namely the labyrinth fish-fence (see Herman 1901: 40-9; von Brandt 1984: 163-5, Figs 280-1). The general purpose of this type of barrier trap, some ethnographic and historical examples of

Figure 5.
(Figure 4 is on front cover)
Stylised giraffes on middle Predynastic (Naqada I or Amratian) white cross-lined ware (after Petrie 1920: Pl. XVIII, 73).

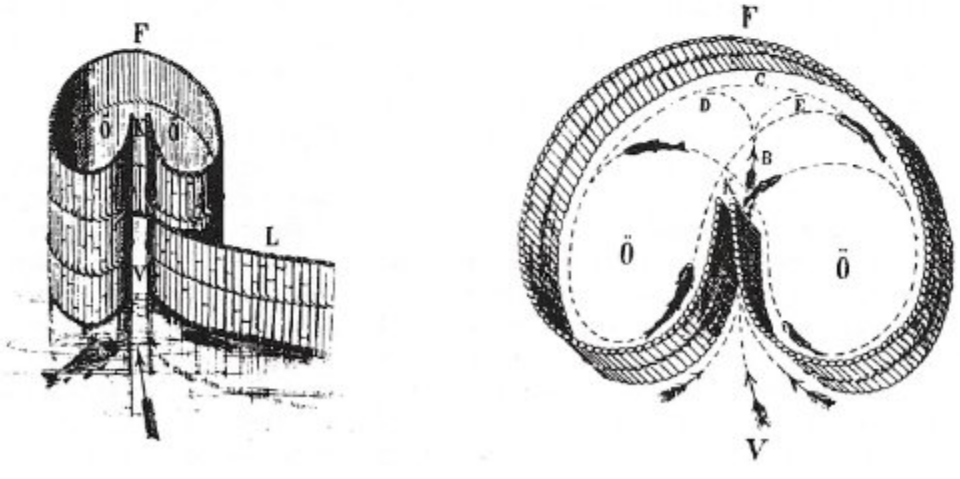

Figure 6.
Simple forms of labyrinth fish-traps (after Herman 1901).

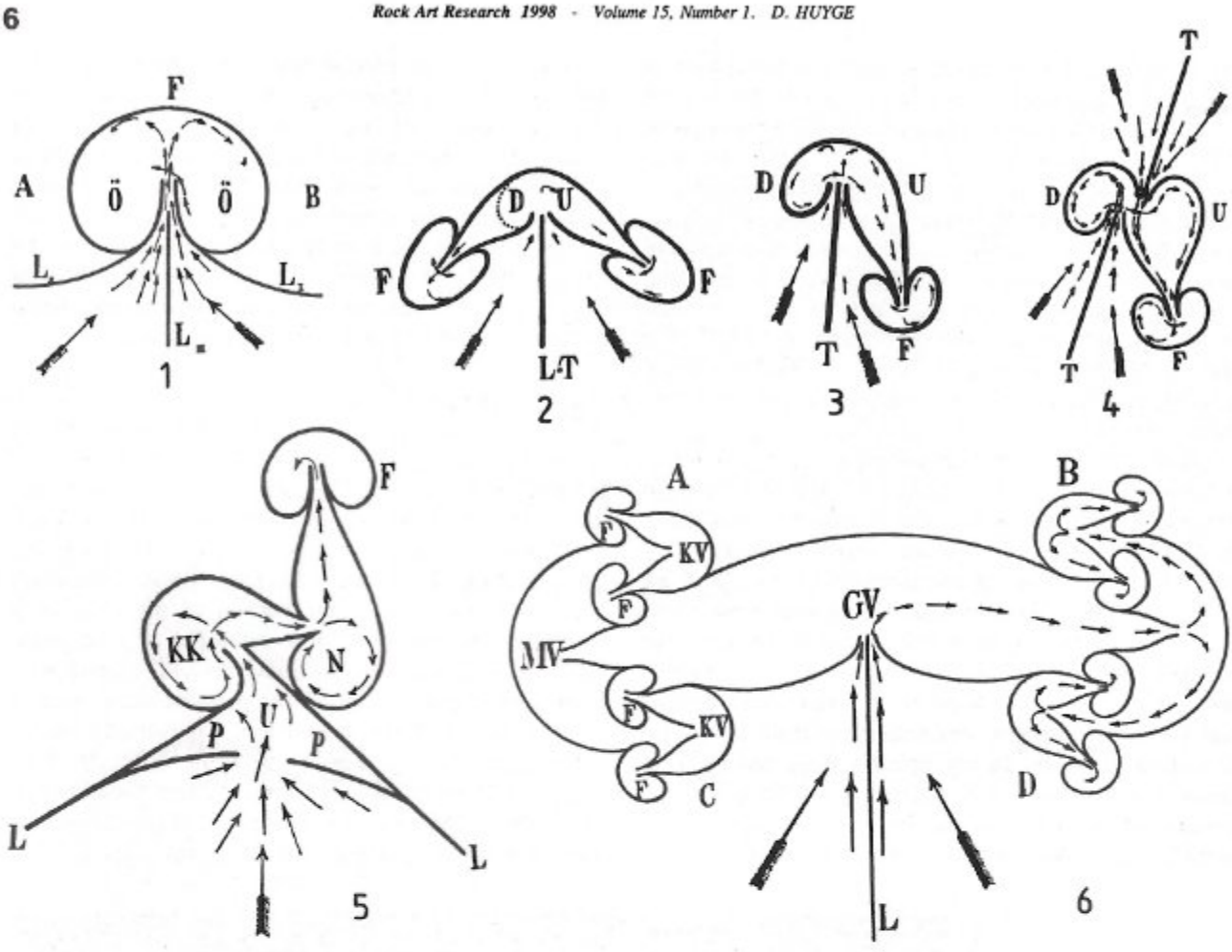

Figure 7. Ground plans of labyrinth fish-traps from northern and eastern Europe (1-5) and Japan (6). Arrows indicate movement of fish (after Herman 1901).

which are reproduced in Figures 6 and 7, is to channel and barricade fish into a particular area or confined space (a catching chamber) where they can easily be speared, netted or simply collected by hand. Fish are driven into the trap by the current, receding waters or artificial noise, and are prevented from escape by of the narrow entrances and the sophisticated design of the walls which leads them on a never-ending, winding path.

Examples from the ethnographic record indicate that the use of these traps is generally restricted to aquatic environments with a gradually sloping bed and a healthy supply of reeds or sticks (Brewer and Freedman 1989: 31). The latter materials are usually used in their construction. Alternatively, this type of trap (or certain parts of it) can also be built of piled-up stones (see e.g. Serjeant 1968: 493; Deacon 1984: 293).

Nubian and Saharan parallels

Apart from the El-Hosh petroglyphs, other rock drawings that may represent such fish-trapping devices are extremely rare. Among the several thousand rock drawings that were recorded in Lower Nubia during the archaeological rescue surveys of the early 1960s, only one specimen can be related to the presently discussed drawings. This completely patinated, semi-circular figure with a curved line attached to one of its sides (Figure 8) shows the simplest form of a labyrinth fish-trap possible (compare with Figure 6). It has been recorded on Site 382, in the mainland area of the Second Cataract, between the villages of Abka and Mowrada (see Hellström 1970: 187-8). Other, more sophisticated counterparts have been identified in central Saharan (southern Algerian) rock art (see Huyge 1994: Fig. 1). The latter differ from the El-Hosh designs by their general outline, which is fork shaped rather than curvilinear and irregular. What they have in common with the El-Hosh petroglyphs, however, are the diagnostic mushroom-shaped additions or 'hearts'.

Discussion

Whereas representations of barrier fish-traps are unknown in classical Egyptian iconography, some textual evidence (classical authors and modern ethnographic records) attests the use of this kind of fishing gear in the Nile Valley and the Delta during the Graeco-Roman Period and in modern times (see Brewer and Friedman 1989: 31-2). Moreover, possible barrier traps, built of piled-up stone blocks, have also been recovered in an archaeological (?) context at Abka village in Lower Nubia (see Myers 1958: Pl. XXXIV, below; the caption

reads: 'said to be very old'). Be that as it may, the identification of the El-Hosh designs as fish-catching facilities and their suggested age are in complete accordance with the economic importance of riverine resource exploitation and the particular entrapment technology required in the late Palaeolithic of the Nile Valley. As archaeozoologist Van Neer (1989, 1994) has convincingly argued, on the basis of the study of fossil ichthyofaunas from Egypt and Sudanese Nubia, the place of capture of fish during that period was essentially the inundation area (flood plain) and not the main river channel. Evidently, the less turbulent, wade-able waters of the former habitat were pre-eminently suitable for the installation of stationary trapping devices, such as dams and fences. Due to new developments in procurement technology, such as the use of watercraft (rafts or boats), it is only from the terminal Palaeolithic onwards (c. 6000 B.C.) that fishing was also practised in open Nile waters.

Figure 8. *Petroglyph 382c1 from the Second Cataract area in Lower Nubia (chalked) (after Hellström 1970: Pl. 108, 4).*

It is, of course, extremely difficult to conceive what the symbolic added value (if any) of the El-Hosh fish-traps (and similar petroglyphs elsewhere) may be. Even if these images represent trivial objects, their function and meaning in the general context of the Nile Valley rock art is not necessarily mundane. In this particular case I think it may tentatively be suggested that these drawings relate to special ritual techniques that have to be observed in order to increase the efficiency of fishing gear and secure a 'miraculous draught of fishes'. Indeed, many relics of such opportunistic rites, addressed to benevolent gods and powers beyond man, persist today, even in highly developed, sophisticated fisheries (von Brandt 1984: 276-82).

Acknowledgements

I would like to thank Shawn Bubel and Wim Van Neer for reading and commenting on an earlier draft of this paper, as well as its two *RAR* referees. Future research at El-Hosh will be sponsored by the National Geographic Society and the Fund for Scientific Research - Flanders.

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MS received 26 September 1997.

RAR 15-437

COMMENTS

'Direct dating' analyses required

By FRIEDRICH BERGER

Re-visiting known rock art sites sometimes results in interesting new information. An example is the upper part of Karkur Thal in the Uweinat Mountains which was explored by van Noten (1978: 9-10) after Rhotert and the Frobenius team did not have enough time in 1933. Another example are the highly patinated human figures with round heads in Zolat el Hammad, northern Sudan, which were first reported by Kröpelin (1990, 1993), after Newbold (1924) and Rhotert (1952) had missed them for various reasons. Huyge is therefore to be commended that he rediscovered the highly patinated petroglyphs at El-Hosh. This kind of rock art is only noticed at close inspection and at favourable sun light. Normally that happens if less patinated rock art is nearby which more easily springs to the eye. There may be many more places in the Sahara where fully patinated petroglyphs have not been noticed so far. It is important to explore and record them in order to get a full picture of the earliest surviving phase of the art.

The high degree of patination is also the reason for another problem. It is difficult to record and reproduce these petroglyphs. On Figure 4 the curvilinear designs are visible. However, it is difficult to see where and how the author interprets fish-traps. A drawing of the curvilinear designs may help.

The interpretation of the rock art of the Sahara is characterised by the lack of application of direct dating methods. Traditionally the rock art of the Nile Valley is stylistically compared to the mobile art (e.g. Cervícek 1993). The comparison of the giraffes from Figure 4 with Naqada I is generally applied despite giraffes of this style appearing in a larger area than the Naqada pottery, e.g. in

Zolat el Hammad (Kröpelin 1993: Foto 13a).

On the basis of patina, curvilinear and other non-figurative petroglyphs belong to the oldest rock art in the Sahara. Taking this kind of petroglyphs as a stylistic element, various authors correlate the rock art from their research areas with the Upper Nile Valley at Abka, where Myers (1958, 1960) was able to relate this type of rock art to archaeological dates. These are, for example, Staewen et al. (1969; 1987: 322-5, Taf. 33) for Taar Doi in North Tibesti, and Hallier (1995: 19, 34) for the Djado area in north-eastern Niger. Huyge uses the same comparison through Davis (1984). The purpose of the comparisons is to establish a certain time element for this style and/or to investigate the diffusion and origin of the non-figurative style. To my knowledge nobody has studied whether the non-figurative petroglyphs may represent entoptic phenomena (phosphene forms). In that case the time element and the 'migration' aspect would become void as entoptic phenomena may have been engraved by anybody at any time.

Myers leaves it open whether the earliest level of the Abka site is Mesolithic or Neolithic as there is little evidence 'whether the people were food-gatherers or food-producers' (1960: 180). Davis (1984) incorporates the data of Myers into a more general review. However, he also states 'simply because some non-representational drawings might be as old as 9000 B.C. does not imply that they are Palaeolithic' (Davis 1984: 90). Huyge's wording suggests that he is fully aware of the uncertainty — not of the age, but of the allocation to Palaeolithic. But is it really important whether the petroglyphs are Palaeolithic or Neolithic?

Concerning the function of the petroglyphs of El-Hosh it is indeed extremely difficult to determine it. We may therefore abstain from an interpretation.

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RAR 15-438

Fish-traps queried

By ACHILLES GAUTIER

My comment on the interpretation proposed by my colleague and friend Dirk Huyge will be brief. I have no difficulties whatsoever to accept that the rock drawings of el-Hosh may represent fishing-traps, especially since the use of such fishing gear during the Greco-Roman period and in modern times is attested in Egypt. However, I have a problem when it comes to assessing the need for such devices in pre-Historic times. Upper Palaeolithic people along the Egyptian Nile appear to have practised resource scheduling in a successful way and their annual round included probably two periods during which they could harvest catfish (*Clarias* sp.) and other fishes in the Nile floodplain. The first period coincides with the rising flood, when fish migrated to the alluvial plain for spawning, the second would focus on fish trapped in residual ponds when the flood receded. If fish traps were used in pre-Historic times, most likely this occurred during the flood recession (Gautier 1987; Gautier and Van Neer 1989; Wendorf and Schild 1989; Van Neer 1994). My impression, fuelled by stories told to me by Egyptian colleagues, is that fish harvesting in the Nile floodplain during the flood is very easy and that Palaeolithic people would have felt little need or incentive to build fish-traps. Such contraptions may have been put up only in special circumstances and at certain localities, where harvesting fish was difficult. My question then is whether such sites existed near el-Hosh in Upper Palaeolithic times?

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RAR 15-439

'Fishing magic': an avatar of the old 'hunting magic'?

By JEAN-LOÏC LE QUELLEC

The curvilinear designs dealt with in this paper are the subject of two kinds of assumptions: chronological (they might be Palaeolithic) and interpretive (they might represent fish-traps).

First, the attribution to the Palaeolithic rests on the '*substantial difference in degree of patination*' between these petroglyphs and a series of giraffes superimposed over some snaky tracings.

This case of superposition suffices effectively to demonstrate that the curvilinear designs predate the giraffes, but what accuracy can be achieved by such a relative chronology? In fact, the curvilinear drawings, having been pounded earlier, are older than the giraffes, and they may even represent the earliest chronological level of local rock pictures. But one cannot generalise and say that they belong to another chronological level on the grounds that a single superposition might be significant. Actually, the curvilinear designs could be only *slightly* older, and little chronological information (if any) can be derived from that observation. In contrast, an effective chronology should be evidenced by the fact that representational petroglyphs overlap geometrics with regularity, for example.

It is not to be forgotten that patina is not proportional to time. It can thus be understood that no serious argument allows an assessment to be made concerning the precedence of the oldest tracings (supposedly 'several thousands of years', according to Dirk Huyge), even in the case of badly weathered petroglyphs: it might be

'several thousands of years' as much as few centuries or some decades — nobody knows.

Indeed, the difference of patina can be attributable either to the duration or to the intensity of the patination process, and in the light of all the factors concerned there is no reason here to particularly favour the duration. Except where statistical data are available, the degree of patination is not very helpful in establishing a relative chronology, and as Dirk Huyge remarks, it is thus necessary to wait for a direct dating possibility.

A formal analogy has led to the interpretation that some enigmatic curvilinear designs were 'labyrinth fish fences'. This second assumption leans mainly on a formal analogy between these petroglyphs and the plan views of a series of traps from ... Europe and Japan.

Of course, such abstract designs might well symbolise some devices for capture, but no other petroglyph of the Nile Valley has ever doubtlessly been read as a 'ground plan' (of an habitation structure, for example); within that artistic context, representing the ground plan of a fishing-trap is thus an extremely unlikely event.

Moreover, the graphic analogy appears superficial: the petroglyph published by Winkler does not reveal where the fish could have penetrated (some of the cordiform protuberances are completely closed!), and the whole system would have been uselessly complex.

We are told that the motivation for such a representation might have been to increase magically the efficiency of fishing. I find it profoundly unconvincing that such an odd practice should have existed. In any case, the economic importance of riverine resource exploitation at that time would have demanded to multiply this type of images, while Winkler's is the only example of its type.

The significance of the non-representational drawings cannot be made from elusive resemblance with ethnographic objects chosen in the whole world, as it is shown by the example of the 'tectiforms' of the European Ice Art. As it appears to us now, the interpretation of isolated signs is ruled out: with the rare exception of precise representations authorising direct interpretation (as it is sometimes the case in central Sahara), one has to take into account a whole symbolic system. It is particularly true of the geometrics: we cannot decipher them, but the intent is that some aspects of the system ordering their representation be made accessible to our knowledge .

The mushroom-like figures of el-Hosh may have been made for magical purposes, but we cannot find ways of falsifying such an assumption, and the chances of archaeologists detecting magical motivations are less than slight. That petroglyph being unique, there is no way to place it in a coherent symbolic system, and the absence of naturalistic details precludes any fishing interpretation. Ultimately, it seems needless to evoke a 'fishing magic' that reminds strongly of the once highly prized 'hunting magic' invoked by ancient pre-historians to explain any unaccountable picture.

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RAR 15-440

REPLY

A 'best fit' and nothing more than that

By DIRK HUYGE

I am thankful to Dr Friedrich Berger, Professor Achilles Gautier and Dr Jean-Loïc Le Quellec for taking the trouble to comment on my brief paper. Their remarks and suggestions are varied and replying to them in full would probably result in an apologia much longer than my original article. The editor of *RAR* has urged me to keep this reply brief and I will try to meet his demand.

Whereas both Berger's and Gautier's remarks with regard to my chronological attribution and/or interpretation of the El-Hosh petroglyphs are quite amiable and indulgent, Le Quellec's review is much more severe. I have the highest esteem for Dr Le Quellec, and what he has written about the dating of Myers' petroglyphs at Abka in Lower Nubia, for instance, is perfectly valid (see Le Quellec 1997). I fear, however, that he has somehow overlooked the word 'possible' in the title of my contribution. In contrast to what he says in the introductory statement of his critique, I do not assume anything (and, of course, I certainly do not claim to have found proof of anything). On the basis of a series of arguments, both with regard to chronology and interpretation, I have suggested what is in my opinion a 'best fit'. Let me clarify this.

As regards chronology, Le Quellec justly doubts the usefulness of patina as a tool for assessing age differences between petroglyphs. It remains a fact, however, that the curvilinear designs discussed in my contribution are much more intensively patinated than the giraffes in the panel of Figure 4 (which are superimposed over at least one curvilinear figure with a characteristic heart-shaped addition). New Kingdom petroglyphs nearby, amongst others a typical boat drawing of that period (moreover having a comparable exposure to the natural agents), bear a patina very similar in intensity to that of the giraffes. If these giraffes are indeed middle Predynastic in age (again a 'best fit' suggestion!), they are separated from the New Kingdom drawings by a time span of approximately 2000 to 2500 years. Taking into account the fact that the patina difference between the giraffes and the curvilinear motifs is much larger than that between the giraffes and the New Kingdom-boat petroglyph, I would be inclined to say that the curvilinear motifs are (at least) several thousand years earlier than the giraffes. If this is correct, they may well belong to the 8th or 7th millennium B.C. (and may even be older). In this part of the Nile Valley, the earliest evidence of a

'Neolithic' phase (or 'Predynastic' as it is mostly called) dates from about 5000 B.C. The Elkabian lithic industry and faunal materials. discovered by Pierre M. Vermeersch (1978) at the site of Elkab, about 50 km north of El-Hosh, have been securely dated to around 7000 B.C. This occupation is clearly 'Palaeolithic', in the sense that its subsistence economy is entirely dependent on hunting and fishing and that there is no indication whatsoever of organised food production. If the above dating of the El-Hosh curvilinear petroglyphs is correct, it is clear that they fall within the time range of the Nile Valley late or terminal Palaeolithic (and this is, moreover, perfectly consistent with the identification of the represented 'devices' as labyrinth fish-traps). The AMS radiocarbon analysis of organics in the rock varnish (alluded to both by Berger and Le Quellec) is currently being planned (in collaboration with Dr Alan Watchman of James Cook University, Townsville, Australia). However, even if a Palaeolithic direct date could be obtained (or rather, a *terminus ante quem* indicating that the drawings are indeed that old), I would still be very hesitant to consider this as 'proof'. In view of the fact that we may not know the precise origin of the organics in the varnish rind, it would probably be wiser to just add this result to the list of arguments.

And what about the interpretation? The examples from Europe and Japan (Figure 7), scorned by Le Quellec, have simply been chosen because they were at hand. They are illustrative for a type of device that is universally known. There are many different ways of constructing a labyrinth fish-trap, but, ultimately, all are variations on a very similar basic design (namely that of Figure 6). I could also have produced examples from Bahrain (see Serjeant 1968), for instance, but would these have been more convincing? The fact is that such devices have been in use in the Nile Valley in later times (and one of the reasons why they were not represented in classical Egyptian iconography may be that they are 'passive' fishing gear, not requiring the constant attention and active intervention of humans, which evidently makes them less suitable subjects for the popular 'animated' scenes of daily life). Professor Gautier has questioned the need for such fishing devices during pre-Historic times in Egypt. In his comment, however, he himself has provided an adequate response to his query. The fact that these drawings are confined to the El-Hosh area (and maybe another example in the vicinity of the Second Cataract in Lower Nubia) may indicate a geographical limitation to the use of this fishing technique. The landscape of El-Hosh, characterised by many small, flat-bottomed wadis transecting the Nubia sandstone formation, may have been particularly suitable for the installation of such stationary trapping devices. Elsewhere in Egypt, for instance at the late Palaeolithic sites of Makhadma (Vermeersch et al. 1989), fish harvesting took place in a fundamentally different physical environment: a spacious, wade-able, inundated floodplain, requiring other, probably much less sophisticated capture methods: grasping by hand, use of striking gear, fish gorges, nets, scoop baskets etc. Hopefully, a thorough archaeological survey of the area of El-Hosh, which remains to be undertaken, may provide more tangible evidence with regard to the subsistence activities (and possibly also fishing practices) of the local Palaeolithic and later communities.

Dr Le Quellec has remarked that no other petroglyph of the Nile Valley has ever doubtlessly been read as a ground plan. This is perfectly true. I know of no other rock drawing in this extremely rich rock art tradition that may represent such a subject (although some side views of architectural structures are known). But maybe this is just another argument to conclude that this particular type of petroglyph is beyond the artistic context and single-progress-line of rock art that runs from the Predynastic to the Graeco-Roman period.

As Dr Berger has suggested, it might be wisest to refrain from any interpretation. But would selecting this safest approach not make rock art research a duller occupation? In any case, it was certainly not my intention to make a plea in favour of a return to 'the old hunting magic'. Hunting magic can on no account be regarded as a comprehensive explanation for any pre-Historic art tradition. But the fact that it cannot be a comprehensive justification does not imply that it can never have been a motivation at all for executing rock drawings. Other explanations than 'magic' have been proposed for similar petroglyphs elsewhere in the world. Fish-traps apparently are a very common motif in northern Amazonian rock art, for instance (see Williams 1979, 1985: 360-7). In this case, however, the traps are consistently associated with rapids and waterfalls, places where they were evidently effective. As such, these rock drawings may 'imply an intention to record information relevant to selective exploitation of the fish fauna' (Williams 1985: 367). They are, in other words, 'resource signposts'. This seems a perfectly logical and plausible explanation to me. If such a relationship between fish-traps and topographical features had also been the case in the rock art of the Nile Valley, I might have preferred to propose an analogous 'instructional-informative' motivation. Be that as it may, there is a tremendous amount of ethnographic evidence around, demonstrating that 'fishing magic' is not the 'odd practice' Le Quellec considers it to be (see von Brandt 1984: 276-82).

In my opinion the suggested age estimate of the El-Hosh curvilinear designs (late Palaeolithic) and their identification (labyrinth fish-traps) are in perfect agreement. If another, more convincing age and/or interpretation is suggested, I will be the first to applaud and rethink my position. I cannot, however, share Le Quellec's defeatist viewpoint that an hypothesis should not be advanced unless it can be falsified. Why in God's name should this be written in our epistemological code of conduct?

*

Résumé. *Sur base des sujets principaux représentant des bateaux, des figurations anthropomorphes et des animaux, l'art rupestre de la vallée du Nil est dans la plupart des cas d'âge préhistorique tardif (période Prédynastique) ou d'époque archaïque (vers 4400-2650 av. J.-C.). Bien que diverses propositions aient été émises, peu d'arguments, à l'heure actuelle, ont été avancés pour soutenir l'origine paléolithique d'une partie des représentations rupestres. Les observations de terrain, effectuées sur le site d'El-Hosh en Haute-Egypte, suggèrent un âge paléolithique final pour certaines gravures curvilinéaires, fortement patinées, qui pourraient être interprêtées comme des pièges à pêcher labyrinthiques.*

Zusammenfassung. *Auf Grund der häufigsten Themen (Boote, anthropomorphe Figuren und Tiere) ist der Großteil der Felskunst des oberägyptischen Niltales offensichtlich späten vor-Geschichtlichen (vor-Dynastischen) oder Frühen Dynastischen Alters (ca. 4400-2650 v. Chr.). Obgleich etliche Propositionen dargelegt worden sind, sind nur wenige Beweise für eine mögliche paläolithische Genese eines Teils der Felszeichnungen vorgelegt worden. Auf der Basis von Beobachtungen an der oberägyptischen Station El-Hosh schlägt dieser Artikel ein spätpaläolithisches Alter für tiefpatinierte kurvilineare Motife vor, die versuchsweise als Labyrinth-Fischfallen gedeutet werden.*

Resumen. *Sobre la base de su principal tema (botes, figuras antropomorfas y animales), la mayor parte del arte rupestre del Valle en el Alto Nilo Egipcio es manifiestamente de edad Prehistórico Tardío (Predinástico) o Dinástico Temprano (4400-2650 a.C.). Si bien varias sugerencias han sido hechas, pocos argumentos han sido expuestos para apoyar un posible origen Paleolítico de una parte de los dibujos rupestres. Sobre la base de observaciones de campo en el alto sitio Egipcio de El-Hosh, esta contribución sugiere una edad Paleolítica tardía para los diseños curvilíneos, intensamente patinados, que tentativamente pueden ser identificados como trampas laberintos para peces.*

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KEYWORDS: ***Rock painting - Water - Restoration - Electron microscopy - Texas - U.S.A.***

EFFECT OF WATER ON LOWER PECOS RIVER ROCK PAINTINGS IN TEXAS

Elmo J. Mawk and Marvin W. Rowe

Abstract. We utilised scanning electron microscopy to investigate the physico-chemical changes that occur to rock painting surfaces following application of water. Dissolution effects are visible microscopically; gypsum is selectively removed, leaving the less soluble whewellite and possibly calcite relatively enriched on the remaining surface. It is not known how these changes affect long-term (>100 year) survivability of rock paintings during natural exposure, but anecdotal evidence indicates that subtle effects, not dramatic ones, are seen over a fifty-year time span.

Introduction

Natural mineral accretions slowly accumulate on rock surfaces and on top of rock paintings after they are painted. In the Lower Pecos River region of Texas, the mineralogy of this accretionary matter has been extensively studied (Zolensky 1982; Silver 1985; Russ et al. 1994; Hyman et al. 1996). Lower Pecos River area accretions are comprised primarily of whewellite (calcium oxalate, $CaC_2O_4.H_2O$), with calcite (calcium carbonate, $CaCO_3$) and gypsum (hydrated calcium sulphate, $CaSO_4.2H_2O$) to a lesser degree. Treating rock paintings with water, both to enhance photographic images and as a restoration practice through the application of water to absorbent paper placed over rock paintings (poultices), has been practiced in the past and may continue to the present. Stigma is now associated with the use of water to aid photography. We examined physical and chemical effects that occur with the wetting process.

Lower Pecos River region, Texas. The study area is in Seminole Canyon in the Lower Pecos River region of Texas (see Figure 1 in Hyman et al. 1996). Pre-Historic people have occupied the region beginning approximately 10 500 years ago, as shown by the archaeological occupational record (Hester 1988: 54-5; Turpin 1991), and were still living in the area at the time of European contact, as evidenced by the appearance of European influences in the rock art: e.g. churches, horses, European style dress (Jackson 1938: 227-8; Kirkland and Newcomb 1967: 104-5). However, no extant group has claimed this region as its homeland. The surface geology is dominated by Cretaceous limestone that has been eroded into numerous deep, narrow drainage canyons. The down-cutting is the result of drainage of three rivers, the Pecos, Devils and Rio Grande, and their tributary systems. Because of the variable density and solubility of the limestone walls of these canyons, countless solution cavities, overhangs and rockshelters were formed.

Rock art. These rockshelters provided protection for some of the most extensive rock art in North America (Jackson 1938; Kirkland and Newcomb 1967; Turpin 1982, 1984, 1986a, 1986b; Zintgraff and Turpin 1991). The Lower Pecos River area rock art seems to have been created in near isolation from other pre-Historic cultures elsewhere in the Northern Hemisphere of the New World during any given time period. One genre of rock paintings from the Lower Pecos River region of Texas, 'Red Monochrome', is characterised by large, roughly life-sized, mostly red coloured anthropomorphous and zoomorphic figures. Dissimilarity between this genre and the older Pecos River genre led archaeologists to suggest that the Red Monochrome painters were newcomers into the region, unrelated to its former inhabitants (Kirkland and Newcomb 1968; Turpin 1986a). One Red Monochrome composite image with lizard-like features was dated by Ilger et al. (1996) at 1125 $\pm$ 85 radiocarbon years before present (BP); it showed some similarity with figures in the Four Corners region of Arizona, Colorado, New Mexico and Utah made during the Pueblo I period (A.D. 700-900; Schaafsma 1980; Cole 1990), supporting the earlier contention of movement of the 'Red Monochrome people' from another area into the Lower Pecos River region. One sample of another rock painting genre, 'Red Linear', primarily tiny dark-red stick figures, usually <10 cm high, was dated by Ilger et al. (1996) at very nearly the same age, 1280 $\pm$ 135 years BP. The polychrome (shades of red, black, orange, yellow and white) Pecos River genre is the oldest in the region, having been dated at about 2750 to

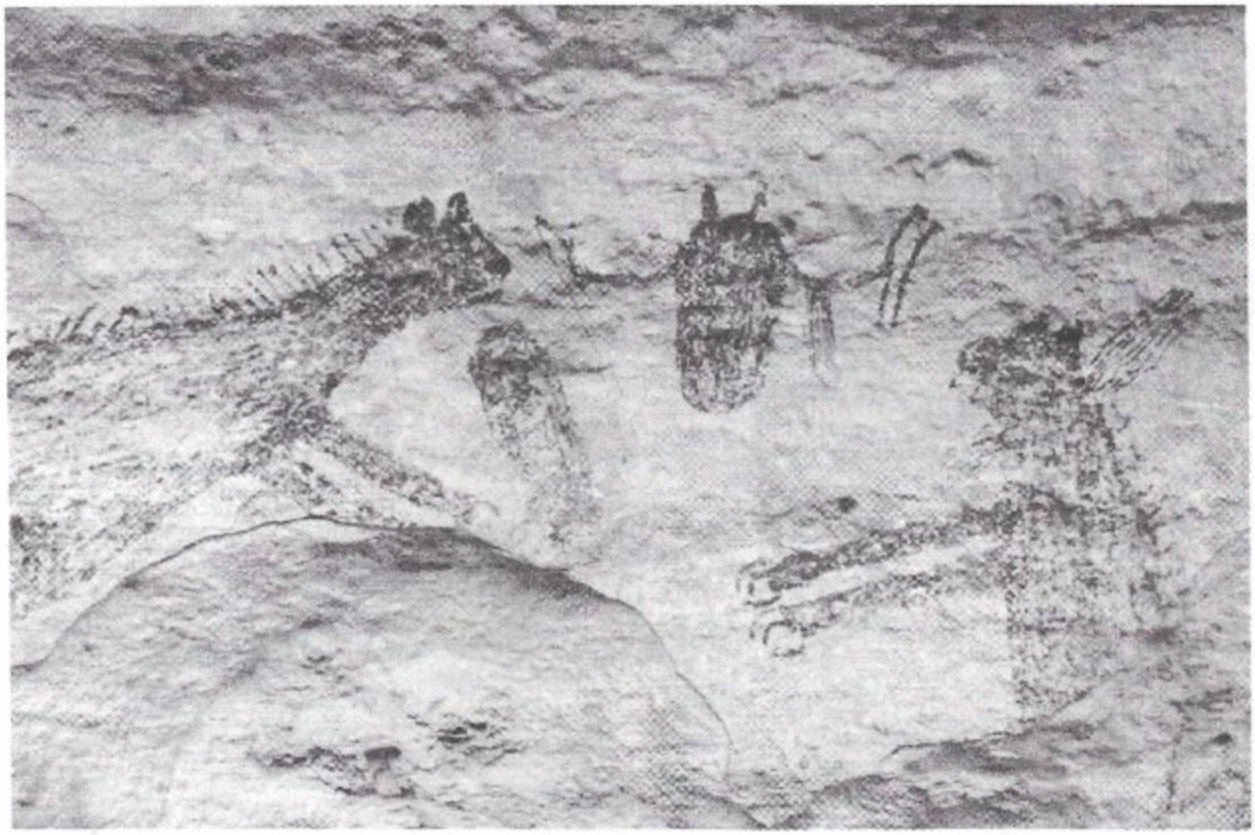

Figure 1. Photograph of a typical Pecos River genre rock painting panel. The bodies of the panther motifs are ~1.5 metres long. The central composite figure is holding what resembles an atlatl.

4200 years BP (Hyman and Rowe 1997, and references therein from our laboratory). We chose a sample of the Pecos River genre for this study. Figure 1 shows a characteristic Pecos River genre rock painting, a composite anthropomorphous/zoomorphic figure between two panthers.

Shelter 41VV75 was chosen for sample collection because severe natural exfoliation has already occurred to the extent that less than half of most rock paintings at the site still remain on the wall. Because of the deterioration at that site, Turpin (1982) suggested that it as an ideal one for sampling for research studies. The shelter is situated in the Seminole Canyon State Historic Park about 50 km north-west of Del Rio, Texas, near the confluences of the Pecos, Devils and Rio Grande rivers. The area is the home of more than 250 rock art sites, almost exclusively rock paintings, some of larger-than-life-sized composite and abstract figures.

Experimental procedure

To examine the physico-chemical effect brought about by contact of water with the surface of a rock painting, we immersed half of a 5 mm-sized rock painting sample in distilled water for 30 minutes under ultrasonication. The half immediately adjacent to the water-soaked one was left dry to serve as a control. We have sometimes seen rock painting samples brightened considerably by such rinsing in water as a preliminary treatment before subjecting the sample to plasma-chemical treatment prior to accelerator mass spectrometric radiocarbon dating. In the sample studied here, however, we could ascertain no macroscopic visual difference between the water-treated and the dry halves due to rinsing in water. But we also examined the changes that occurred using scanning electron microscopy (SEM). The instrument used, under management of the Texas A&M University Electron Microscopy Center, is a JEOL JSM-6400 scanning electron microscope that is equipped with the capability of energy dispersive x-ray spectroscopy (EDS). A selected microscopic region of the sample can be analysed for major and minor element composition, and from that, mineral constituents often ascertained.

For visually observing the surfaces of rock paintings, SEM has considerable advantage over light microscopy in that: (1) the depth of field is much greater in SEM than in light microscopy and; (2) qualitative chemical analyses are possible using SEM-EDS. The former is important because of the roughness of a typical rock painting surface in the Lower Pecos River region, an example of which is shown in Figure 2.

Results and discussion

The formation of a botryoidal accretionary surface makes the surfaces rough as shown in the scanning electron microphotographs of Figure 2. The effect of applying water to such a sample is not striking at the multiplication shown in the SEM photograph in Figure

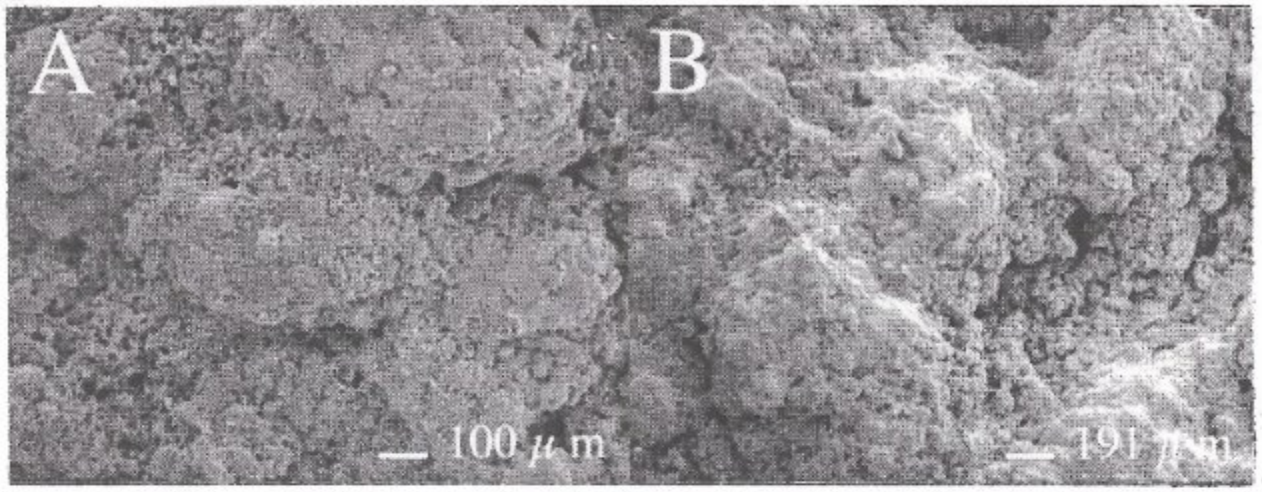

Figure 2. Low magnification SEM photographs of the untreated rock painting sample on the left and the water-treated sample on the right.

2. However, a distinct change in appearance of the water-treated surface is seen at higher magnification. For example, the SEM photographic montage shown in Figure 3A-F demonstrates that effect. After the rock painting was immersed in water, the surfaces are much more highly crystalline (Figure 3A-D) than the unmoistened control sample (Figure 3E-F), as photomicrographs of the control sample at similar magnification show. Clearly, there is a substantial change in the physico-chemical nature of the rock painting surfaces after water treatment.

The change that would be predicted when a rock painting surface in the Lower Pecos River region is drenched with water is that gypsum, $CaSO_4.2H_2O$, present in the accretion layer, would dissolve selectively over the whewellite and calcite constituents. Calcium sulphate is roughly 100 times more soluble in pure water than calcium oxalate or calcium carbonate. Thus, we would expect to see considerably more gypsum in the untreated sample of the rock painting compared to the sample that was soaked in water. That was confirmed by SEM-EDS analysis, where the dry control sample showed significant peaks due to calcium and sulphur, indicative of the presence of gypsum. However, after water treatment, no x-ray peaks were seen for sulphur, indicating selective removal of gypsum. Isolated micro-crystals of gypsum were still present on the water-treated sample, but were so rare that they had negligible effect on the overall elemental analysis.

Although physico-chemical change was apparent, the effect of that change on the stability of rock painting surfaces to natural adverse processes such as the freeze-thaw cycle that results in spallation, is more difficult to fathom. There is little evidence from which to infer what the effect of the selective dissolution of the gypsum will be over the long term. Three effects of water treatment, two acting in opposition to the third, can be surmised.

(1) Dust may be removed from the rock painting surface resulting in a brighter painted surface. That is one of the purposes of water poultice treatment in restoration attempts.
(2) A rock painting may be more clearly visible after water treatment due to removal of the translucent gypsum. However, the whewellite and calcite will remain largely unaffected, so the overall effect may not always be discernible — as it was not in the sample studied here. We have found that the visual aspect varies among individual samples; some are noticeably improved, some are not.
(3) Furthermore, whewellite accumulation may be enhanced in the long term by the treatment.

If whewellite accumulation is controlled by bacterial growth, it is conceivable that enhanced whewellite deposition may occur if latent bacteria flourish due to the increased moisture. Since water will evaporate normally in a matter of minutes from a natural rock surface in the arid Lower Pecos River region, we expect that effect will not be important. There are fifty years or more of anecdotal evidence in SW Texas that suggests negligible short-term effect on the rock paintings that were once sprayed with water for photographic enhancement. Many rock paintings moistened for photography are still visually indistinguishable from their photographs taken many years ago. Certainly possible deleterious effects of wetting rock paintings must therefore be subtle, rather than drastic; otherwise dramatic effects would have been noticed from the past practice of wetting for photographic purposes. We support the policy of not wetting rock paintings for photographic purposes, but further research is necessary to determine with certainty whether the changes associated with water treatment, whether from natural precipitation or by human application, are detrimental or beneficial to the long-term conservation of the visual artefacts.

We realise that the experiment reported here is not an accurate representation of what occurs when water is sprayed on a rock painting for enhanced photography,

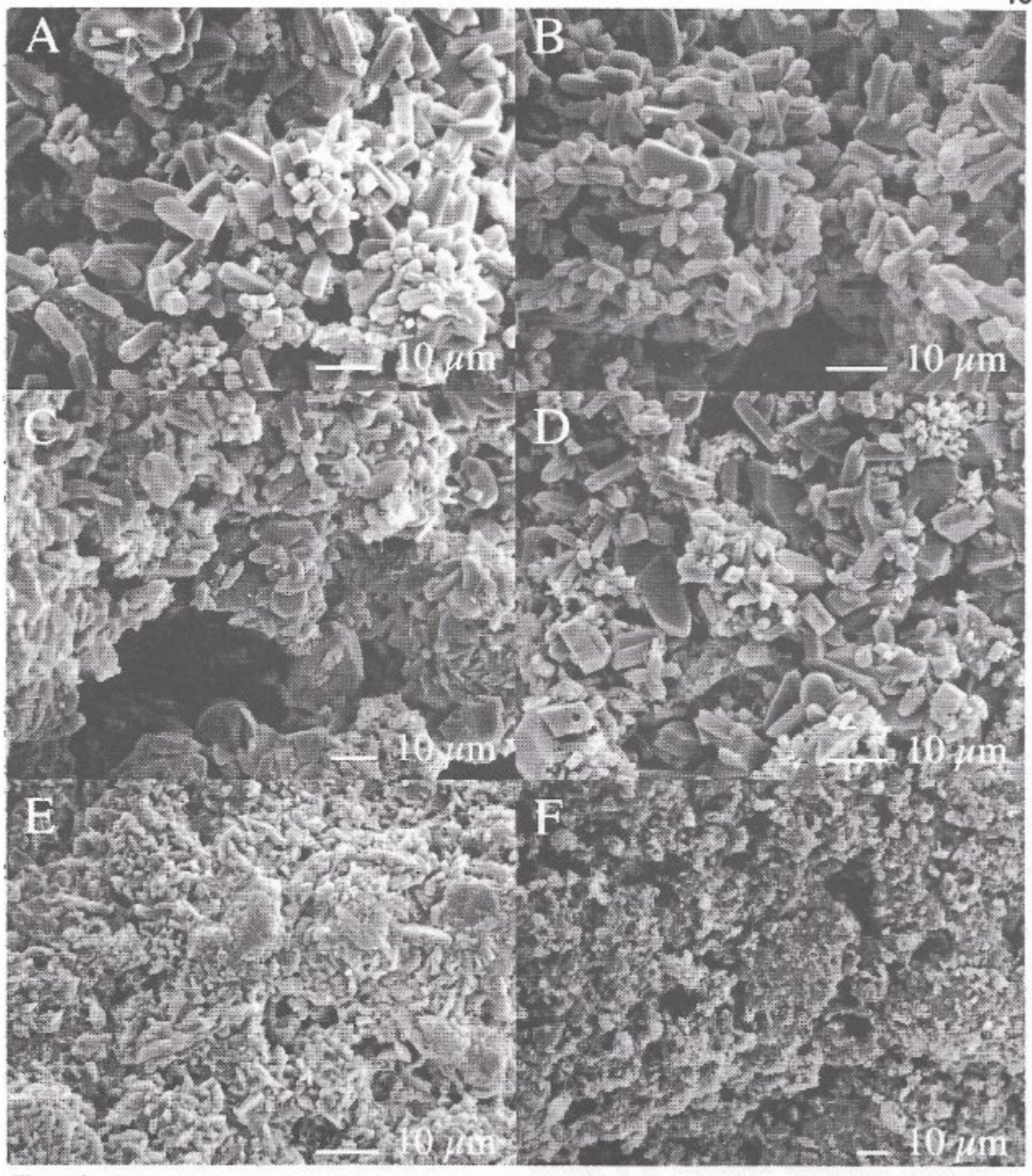

Figure 3. SEM photographs of four areas on the water-treated rock painting sample (the top four panels of this figure) and the two from the unmoistened control rock painting (the bottom two panels). Notice that the water-treated sample is much more highly crystalline than the dry control.

or when water is applied to an absorbent sheet of paper for restoration, or even during a typical rainfall. In the first case, even if gypsum were initially dissolved preferentially, it would redeposit upon drying. How this recrystallisation would affect the paintings can only be hypothesised. Our experimental situation is closer to the paper/water poultice application. There it may be expected that when gypsum preferentially dissolves, it will then be absorbed onto the paper and thus removed. Rain fall would be similar to our experiment only for the case of heavy direct rains, where the dissolved gypsum would be washed away. Furthermore, these results cannot be extrapolated from one region to another. The effect of the water is dependent on the micro-geochemistry of the rock painting surface. The Lower Pecos River region is an arid limestone region with paintings on walls of open shelters and exposed canyon walls. Similar geochemical areas will likely yield results like those reported here; but different areas (e.g. sandstone formations) will not.

Acknowledgments

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Résumé. *Nous avons utilisé l'ultramicroscopie pour examiner les changements physico-chimiques qui ont lieu sur la surface des peintures rupestres après l'application d'eau. Les effets de la dissolution sont visibles au microscope; le gypse est extrait sélectivement pour laisser sur la surface qui reste un dépôt relativement enrichi de whewellite moins soluble et peut-être de calcite. Nous ne savons pas la manière dont ces changements affectent la survivance à long terme (>100 ans) des peintures rupestres durant une exposition naturelle, cependant l'évidence anecdotique indique que des effets subtils, plutôt que dramatiques, sont observés sur une période de cinquante années.*

Zusammenfassung. *Ein Elektronenmikroskop wurde verwendet, die physisch-chemischen Veränderungen zu untersuchen, die stattfinden, wenn Wasser auf die Oberflächen von Felsmalereien aufgetragen wird. Auflösungswirkungen sind mikroskopisch sichtbar; Gips wird selektiv gelöst, was den weniger löslichen Whewellit und möglicherweise Kalzit relativ angereichert an der verbleibenden Oberfläche zurückläßt. Es ist nicht bekannt, wie diese Veränderungen die langfristige (> 100 Jahre) Überlebensfähigkeit der Felsmalereien unter natürlicher Aussetzung beeinflussen, doch anekdotische Evidenz deutet an, daß schwer merkbare eher als auffallende Effekte über einen Zeitraum von fünfzig Jahren zu sehen sind.*

Resumen. *Hemos utilizado el escudriñamiento de electrones por microscopía para investigar los cambios físico-químicos que se producen en las superficies con pinturas rupestres después de la aplicación de agua. Efectos de disolución son visibles al microscopio; el yeso es selectivamente removido dejando el menos soluble oxalato de calcio (Whewellita) y posiblemente calcita relativamente enriquecidos en la superficie que queda. No se sabe cómo éstos cambios afectan la supervivencia a largo plazo (> 100 años) de las pinturas rupestres durante la exposición natural, pero evidencia anecdótica indica que efectos sutiles, no dramáticos, son observados en lapsos mayores a los cincuenta años.*

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KEYWORDS: *Information exchange - Language - Symbols - Validation - Australia*

SEX, LIES AND SYMBOLIC BEHAVIOUR

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Abstract. Information exchange is fundamental to the operation of all extant human societies — how they use resources, structure social relations within and between groups, maintain cultural continuity and change. Symbolic evidences, including use of style, have been used to reconstruct aspects of pre-Historic ideology. If useful theoretical perspectives are developed, symbols also provide a key for the investigation of other cultural core elements. This paper begins by outlining a general model for the function and origins of symbol use in human communication. It then examines a case study from Aboriginal Australia. General implications for the interpretation of inferred symbolic evidences in the archaeological record are discussed.

Introduction

Human groups occupy a unique ecological niche, which depends upon exchange of information within and between groups to ensure biological and social viability. In fact, efficient use of resources by all modern human groups depends upon the ability to communicate information about resource availability and distribution. Information concerning the social landscape — on the distribution of friends, enemies and potential mates — is also an essential basis for decision-making.

Language is the main communicative medium for information exchange within and between groups. Given our niche option, there must have been strong selective pressure on ancestral human populations to develop communication systems of increasing complexity, especially language.

With the possible exception of higher primates (e.g. Savage-Rumbaugh and McDonald 1988), animals can not consciously lie to their fellows. Humans do. Therefore, at a certain stage of human communicative development, the potential arose to pass on false information (Conkey 1978: 74; Noble and Davidson 1993: 141). Such misinformation is potentially of great advantage to the source and of major disadvantage to the recipient. Information received therefore needs to be carefully filtered and assessed, but biological means of assessment, such as monitoring the body language of source individuals, are only suitable for gauging the veracity of certain types of information in close encounter situations. Therefore, with increasing communicative complexity, there must have been strong selective pressure to develop cultural means for recipient individuals or groups to authenticate information by assessing the relevance, 'trust-worthiness' and authority of the source (Davidson and Noble 1992: 139; Moore 1983: 185).

In all recent human groups, conventional, esoteric symbols and knowledge are used to denote allegiance, authority and status within information exchange systems. Examples in Western society include titles, academic gowns, insignia of military rank, uniforms, flags, judges' wigs, diplomas, and other stylistic features of dress and ornamentation. Stylistic markers can also be used to deceive. Spies, for instance, may adopt the uniform of the enemy. Redundancy and the ability to cross-check information and sources are therefore important parts of the validation process. In modern journalism, stories are routinely checked with a number of sources, while symbolic systems generally rely on sets of markers to signify a particular status. Soldiers, for instance, broadcast their affiliation with specific helmet styles. On closer inspection they also have a range of more specific insignia. Closer still, they may have to show 'official' identification papers (cf. Wobst 1974).

Language and validation markers are functionally integrated, symbolic systems for information exchange. In fact, the same evolutionary pressures responsible for refinement of human communication systems must have acted to produce a like sophistication in validation systems. Initiation ceremonies, creation myths, distinctive decorative systems, rock art and other symbolic behaviours, all function primarily to establish the status of individuals in information exchange and decision-making. In an evolutionary perspective, the complexity of information validation systems must have developed in tandem with the increasing complexity of primary information systems.

The crux of the hypothesis is that:

(a) Language is the primary human communicative means for conveying ecological and social informa-

tion crucial for individual or group survival.

(b) Symbolic behaviour and esoteric knowledge systems function primarily as a means to give individuals standing in the exchange of such ecological and social information.

(c) Symbolic behaviour and esoteric knowledge systems evolved primarily as a means to give individuals standing in the exchange of such ecological and social information.

The validity of the first proposition is self evident. The second and third propositions are intertwined: the role of symbol use and esoteric knowledge in modern human communication has implications for the processes of development, as does the associative context of early symbol use. The following sections are concerned with these points.

Testing the theory: Aboriginal Australia

In well-documented social systems, such as in Aboriginal Australia, the primary purpose of decoration, style, ceremony and symbolic knowledge is to express standing in information exchange and decision-making. For instance, each Aboriginal clan estate contained story and totem sites derived from the actions of creative ancestral beings, and rights to speak for country and use resources depended upon knowledge about this associated sacred law (e.g. Chase 1984; Sutton and Rigsby 1982; 158). Continued ownership of land was on the basis that clans maintained the sacred law, performed required ceremonies and passed on the law to succeeding generations (Morphy 1991: 49).

Ceremonial items, ceremonies, designs used in bark paintings, body paintings and rock art, and songs were all embedded in the creation myths associated with particular tracts of country (e.g. Spencer and Gillen 1899: 201; Strehlow 1970). They served as a tangible charter for land ownership and rights to use them were guarded. In fact, unauthorised use was tantamount to staking a claim for associated country and could lead to serious disputes. Some items, ceremonies and designs were publicly displayed, others were only used in restricted contexts. However, the same form could have 'outside' and 'inside' levels of significance (e.g. Morphy 1991: 78).

There was also a close relationship between the primary communicative medium, language, and locales. For instance, in Cape York Peninsula, each clan estate had its own dialect, used by the occupants of that estate regardless of their actual clan affiliation (Roth 1910). Choice of language in mixed group situations, as at Beswick Settlement, may also reflect inter-personal power relations (Claire Smith, pers. comm.). At a larger scale, there was substantial overlap between patterns of marital exchange, social gatherings and language — hence the definition of a 'tribe' (see Tindale 1974).

Esoteric, conventional knowledge about the relevant creation myths validated land ownership, while differences in level of initiation into the symbolic knowledge system determined status within the group decision-making hierarchy. Within clan groups, knowledge of the symbolic landscape was differentially accessed on the basis of sex, generation, primogeniture and sub-group affiliation. This hierarchy of ritual authority based on the layering of symbolic knowledge provided the fundamental basis for achieving social and economic power (Williams 1985: 98ff). Social control by senior, graded men was exercised in a number of ways; for instance, by withholding knowledge essential for an individual's social advancement (e.g. Morphy 1991: 63).

Individuals progressively acquired knowledge about the symbolic landscape and associated paraphernalia, both informally and by passing through a series of formal initiation ceremonies. The graded status, allegiance and authority of individuals was reflected in body paintings, body scarring, tooth avulsion, circumcision and subincision. Conventional symbols of status and affiliation minimised the risk of individuals misinterpreting the social identity or ranking of other individuals — a potential cause of social tension and conflict (Morwood 1987: 340).

The tracks of Ancestral Beings crossed many clan estates ensuring that a clan's sacred knowledge overlapped and tied in to that of neighbouring clans. Clan members therefore had standing at the regional level, which was exhibited during large-scale ceremonies involving different groups. Symbolic items from different clan estates, but relating to the same Ancestral Track, also had formal similarities (e.g. Taylor 1979). The length of Ancestral Tracks was related to the nature of country: in central Australia, they linked widespread groups, whereas in Cape York Peninsula and the western Kimberley they were comparatively short (e.g. Layton 1985: 441).

Validation markers also served to give standing in the formal exchange of information between groups. For instance, invitations for other groups to attend fights, feasts or ceremonies were commonly conveyed by messengers bearing message sticks and specific body paintings as symbols of their authority (e.g. Mathew 1910: 114; Petrie 1904: 38).

The need for people to have localised symbolic knowledge to use resources served as a way of reducing territorial access (e.g. Biernoff 1978). Not knowing the stories for a locale put strangers at a tremendous disadvantage, as von Sturmer (1978: 295) notes:

> Even men of high status are fearful to move until they have been properly introduced to the country, noting the location of 'story places' (awu) and discovering the direction in which it is safe to go hunting.

Within a potential social and economic catchment, local Aboriginal populations could be sub-divided on the basis of clan, resident group, moiety, section, matri-totemic group, initiation grade, sex and so on. Symbolic markers of sub-division affiliation and status involved a range of media, some for public display (e.g. shield motifs), others for use in restricted contexts (e.g. *tjuringa*). The structural characteristics of these validation sub-systems were determined by the distribution, role

and the information requirements of their membership.

Each validation sub-system had a unique configuration of markers, but the complexity of sub-system overlap and inter-dependence ensured a like overlap and interdependence in symbolic behaviours and knowledge. For instance, in central Australia 'restricted' art emphasised use of geometric and track motifs, whereas public art tended to be figurative. Despite this, there was considerable overlap (see Mountford 1976: Pl. 15).

There have been many semiological studies undertaken on Aboriginal decorative arts, which have demonstrated how social and ecological information is encoded (e.g. Morphy 1991; Taylor 1979, 1987; Munn 1973). A crucial point, however, is that this information is *not* inherent in bark paintings, *tjuringa* designs, or shield motifs, which are only meaningful to an informed audience. In addition, more refined levels of interpretation are restricted to those formally initiated into associated levels of symbolic knowledge. Decorative arts not only signify tribal, clan, totemic and graded status and affiliation, but all categories reinforce the symbolic information hierarchy, which in turn determines access to resources, social status and influence in decision-making.

Discussion

Archaeological evidence for symbolic behavioural systems appeared late in the human evolutionary sequence. About 36 000 years ago, the appearance of personal decoration, the stylistic embellishment of material culture and art in the Aurignacian of at least two regions mark the appearance of the Upper Palaeolithic in western Europe (Delluc and Delluc 1981; Müller-Beck 1983: 287-8, 303-16). The significance of this change has been the subject of much debate. Gamble (1980), for instance, has argued that the increased information requirements of more socially and economically complex human societies led to the development of subsidiary systems for information transfer. In contrast, Davidson and Noble (1989) suggest that the appearance of depiction in the European Upper Palaeolithic, perhaps by the fixing of gestures in permanent media, initiated the capacity to symbolise, and that this allowed the development of reflective languages, which have tremendous adaptive value.

Although the specific mechanisms for the development of language are debatable, the fact that it is underwritten by the ability to symbolise is not — and the earliest indisputable evidence in the archaeological record for the use of symbols occurs in the European Upper Palaeolithic (i.e. representational art). The organisational complexity of human activities evident in various parts of the world from at least this time (e.g. co-ordinated mass-hunting techniques, the sea voyages required to reach Australia), also indicates an associated communicative complexity indicative of language (see Noble and Davidson 1992). If the primary role of early symbolic behaviours was to mark, communicate and maintain the status of sources and recipients in information exchange, then one would expect evidence for hierarchical structuring within the system.

The location of some Upper Palaeolithic rock art panels deep underground indicates that they and the associated symbolic information were of restricted access (Bahn and Vertut 1988: 13). As well as figurative motifs, in which the superficial aspects of reference are self-evident, the earliest known art systems all include geometric motifs for which meaning has to be explained and learnt. The location and esoteric content of some early art assemblages indicate that there was differential access to meaning and that individuals had to be initiated into this meaning. The evidence suggests that some artistic behaviour during the European Upper Palaeolithic was related to the creation and maintenance of a hierarchy of symbolic knowledge. Such status differences function to give individuals social standing in general information exchange and decision-making. Such standing needs to be validated.

Implications of the model

Of particular importance is the fact that this theoretical perspective on the origins of symbolic behaviour has practical application for the archaeological study of information exchange, resource use, mating networks and decision-making.

Human communication systems are potentially open-ended, and exchange of peripheral information can occur over huge distances. However, only a sub-set of the information available will be crucial at varying times/circumstances for a group's decision-making and survival. At a minimum, structured validation systems are required for exchange of this sub-set of ecological and social information.

Information evaluation comes at a cost. This cost can be reduced by limiting the number of acceptable participants, by using esoteric means for encoding social affiliation and standing (Johnson 1978). Maintenance costs can also be reduced by stylistically bounding validation systems to coincide with the marital and resource catchments of user groups — the extent of validation systems will therefore be determined by a 'need to know basis'.

The nature of ecological and social information exchange is determined by specific economic and associated social requirements. This means that the structural characteristics of symbolic systems relate directly to the nature of the social/resource catchment relevant to the user groups, group or sub-group. The patterning of symbolic behaviours is thereby functionally embedded in the operation of specific types of information exchange/validation systems. In turn the latter are tailored to specific social and economic requirements. This means that symbolic evidences in the archaeological record have the potential to document core elements of pre-Historic land use — as well as ideology (see Godwin 1990).

The geographical extent of validation systems will depend upon the quantity, distribution and reliability of resources, as well as other factors determining population density. In unpredictable, unproductive and/or recently colonised environments, widespread information

nets are necessary if people are to cluster or disperse in response to environmental conditions and resource availability. Individuals spread over a wide area will need to have recognised status within the information/validation system. The associated symbols and symbolic knowledge should be similarly widespread. Localised symbolic knowledge should also be closely integrated into extensive networks incorporating all groups within the potential resource catchment. Because of the demographic flexibility required for exploitation of such poor environments, changes in symbol use should also be gradual, with the need for accurate assessment of an individual's communicative standing diminishing as a function of distance.

In more predictive, productive and sedentary situations use of resources is more localised. Validation systems for social and ecological information are therefore similarly localised — closely tied to what Wobst (1974: 154) has termed the minimum equilibrium size for the society — that population size needed to guarantee a supply of suitable mates. In particularly poor environments, this choice of suitable mates may be arbitrarily restricted by the complexity of social rules which restrict potential marriage partners. Such rules are of adaptive value in that long-distance marital exchange and the resulting social alliances increase the potential resource catchment (Yengoyan 1976).

The association between resource poor, unpredictable environments and widespread art systems and vice versa, has been documented ethnographically (e.g. Smith 1992). The same general principle has been used to infer the environmental and demographic context of art in the archaeological record (e.g. Brandt and Carder 1987; Gamble 1982; Lewis 1988: Morwood 1979, 1984, 1992, 1994), but the rationale has been inductive. The need for validation markers in the exchange of essential social and ecological information between groups provides a specific mechanism for explaining the association between environment and the distributional characteristics of symbol use. With more detailed analysis of their cultural and natural context, symbolic evidences should provide another means to investigate the nature of land-use (intensive or extensive), residence patterns (sedentary or nomadic), social relations and population levels (high or low, clustered or dispersed).

The corollary of a functionalist interpretation for symbolic behaviours is that those groups not dependant on widespread exchange of economic information with other groups, will not have highly formalised symbolic/ceremonial systems or markers for establishing the status of individuals. In this regard, the communicative and symbolic systems of hunter-gatherer groups like the Shoshone, Western Ute and Paiute of the American Great Basin (e.g. Steward 1938), the !Kung of the Kalahari Desert in Botswana (e.g. Lee 1979) and the Hadza of East Africa (e.g. Woodburn 1968) would all make useful comparisons with those of Aboriginal Australia (see Peterson 1979). For instance, in the case of the Shoshone, communal enterprises involving groups of families or villages were limited and brief. Alliances tended to be temporary and shifting. The powers of headman and shamans in negotiation, control and decision-making were limited. Ritual life is reported to have been similarly restricted with festivals, sweat houses, mourning ceremonies, and some warfare contributing to group cohesion in varying degrees (e.g. Steward 1938: 45, 55, 75, 257). Although research on the rock art of the region has shown that Great Basin ritual life was more elaborate than previously thought, the contexts of production confirm the essentially private (within-group) nature of ceremony in the region (Whitley 1987: 184; see Wiessner 1984 for the !Kung).

Any human population will have different interest groups, differential information flow, and hence a variety of information sub-systems associated with different but overlapping validation sub-systems. Because individuals may play a variety of social and managerial roles according to circumstance, age, gender, initiation status, experience and sub-group affiliation, symbolic sub-systems associated with different status roles should be characterised by overlap and 'leakage'. This means that the contextual analysis of symbol use can be undertaken at different levels of resolution, corresponding to the flow of information between and within residential groups.

Conclusions

In this paper I have argued for a functional relationship between the distributional structure of symbolic behaviours, information exchange, resource use and marital exchange — clearly these also have implications for gene flow, language use and differentiation, and the development of decision-making hierarchies and social stratification. These are core elements of any human society. If the model is upheld and further developed, it represents a basic structural principle for the investigation of the past. Far from being at the periphery of archaeology, the study of symbol use, including rock art, decoration and ornamentation, has the potential to more fully document the complexity of human change and achievement.

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Résumé. *L'échange d'information est fondamental au fonctionnement de toutes les sociétés humaines présentes — à la façon dont celles-ci utilisent les ressources, structurent les*

rapports sociaux parmi et entre les groupes, et maintiennent la continuité culturelle et le changement. L'évidence symbolique, y compris l'emploi du style, a été utilisée pour reconstruire des aspects de l'idéologie préhistorique. En développant des perspectives théorétiques utiles, les symboles peuvent aussi fournir une clé à l'investigation d'autres éléments culturels essentiels. Cet article commence par délinéer un modèle général du rôle et des origines de l'usage du symbole dans la communication humaine. On examine en suite un cas de l'Australie aborigène. Les implications générales sont discutées concernant l'interprétation de l'évidence symbolique déduite du registre archéologique.

Zusammenfassung. *Informations-Austausch ist für das Funktionieren aller bestehenden menschlichen Gesellschaften unentbehrlich — wie sie ihre Quellen verwenden, soziale Verhältnisse innerhalb und zwischen Gruppen aufbauen, oder kulturelle Kontinuität und Änderung erhalten. Symbolische Beweismittel, einschließlich der Verwendung von Stil, wurden dazu verwendet, Aspekte vor-geschichtlicher Ideologie zu rekonstruieren. Wenn nützliche theoretische Perspektiven verwendet werden, liefern Symbole auch einen Schlüssel für die Untersuchung anderer kultureller Kern-Elemente. Dieser Artikel beginnt damit, ein allgemeines Modell für die Funktion und Ursprünge von Symbol-Verwendung in menschlicher Verständigung zu umreißen. Er untersucht dann ein Beispiel aus Aboriginal Australien. Allgemeine Folgerungen für die Deutung von gefolgerter symbolischer Evidenz in archäologischen Aufzeichnungen werden besprochen.*

Resumen. *El intercambio de información es fundamental para la operación de todas las sociedades humanas actuales — cómo usan los recursos, relaciones de estructura social dentro y entre grupos, mantenimiento de continuidad cultural y cambio. Evidencias simbólicas, incluyendo el uso de estilo, han sido usados para reconstruir aspectos de ideología prehistórica. Si se desarrollan perspectivas teóricas útiles, los símbolos también proveen una clave para la investigación de otros elementos culturales substanciales. Este artículo comienza por delinear un modelo general para la función y orígenes del uso de símbolos en la comunicación humana. Luego examina un estudio de caso de la Australia Aborigen. Implicaciones generales para la interpretación de evidencias simbólicas inferidas en el registro arqueológico son discutidas.*

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THE TECHNOLOGY OF PETROGLYPHS

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Abstract. Methods of making petroglyphs are examined, both through characteristic traces in the rock art and the implements used in creating this rock art. Rock carving tools are discussed from ethnographic and archaeological perspectives, and the scope of their detailed study is considered. Particular attention is given to the use of replication experiments and the newly introduced use of petroglyph-making implements as a means of estimating the age of rock art. The paper concludes with a call for the establishment of a project systematically both to study petroglyphs, and to monitor their taphonomy under controlled conditions over a very long period.

Introduction

Globally, rock art motifs can be divided into two principal classes on the basis of their method of manufacture: those made by a reductive process (petroglyphs), and those made by an additive process (paintings, wax figures etc.). This distinction is not only practical and sensible, but widespread in the art; it affects site preservation and management practices; and, perhaps most importantly, it is reflected in the way we conduct *rock art science*. For instance, the methods used in determining the possible ages of rock art differ greatly according to whether the art was made by an additive or a reductive process. This paper addresses petroglyph manufacturing methods and, particularly, the reductive processes they involve.

The lack of fundamental studies of many aspects of rock art is a fair indication of the recent development of rock art science. For instance, the first scientific publication on how to discriminate rock art from natural rock markings — an issue that is very fundamental to the discipline — appeared only in 1994. Until then it was common for researchers to mis-identify both anthropic and natural rock markings. 'Direct' methods of age estimation of rock art (often called 'rock art dating') have only been developed over the last couple of decades, and especially since about 1990. Similarly, the question of the technology of rock art production has not attracted a great deal of interest, and there is no publication systematically addressing this topic. Because of this lack of basic research, students of rock art have often commented on the technology of rock markings in a cursory and more-or-less subjective fashion. Methods of making rock art were in most cases considered without recourse to ethnographic observation, replication experiments or detailed examination (particularly microscopic analysis).

As in the case of systematically discriminating between anthropic and non-anthropic rock markings (Bednarik 1994a), it is necessary to examine the present topic by considering very basic issues. There is a close nexus between the technology of petroglyphs and the terminology used to describe them. Indeed, terminological ambiguity and confusion have significantly contributed to past misunderstandings.

Terminological issues

In our discipline, there might be seen to be an inverse proportion of the number of hypotheses produced to the quantity of scientific information actually available. It has also spawned the greatest diversity of idiosyncratic terminologies relative to the number of practitioners. In Australia, the two major attempts to create rock art terminologies are those of McCarthy (1967, 1969) and Maynard (1977). Globally, some degree of standardisation has been introduced since the advent of *Rock Art Research* (in 1984) and the International Federation of Rock Art Organisations (IFRAO - in 1988), but agreement on terms remains elusive. This is confusing to the newcomer, it continues to fuel systematic disagreements between researchers, and it is often directly related to issues concerning technology. To see this it is useful to examine the debate between McCarthy and Maynard (cf. McCarthy 1989 and debate).

Maynard, whose proposed system is more consistent and analytically relevant than McCarthy's (essentially for the reasons she states), considers the need for a typology paramount: without it, quantitative analysis is impossible. She compares this need to the prerequisite typology for stone tool studies, apparently considering that the lithic taxonomies created by archaeologists are valid outside of archaeological constructs. Recognising how typologies are not usually designed by sound principles, but 'grow, like mushrooms, in the dark' (Maynard 1977: 388), she offers a comprehensive classification system

based on her own understanding of Australian rock art. In analysing inconsistencies in McCarthy's nomenclature, Maynard observes for instance the ambiguity in using the term 'engraving' both as a major term (in the sense of 'petroglyph') and for a specific technique (incising, scratching or cutting action). In her own system, based on the variables of technique, form, motif, size and character, she lists three headings for reductive-technique rock art forms (petroglyphs) according to whether the figures were made by friction, percussion or rotation. Under 'percussion' she offers the sub-headings 'direct percussion' (pounding) and 'indirect percussion' (pecking). In other words: percussion petroglyphs were made either by using a hammer in one hand ('pounded'), or a hammer in one hand and a chisel (or bit, punch or gad) in the other ('pecked'). The term pecking (or peck marks, pecked designs etc.) has been widely adopted and is one of the most frequently used technological terms one now reads in rock art descriptions.

I have made an effort to follow this terminology (cf. Bednarik 1984), but have found that most Australian writers avoid the word 'pounding', using 'pecking' for practically all percussion petroglyphs. This can either mean that they reject Maynard's nomenclature, or that they believe that most Australian petroglyphs were made by indirect percussion. My own research has produced no evidence that the indirect percussion method was ever used, in Australia or in any other continent, in any significant frequency — if indeed at all. If indirect percussion was used, with a stone 'chisel' and a stone hammer, this should have resulted in vast numbers of discarded stone implements with distinctive bipolar damage (similar to the 'fabricator' or *outil écaillé*). No such tools have been reported from petroglyph sites. The idea of indirect percussion is an unsupported, academic pronouncement ('academic' in the sense of 'impractical') and its advocates have not demonstrated the technique by replication (Bednarik 1991a: 117). It would require between 25 000 and 100 000 impact nicks per square metre of pecked petroglyph area (many figures are larger than that), and on completion the artist's fingers would probably require amputation. I have seen sites with over 1000 m^2 of 'pecked' area, and if we assume that each chisel can make 100 nicks before it is too worn and that each such slug weighs just 25 g, we should have at least 25 tons of such slugs at these sites.

Preoccupation with the question of direct *versus* indirect percussion seems to result from an over-emphasis of difference between motifs with precisely directed, deep percussion marks, and those with more diffuse, shallow and apparently less well directed marks, and the conclusion that the two must be attributable to two different production methods. In reality, other variables are more likely to account for technological differences. These variations might include the type of rock, depth of weathering zone, presence of case hardening, direction of impact, presence of moisture, and various attributes of the percussion tool used. The tendency of explaining different impact marks as the result of different techniques is consistent with other archaeological interpretations: that the specialist is capable of distinguishing taxonomic entities among the physical evidence considered to be of archaeological relevance (Bednarik 1994a).

There are various other problems with Maynard's classification system which need not concern us here. Its best features, however, have tended to be ignored. Her endeavour to establish a technology-based terminology led her to point out that very few Australian petroglyphs are 'engravings' (i.e. have been produced by a method similar to that of traditional metal engraving), and yet the term 'engraving' continues to be used by some Australian and British archaeologists in describing all rock art made by the removal of mineral mass. Again, this misuse of technology-derived terminology is attributable to a misunderstanding of technology: an 'engraving', as Maynard points out, is a marking made with a burin or graver. In palaeoart studies it typically refers to a subtractive process producing markings on portable objects (stone, bone, ivory, ostrich eggshell, amber etc.) and to similar markings on rock. These were, as Maynard argues, made by friction (or, to be more specific, by incision, scratching or abrasion), and certainly not by percussion of any type (unless a combination of techniques was used). In short, the use of 'engraving' to describe a percussion petroglyph seems to indicate lack of technological understanding.

Insistence upon the use of rigorous terminology is not mere pedantry; terminological confusion reflecting poor understanding of technology is likely to result in unrigorous, poorly founded models and, more serious still, in neglect of crucial archaeological evidence.

Archaeological views and their effects

In a recent major review of Australian rock art, Flood (1997) includes a chapter on petroglyph techniques. She begins by repeating the separation of petroglyphs into those made by direct and those by indirect percussion and then states that (Flood 1997: 103)

> It used to be thought that the hammer and chisel method gave clean edges, precise lines and some depth to an engraving, whereas pounded examples were shallower and more diffused, but when John Clegg read this statement in my first draft of this chapter he decided to check it by experimental archaeology. So, at Easter 1996 [i.e. before Flood's book appeared], he drove out to western New South Wales, collected some sandstone slabs from the Mootwingee region (*not* from the site itself) and contacted archaeologist Dan Witter and Badger Bates, an Aboriginal site officer of the New South Wales National Parks & Wildlife Service. In Dan's garden in Broken Hill they proceeded to make engravings by both the indirect and direct methods. Contrary to conventional view, they found direct percussion with a fist-sized quartz hammerstone far more effective than the indirect method.

The question to ask here is not what Clegg's results were, but why there should have been a 'conventional view' among Australian archaeologists that was contrary to the findings of rock art scientists and ethnographic observers of rock art practice (see below). This is a question of heuristic dynamics in archaeology, a subject that I find immensely interesting. Rock art scientists

have conducted such replication work for decades, have learnt to recognise petroglyph-producing implements from their findings and have collected large numbers of such tools, in every continent. Ethnographers have recorded the making of petroglyphs for many more decades (see below). Archaeologists commenting on this subject seem unaware of both the ethnographic and scientific evidence available on this topic, and have created a purely theoretical system of taxonomy which is essentially impractical and derived from confirmation (science is falsification based).

Flood also refers to implements used in the production of petroglyphs elsewhere in her book, in relation to motifs made on the walls and ceilings of Australian limestone caves. She recounts some of my results concerning the tool materials used in making cave petroglyphs, and dedicates several pages to the question of how the anthropic ceiling markings in Orchestra Shell Cave (OSC), north of Perth, were made (Flood 1997: 59-66). Hallam (1971) suggested that the markings were produced with an animal claw fastened to the end of a stick, apparently without previous experience in the study of either animal scratches or finger flutings. As I was conducting a global review of both types of markings, I found her explanation not convincing, and expected to find animal scratches (which I have studied in about 1000 caves and shelters, examining samples in all continents, in dozens of countries) in the cave. Upon examining those in OSC I found that they were clearly finger markings, although heavily affected by travertine growth and erosion. Flood has found that Hallam continues to disagree with my interpretation and to hold fast to her hand-held claw hypothesis.

Flood actually offers a third explanation: that the subject markings in OSC are identical to certain markings in my photograph from Karake Cave which the researchers of the Parietal Markings Project unanimously define as standard animal scratches (Bednarik 1991b: Fig. 16). She concludes from this that both Hallam and I are right. But this is entirely wrong because Hallam and I agree fundamentally that the ceiling markings in OSC are humanly made. We only differ on the tool involved. In OSC, as in any other cave of the world (except on certain islands), there are animal scratches, but they are not the issue; the ceiling markings in one part of the cave are the issue.

This example illustrates the kind of trivialisation of aspects of the technology of rock art: opinions are formed almost without justification, on the basis of pictures in publications or similar spurious factors. In a scientific sense, rock art is not an archaeological phenomenon, but a geomorphological one: it is a form of biological weathering, a subject of human ethology. Most archaeological commentators on rock art ignore the geomorphological processes that have affected the art (e.g. the behaviour of carbonate speleothems or patterns of weathering in a cave environment), and yet rock art science has shown that it is primarily through these processes and their results that rock art can be studied scientifically.

One could argue that it does not matter if archaeologists invent a mythology about rock art; it does no harm. But this is not strictly true. Archaeologists are often placed in positions of executive control over rock art sites; they often excavate at rock art sites. If archaeologists are unable to recognise the tools used in the production of petroglyphs then they will not find or recognise the petroglyph tools in sediments below or near petroglyphs. Such finds will go unreported even though they are of profound importance to the archaeology of the site in question. For example, petroglyph tools in stratified sediments might be able to be dated, and since they were associated directly with some of the petroglyphs present they may provide reliable age estimations for the rock art.

Numerous archaeological excavations have been conducted at petroglyph sites, but there are no reports of stratified petroglyph-producing tools from nearly all of them. Since such tools have often been observed as surface finds by a few specialists (see below) it is to be expected that they should also occur below ground, especially at early sites. The explanation is probably to be found in the inability of most archaeologists to recognise such tools. Any such tools from stratified contexts would provide crucial archaeological evidence at a petroglyph site.

A recent illustration of this limitation is found in the reports of the numerous excavations conducted by several archaeologists in the Côa valley of northern Portugal, in most cases at the foot of petroglyph panels. As Swartz has already observed in relation to these excavations, 'important associated materials may be lost or destroyed, e.g. possible abandoned engraving tools used to make the markings' (Swartz 1997a: 73). Having conducted systematic removal of mineral and lichen covers at these sites (which have eliminated practically all possibilities of 'direct' dating; Jaffe 1996; Zilhão 1996; Bednarik 1996a; Swartz 1997a, 1997b), state-funded researchers have also eliminated the possibility of dating petroglyphs via stratified petroglyph-making implements because they lacked the competence to recognise them.

Ethnographic observations

The most extensive ethnographic information we possess about rock art is that of Australia, where painting on rock continues to the present day. Aboriginal painting traditions have not only survived, they thrive today on media such as bark and canvas. Knowledge about the cultural context and the techniques used in rock painting continues to be collected (e.g. Mulvaney 1996), and numerous Aboriginal communities across the country perceive recent rock art traditions as ongoing — as externalisations of living culture (Ward 1992).

Petroglyphs, on the other hand, are usually ascribed to 'the ancients' (as are some paintings), or are considered to be of non-human origins. They may have been made by ancestral heroes, or they are attributed to the time 'when the rocks were still soft' (Flood 1995; Mow-

aljarlai and Vinnicombe 1995). Although there is certainly a distinct paucity of ethnographic data concerning the production of petroglyphs, detailed accounts nevertheless do exist in Australia. For instance, Mountford has witnessed and photographed the making of petroglyphs on several occasions (1955, 1976). In 1937 he observed the production of sgraffito petroglyphs (figures produced by the removal of a layer of material of colour different to that of the material exposed) at The Granites, and reported that the artist used a 'small rounded pebble held in the hand' (Mountford 1976: 76). His photographs (Pls. 19, 20) show the left-handed use at a pavement site of a fist-sized, flattish cobble of about ten centimetres. A further illustration (Pl. 21) shows a man using a thin cobble of probably much less than 200 grams mass to produce a petroglyph by striking a vertical wall at eye level.

Mountford subsequently observed many recent petroglyphs along the Mann and Musgrave Ranges, and photographed Tjanjundina creating a narrative scene commemorating an emu hunt that had just taken place (Mountford 1976: Pl. 22). Here, the stone hammer held by Tjanjundina is so small it is concealed by his hand.

Much earlier reports are available from the Pilbara, Western Australia. Stokes (1846: 169), in describing the Depuch Island petroglyphs, recognised that images were made by pounding away the dark-brown rock varnish (sgraffito technique), but appears not to have witnessed the making of any petroglyphs. Withnell (1901: 29), also writing about the coastal Pilbara, mentions how the outline of a motif was first sketched with chalk or ochre, and then a 'sharp hard stone' was used to create impact grooves of about four millimetres depth. His description was confirmed by Clement (1903: 9), reporting from the same region. Clement also thought that chalk or charcoal was used to outline the figures, but that they were then hammered with 'a stone axe'. The latter practice seems very unlikely, for two reasons: stone axes are absent or very rare in the Pilbara (cf. Bednarik 1973, 1977: 68), and their sharp edges would not be used for such damaging tasks. So perhaps McCarthy (1961: 143) is right in assuming that Clement and Withnell merely surmised, but never actually saw petroglyphs made. Clement's illustration of a petroglyph-making implement (1903: Pl. 3) is not of an axe, but of a thin cobble, similar to that which Mountford (1976: 81, footnote 9) described from The Granites. On the other hand, Bates (n.d.) reported that petroglyphs were still made at Port Hedland when she was there, and Tindale has mentioned that a petroglyph was made there during his visit (Wright 1968: 71). Moreover, further evidence (Crawford 1964: 44) implies that outlines on Depuch Island were at least sometimes drawn with a sharp object before the petroglyphs were hammered in, which would tend to support Withnell's and Clement's accounts.

Evidence of the use of a pointed tool to initially outline the form of petroglyphs subsequently made by percussion is not limited to Australia. There are many examples among the Côa valley petroglyphs which were first outlined with a stone point, then struck with a stone hammer (Bednarik 1995a). I have observed similar treatment elsewhere, including in Asia (e.g. Siberia) and South America (e.g Peru).

There are further factors suggesting that petroglyph production in the Pilbara continued into this century. When I visited a petroglyph and occupation site near Tom Price (Site 2: Bednarik 1977) in the company of four Indjibandi men in early 1968, one of the men, who was in his seventies then, spontaneously produced a new petroglyph. He made a complex linear, to me non-iconic, motif within ten or twelve minutes. I was curious about several aspects of this event, including whether he had seen this done before. He stated, through a translator, that he had seen the old people do it when he was very young, and that he had done it himself as a child. On the occasion I observed then he used only a single tool, an untrimmed quartz cobble with a pointed end, about seven centimetres long, to strike the rock panel directly.

Implements for the production of petroglyphs

Up to this experience, I had made several false assumptions about the manufacture of petroglyphs, based essentially on the literature I was familiar with at the time: that Australian rock art was sacred and the preserve of initiated men; that one was only allowed to create rock art in one's own tribal territory (the site was not in traditional Indjibandi territory); and that the tools used in making percussion petroglyphs must have been quite large stones. I had not attempted any replication work prior to 1968, and I had simply assumed that to create the impact necessary to achieve the indentations on hard rock (such as diorite, as in the Tom Price example), a tool mass well in excess of a kilogram would be required. I was surprised to see such a small tool (of about 150 to 200 g) used so effectively, and subsequently began to look for suitable tools at petroglyph sites, in Australia as well as in the other continents.

Others have done much the same. In Anati's work, for instance, there are various references to the tools he observed at petroglyph sites (Anati 1976), which he sometimes even found on the carved surfaces themselves (e.g. Anati 1981: 14-5, showing examples from Negev Desert). This prodigious author's principal work is in the Valcamonica of northern Italy, where he has collected many petroglyph-making stone implements (Anati 1994: Fig. 40). At his Centro in Capo di Ponte, in 1981, I examined a series of such tools; they showed me that those found in Europe were practically identical to those I had observed elsewhere since 1968. At nearby Valtellina, similar tools were found in crevices of the large monolith of Rupe Magna, near Grosio (Arcà 1995: Fig. 112; Bednarik in press).

The problem Australian archaeologists have experienced in speculating about the manufacture of petroglyphs (of which their frequent use of the term 'engraving' in the place of 'petroglyph' is symptomatic) has its several parallels in other parts of the world. The

perhaps best example is provided by their Russian colleagues, in relation to the heavily researched Karelian petroglyph sites. Ravdonikas (1936a, 1936b, 1937, 1938) favoured the indirect percussion hypothesis, as did other Russian archaeologists. However, Savvateyev's (1970, 1973, 1976, 1977) detailed research failed to produce such percussion tools from the region's numerous excavations. He mentions dozens of excavations close to petroglyph sites, which have produced not a single tool used for indirect percussion. He did, however, find many 'impact stones', as he calls them: fist-sized quartz cobbles that fit well into the hand, with the working point distinguished by impact-scarring. He reports finding dozens near the mouth of the River Vyg, where Karelia's largest petroglyph site complex is located. Of particular relevance are the petroglyph-making implements he excavated immediately below the Besovy Sledky rock ledge, which bears a very dense concentration of 470 figures covering just a few square metres (Bahn et al. 1995).

At this point I would like to express my exasperation with the term *'petroglyph-making implement'*. Since there is no satisfactory shorter word to define this phenomenon (the word 'pecker' I have seen used is not a good candidate), but one is clearly needed, I shall use the name *mur-e* henceforth. This word is from the Booandik language of the Mt Gambier - Portland region in Australia (Smith 1880: 129). Just to clarify: in its scientific usage, mur-e (singular and plural) refers generically to a tool that has been used in fashioning a petroglyph, and as an adopted word it is not italicised henceforth. Such a tool may be of any material, but in most cases stone was used. Mur-e include percussion tools, abrasion tools, human fingers, and — if we chose to believe Hallam — even animal claws fastened to a stick.

Percussion mur-e

Since becoming aware in 1968 of what to look for, I have observed mur-e, especially those used in percussion, at many sites, and used facsimiles of them in replicative experiments well away from the art. In the Pilbara region of north-western Australia, where I recorded hundreds of petroglyph sites during the 1960s, I had ample opportunity to search the usually barren rock pavements and rock piles with their often large numbers of motifs, frequently being the first non-indigenous person to examine these sites. Mur-e were easy to find in such conditions of very minimal sediment formation and vegetation cover (Figure 1). In the early 1970s I extended my search to various other regions of Australia, increasingly using scientific methods to study mur-e. For instance, in 1971 I examined several at Sturts Meadows, and removed the specimen shown in Figure 2 for detailed analysis. The dark discolouration clearly visible on its impact-fractured point is dark-brown mineral matter. It consisted mainly (in descending order) of SiO_2, Al_2O_3, Fe_2O_3, MnO and TiO_2, and the trace elements Ba, Sr, Cu, Ni, Pb, V, Co and Cr. The composition of the pavement varnish nearby, sampled at the same time, provided a result so similar that there should be no doubt that this white quartz cobble was used to make petroglyphs at the site. In the same year I also observed mur-e at the Mootwingee site mentioned by Flood (1997: 103), but without keeping notes of them.

During the subsequent 27 years I have examined percussion mur-e in all continents except Africa (where I have studied so far only rock paintings and ground rock hollows). While there are no strict consistencies among them (see Figures 3 and 4 for examples) in material type or preparation, several striking characteristics should be noted:

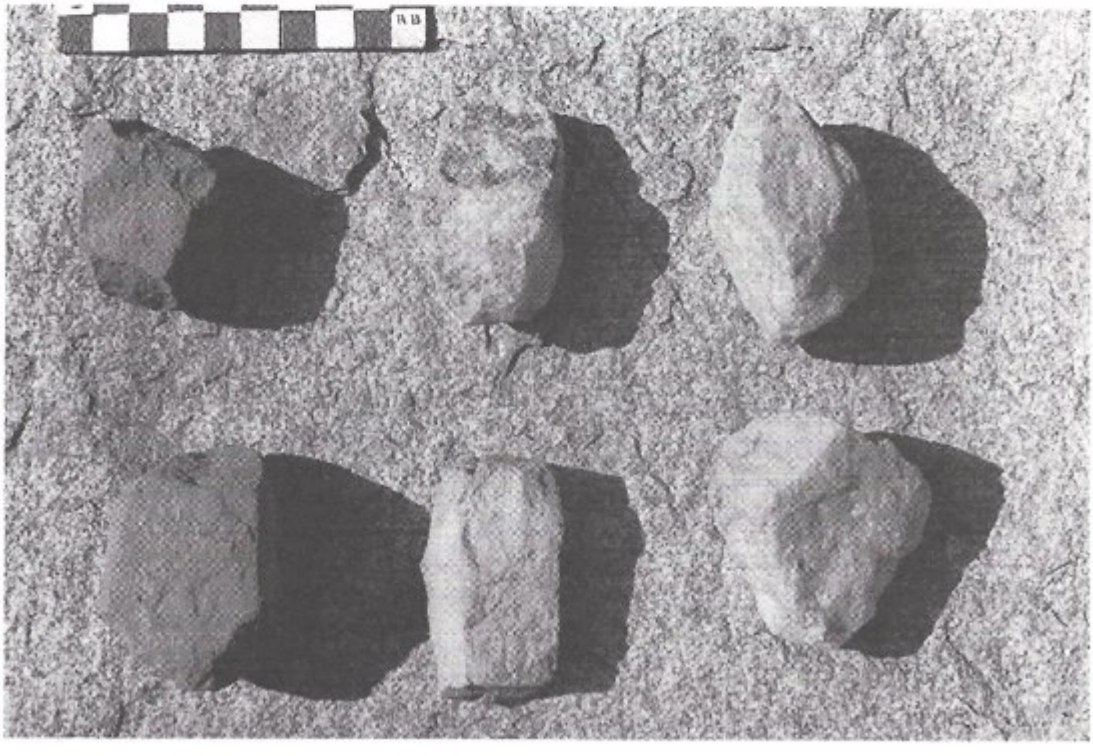

Figure 1. *Mur-e from dense petroglyph concentration on Burrup Peninsula, north-western Australia, photographed in 1968 but left at site.*

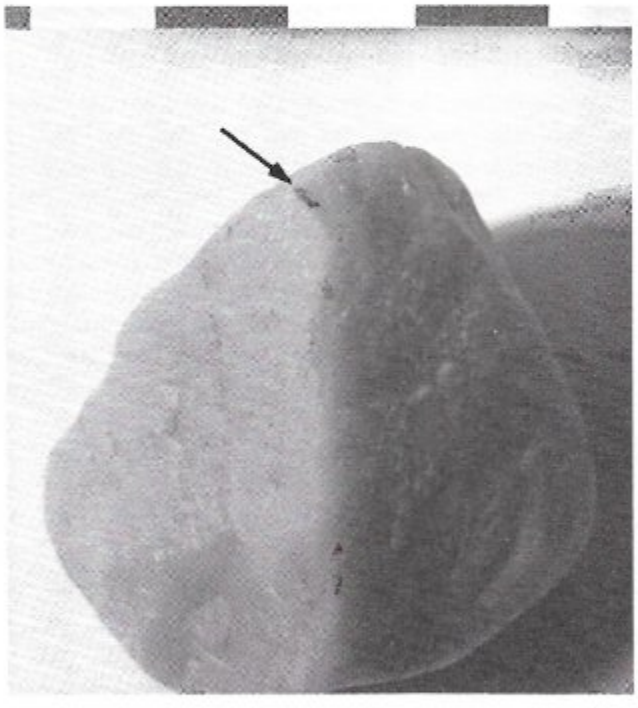

Figure 2. Two views of a quartz mur-e from Stuart's Meadows, western New South Wales. A residue of rock varnish and impact facture are visible on the point (arrow). Collected in 1971, now in AURA Archive.

Size: percussion mur-e are rarely large. As I have not taken scales to the field, and have rarely removed the finds from the sites, I cannot offer detailed statistics. However, percussion mur-e are usually under 150 g, and very rarely over 250 g. Weights of 100 to 130 grams are very common. Depending on the shape and relative density, this would correspond to a maximum dimension of 6 to 8 cm.

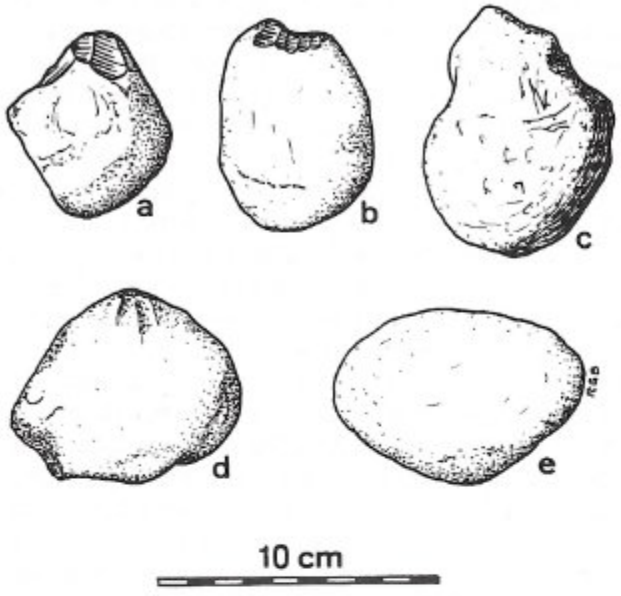

Figure 3. Quartzite mur-e excavated at Luine, a petroglyph site in Valcamonica, northern Italy.

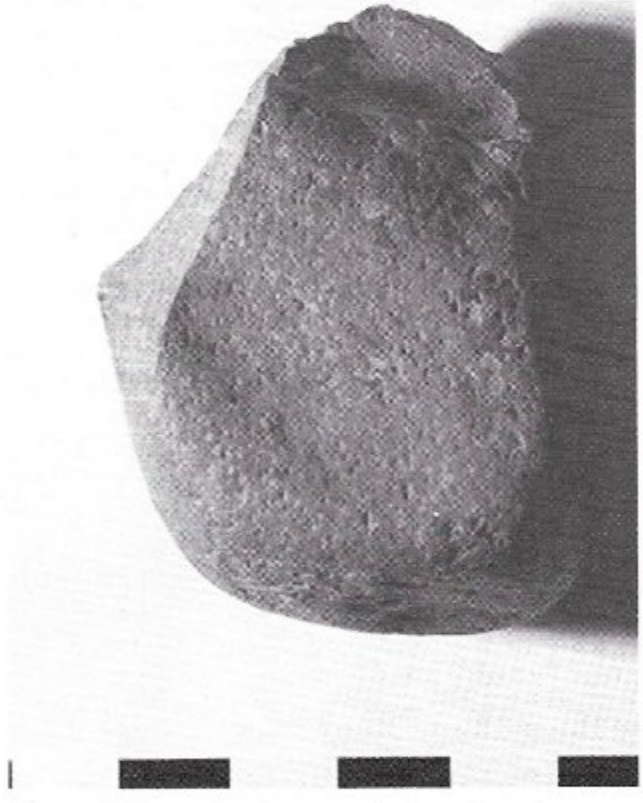

Figure 4. Mur-e of coarse quartzite from the major petroglyph complex of Cerro Blanco, near Caborca, Mexico, collected in 1985 immediately below large decorated panel, now in AURA Archive.

Shape: the axis of maximum dimension usually coincides with the direction of application. There is considerable variation in shape, but overall there is a global preference for pieces with a thick end to be held in the hand, and a pointed end with which to strike the rock surface and which bears the wear marks. There

are, however, also flat and elongate shapes represented, and for patina-bruising even quite round pebbles or cobbles may have been used. Finally, there are also specimens that were used at more than one point (sometimes accounting for more than 25% of the mur-e present at a site).

Materials: in regions with an abundant variety of alluvial cobbles or clastic rocks, there is a distinctive preference for dense quartzites and crystalline quartz of various types. However, in regions of soft rock facies such as schists, carbonates or poorly consolidated sandstones, alternative materials may have been used for mur-e.

Preparation: contrary to a common assumption, few mur-e seem to have been prepared by prior flaking, in Australia and elsewhere. Quite early in my investigations I realised that even where there is some flaking around the working point, this is probably use-wear rather than intentional trimming. If small flakes are removed around the point as a result of impact they actually tend to lead to a more acute point rather than a blunting. However, I estimate that at least 80% of percussion mur-e bear no macroscopic flaking at all, be it use-wear or intentional preparation.

Wear: this is by far the most important and consistent aspect of percussion mur-e. Its characteristics are a direct function of the tool material properties, the rock panel's physical properties, and aspects of application of the tool to the rock panel. If the first two are well understood (see replication work, below), we can reasonably speculate about the third factor. The typical, most common wear-pattern to be observed is that generally acquired by quartzite mur-e when used on sandstone, variations of which are also found when applied to other rock types. There is an elongate, discrete area of bruising, convex (often of 4 to 5 mm latitudinal radius) and of a highly distinctive morphology. The microscopic relief of this facet is greatest at the margins, amounting to just a few microns of depth in the central part. Individual grains are rarely cracked, but their surface has a distinctly 'frosted' appearance when fresh. This wear-pattern cannot be identified with the unaided eye.

Wear-patterns on quartz are quite different. Microscopic conchoidal flake scars are found around minute depressions or faults within the wear facet. They measure usually from 50 to 150 μm. On a highly metamorphosed coarse quartzite, microscopic flaking and deeply developed macroscopic impact fractures can be observed adjacent to the principal impact area. Naturally there are also significant differences according to the type of rock that caused the mur-e wear. Recognition and interpretation of these features is a specialist task. I consider that it would be possible, on the basis of experimentation, to estimate the duration of time a mur-e was used for (i.e. approximately how many nicks it produced, or what length of engraved line).

Other mur-e

Leaving aside stick-mounted animal paws, a great variety of other materials may have been used to produce petroglyphs, especially where the rock is comparatively soft. The softest rock ever used in the making of petroglyphs is a carbonate speleothem called moonmilk (*Mondmilch*, *Montmilch*, *Bergmilch* etc.), a substance of pure calcite that may have the appearance, consistency and crystal structure (in the macroscopic sense) of freshly fallen snow. It can be marked by the slightest finger touch, and it has been marked in this way to produce petroglyphs called finger flutings (digital flutings, *sillons digitaux paralleles* etc.) during the past thirty millennia (Bednarik 1986), in at least France, Spain, Australia and New Guinea. This is one of the most widespread forms of cave art in the world, having survived in at least fifty limestone caves. Details of its very basic 'technology' have been reported in various of my publications, but a new development is the replicative work of Sharpe and Lacombe (1997).

Other types of cave petroglyphs offer considerably more scope for technological analysis. Engravings made with implements (rather than fingers) occur in numerous limestone caves in south-western Europe and southern Australia. Their detailed study (Bednarik 1986, 1987, 1994b, 1997) uses aspects of the methods pioneered by Marshack (1972, 1975, 1986, 1989), and experimentally developed by d'Errico (1987, 1991, 1992, 1994), for portable art objects of antiquity. Foremost in the application of these methods to cave engravings is the use of field optical microscopy, an approach I have used for decades, for securing technological information, for microerosion analysis, and since the 1970s for nanostratigraphy (Bednarik 1979).

As in the study of portable engravings (i.e. markings made with burins or similar tools), such as those of the Upper Palaeolithic of western Europe, microscope-assisted 'internal analysis' can clarify many aspects of the production of cave engravings. These include the direction of abrasion, the point of commencement, and priority of markings in a superimposition sequence. Markings made with the same instrument can sometimes be identified, although I reject the claims of both Marshack and d'Errico that they can also identify tool changes in what are said to be notational sets (cf. Bednarik 1991c).

Cave engravings have sometimes survived in superb detail, especially where a formerly soft wall deposit hardened soon after it was marked. This can often be observed on cave travertine deposits, especially in Australian sites, and 'internal analyses' of engravings have been conducted in both Europe and Australia (Bednarik 1986, 1992, 1994b). At some of the Australian sites, the types of stone tool material used in abrading mur-e were determined through replication studies from the striation patterns (e.g. Bednarik 1987).

Replicative experiments

The great significance of replicative experimentation in the study of petroglyph technology has been empha-

sised repeatedly in papers on fundamental rock art science (Bednarik 1991d [see chapter 'Replicative experiments'], 1992, 1994b). Replication studies of percussion petroglyphs have been conducted on numerous occasions, both in Australia and abroad. Crawford (1964: 44), in considering the technique used in making the petroglyphs on Depuch Island, Western Australia, remarked on how easy he found it to make petroglyphs 'in a minute or two' with 'a few taps on the stone'. McCarthy has conducted various experiments; for instance, he used 'the sharp corner of a piece of ironstone or ferruginous sandstone' to create direct percussion petroglyphs on Sydney sandstone (McCarthy 1967: 19). McCarthy's (1962: 44) experiments at Port Hedland using whelk shells to bore rather than to pound the oolite pavement led to Maynard's (1977) inclusion of the category 'drilled petroglyphs' in her schema. Wright (1968: 34), conducting his own replication experiments, found that he could produce only very small pits in the limestone by rotating the point of a sharp, hard stick. He suggests that sharp hard rocks were used, which is consistent with my own observations at the Port Hedland sites in 1967, later confirmed by microscopy.

Among the examples of replicative petroglyphs that I have examined with the microscope, I found some Russian examples particularly impressive. Many were made under controlled conditions, some were recorded on film. Savvateyev (1977) used mur-e collected from nearby excavations at Belomorsk, on the White Sea, to produce a filled-in image of a whale, similar to pre-Historic figures, in 30 minutes. The most difficult part, he reports, was to produce a precise edge; he attributes this to his lack of experience. His replication studies, like those of other Russian researchers working in Karelia (such as, more recently, A. Faradjev, pers. comm.), were conducted on massive, frequently un-patinated granite pavements.

In my own replicative experiments, conducted from 1968 to the present on many lithologies, I found that the physical effort involved in producing percussion petroglyphs varied enormously according to the rock type, its weathering state or patination (Bednarik 1979), and to a lesser degree on the type of mur-e and technique employed. It is entirely impossible to generalise from isolated experiences, and all variables need to be fully recorded and quantified in such experimentation. For instance, rock types on which percussion petroglyphs were most frequently made are the facies of sandstones found in the sections of the Gondwana plate. Having conducted experiments on these sandstones in southern Africa, India, Australia and South America, I have asked scholars how long they think it would take to create (a) a hammered and abraded groove of ten cm length and one cm depth, and (b) a cupule of 12 mm depth, on well-weathered sandstone. The true answers are (a) one minute and (b) two minutes respectively, but all estimates I was given were very significantly higher (ranging from 15 minutes to 6 hours). This is a fair indication of the effects of an acute lack of experimental work in petroglyph technology, and of inadequately published results of experiments (Figure 5).

Figure 5. Standard petroglyph replicas, consisting of a 10-cm-long hammered and abraded groove of 10 mm depth, and a cupule of 12 mm depth. The mur-e used for each marking are shown, and were subjected to detailed study of wear traces.

The microscopic examination of abraded petroglyphs (engravings) is similar to the forensic procedures of determining from which firearm a bullet was fired. Indeed, many of the well-established methods of forensic science are of relevance to rock art science, but we appear to be reluctant to avail ourselves of them (Bednarik 1992). For instance, the detection of human blood residues, a standard technique in forensic science, was attempted in rock art only a few years ago (Loy et al. 1990; but cf. Nelson 1993). I have described experiments designed to determine the types of stone tool material used in Australian cave engravings at such sites as Nung-kol Cave in South Australia and Mandurah Cave in Western Australia (Bednarik 1987 — this work was not conducted within the caves, but on substitute materials).

There are good reasons, however, to replicate open site percussion petroglyphs at nearby rock surfaces, and to record all details of their production. I have found such replicas, including those I made decades ago, most useful in studying weathering and patination processes. Such studies, in turn, may be relevant to dating research and conservation work. What is therefore required are not only comprehensive records, but a central repository of these records so that future taphonomic studies of petroglyphs can be based on sound information rather than conjecture. Such records, to be adequate for future reference, perhaps centuries from now, need to include the following minimum details:

a. Precise location, so that the actual marking(s) can be found again. The location must be referenced to permanent features, not vegetation, sediment or unstable rock features.
b. Condition and aspects of the rock surface at the time: depth of weathering rind; details of patination; exposure to rain, insolation and wind. Is the rock dry or wet? Which direction is the replica petroglyph facing?
c. Petrology of support rock substrate; rainwater acidity at the site; annual precipitation details.
d. Type and material of mur-e used; their weight; microscopic description of tool wear.
e. Description of manufacturing technique used; time taken.
f. Recording of true colours by photography with a colour scale calibrated for digitised colour re-constitution (IFRAO Standard Scale — Bednarik and Seshadri 1995).

This type of work can produce invaluable new information, not just that concerning petroglyph dating and conservation, but also concerning chemical and physical erosion rates, chemical changes in rock subsurfaces, lichenometry, the formation of rock varnish or other accretionary mineral deposits, and so forth, all of which can help other disciplines besides rock art research. The *ad hoc* approach to the need of replicative experimentation that seems evident from the literature needs to be replaced with a systematic program of research. Such a program could be guided or even administered by the International Federation of Rock Art Organisations (IFRAO).

The dating of mur-e

The most recent development in the study of mur-e is their use in the dating of petroglyph-making activity. The practice of dating the mur-e rather than the petroglyphs was first applied in Bolivia in 1997. The difficulties in dating petroglyphs by a 'direct' method (for definition see Bednarik 1981, 1996b) are well appreciated. Essentially, those very few methods that might provide reliable results are notoriously imprecise and their application is limited to specific rock types and site morphologies. Other methods do exist but they are without exception fraught with difficulties (Bednarik 1979, 1996b; Dorn 1996). One possibility that has not been explored so far is to determine when any mur-e found at petroglyph sites were used. It cannot usually be known on which motif they were used, but if the number of motifs present is small and they seem to be of similar ages, this might suffice to arrive at an estimate of the age of those motifs. Where several mur-e are available from a single site they may be used to estimate the times when different marking traditions were in use. This has been successfully done already.

As in the case of petroglyphs there are two fundamentally different ways of estimating mur-e ages. One is by archaeological methods, using deductive reasoning. Generally this would involve indirect dating of some kind, probably radiocarbon determination of charcoal found in apparent association with the mur-e. Results acquired by these means may well be valid, but it must be cautioned that, as in the case of petroglyphs dated by indirect, archaeological means, there is no simple way to refute the proposition: we have to accept inductive pronouncements on trust (e.g. that the validity of the chronological association of charcoal and mur-e has not been negated by taphonomic factors).

The second method of determining the time a mur-e was used (or last used) is to estimate the age of the wear marks on it. The only technique used so far is that of microerosion analysis applied to fracture edges of percussion mur-e (Bednarik in prep. a). This can only be applied to mur-e found on the surface, preferably on an open rock pavement, and with the certainty that they have not been covered by any sediment since their use. Moreover, it is limited to the kind of rocks suitable for microerosion analysis, particularly the quartz or quartzite often used for mur-e. A further limitation, one which affects precision rather than reliability, is the absence of calibration curves (which continues to hamper the application of microerosion dating generally).

During recent fieldwork in Bolivia I examined several petroglyph sites on the foot of Cerro Tunari in the pleasant company of Jack and Sandra Steinbring, André Prous, Roy Querejazu Lewis and Robert Bednarik Jr. This series of sites exists on monolithic outcrops, several

hundred metres apart, that dot the glacial valley floor some distance from where it abuts the mountain's steep slopes. The outcrops measure several metres across and are a few metres high, and are usually steep sided. The petroglyphs have been made on their upper platform surfaces. We found tiny slivers of white quartz in the cracks of the decorated platform at Kalatrancani 3, and, at nearby Kalatrancani 1, a mur-e of white quartz a few metres from the outcrop. Microscopic examination indicated that the mur-e had been used to pound a hard surface, and I collected quartz fragments at site 3 for detailed analysis. Since they were found on top of the steep-sided rock, several metres above the surrounding plain, it seems highly likely that they have remained from the petroglyph-making activity. Microerosion analysis can easily determine whether these quartz chips were made recently or in the distant past.

Preliminary examination of seven quartz chips from Kalatrancani 3, all under 11 mm long, suggests that they derive from a crystalline quartz morphologically similar to the mur-e from Kalatrancani 1. They were detached about 500 to 600 years ago, which suggests that the petroglyphs among which they were recovered — or at least some or one of them — were made shortly before the arrival of the Spanish in South America. The mur-e from the second site was used slightly earlier.

On another field trip in Bolivia I completed an intensive study of a site I had begun in 1987, the small sandstone cave of Toro Muerto, in the Mizque valley, located near Saipina. The barren rock shelf in front of the cave is strewn with hundreds of stone tools, which I surveyed systematically, finding ten mur-e. Among these I selected the five best specimens (Figure 6), based on clarity of bruising marks and their susceptibility to microerosion dating. (These are now in the keeping of the Sociedad de Investigación del Arte Rupestre de Bolivia.) Excellent microerosion data have been secured from them, indicating that the three most recently used date from about the same time, one is almost twice as old, while the fifth has clearly been used on two different occasions, separated by about 3500 years (Bednarik in prep. b). Earlier I had proposed (Bednarik 1988) that there are three or four episodes of use of the cave documented in its petroglyphs; this proposition was based on the evidence of four exfoliation events then discernible, and directly relatable to the rock art (much of this evidence is no longer present, because in the meantime someone has destroyed part of the petroglyph panel with dynamite). This study shows that, under favourable conditions, it is possible to estimate the ages of a series of petroglyphs without excavating any sediments or even examining the motifs.

Summary

This preliminary review of petroglyph technology is not intended to be exhaustive or comprehensive. My purpose is to stimulate a basic appreciation of the potential and general procedures of technological studies in petroglyph manufacture, and to suggest that there are similar prospects for rock paintings. The primary intention is to convey the enormous potential of this neglected aspect of rock art research, and to show its close nexus with terminological constructs in petroglyph studies.

Several fundamental issues emerge from this paper. In the first place, archaeologists who lack the ability to recognise and to study mur-e need to be discouraged from excavating at and near petroglyph sites, unless they can secure the collaboration of a specialist for this purpose. We cannot afford to continue destroying key evidence at petroglyph sites.

Figure 6. Five mur-e from Cueva Toro Muerto, central Bolivia, collected in 1997, now in SIARB collection.

Secondly, a lack of understanding of the technology of petroglyphs leads to a misuse of terminology. The names used for additive rock art forms are more appropriate than those often applied to petroglyphs, precisely because they are technology-derived terms: stencils, paintings (applied wet), drawings (applied dry), beeswax figures etc. Reductive rock art (petroglyphs) is often defined by subjective technological labels: engraving (often misused), carving (inappropriate), pecking (possibly always misused), pounding, etching (a possibly inappropriate description from South America), boring or drilling (doubtful). Petroglyphs come in two basic forms: as sgraffiti (defined by colour contrast) or as relief petroglyphs (defined by relief depth). Both of these types can be made either by percussion or abrasion. The sgraffito method has been widely used on ceramics in the past and is still used with cement render on building facades. The majority of the world's petroglyphs were sgraffiti. Sgraffito petroglyphs have a limited life span (Bednarik 1994c, 1995b); in most cases they remain visible only for as long as it takes the rock surface to repatinate fully. This applies particularly to rock art sgraffiti made by merely bruising a varnish cover. In archaeology, the technological definition of sgraffito has remained almost unknown (Bednarik 1979: Note 1), and false chronologies were based on this taphonomic misapprehension of how technique may determine longevity (Bednarik 1994c: Fig 1). Indeed, inadequate understanding of taphonomy is a major factor in misinterpreting rock art quantitatively as well as qualitatively, and it is closely related to misapprehensions about technology as it relates to petroglyphs.

Finally, I have suggested the need for an international register of petroglyph replication experiments, which would be a multi-purpose project. A similar proposal was made at the First AURA Congress in 1988: it was intended to facilitate a long-term study of the development of rock varnish, a more limited intent. At that time, digitally-supported colour calibration was not available. The project I envisage would consist of two strategies:

(1) Establishing test stations at suitable sites, in a range of climatic, lithological and biological environments, at which petroglyph replicas are made under entirely controlled and fully recorded conditions. These would then provide the basis of a taphonomic study over several centuries, during which weathering, patination, and microerosion are monitored. This, obviously, would result in a massive improvement of our understanding of the processes involved, beginning with petroglyph technology, and ending with solid knowledge about the effects of variables on dating and other analytical prospects as they relate to petroglyphs. Australia, with its great diversity of rock art environments, would be ideally suited, and such a program would produce significantly better data than laboratory-based experiments of accelerated weathering.

(2) The creation of a global archive of all past and future petroglyph replication work conducted. Establishment and management of such an archive needs to be done by an international organisation; IFRAO could undertake to collate information, and to disseminate the data and results freely to all researchers.

This strategy would not only lead to a significant increase of our basic knowledge of all variables that relate to the preservation/deterioration of petroglyphs, their dating and analytical study, but also would lead to an unprecedented broadening of the scientific basis of our discipline, one that is not realistically achievable by other means. No simplistic approach can improve rock art science; this is a field that needs to take into account many variables. We have experienced significant improvements over the last couple of decades, but we have also learnt that our embryonic science has serious limitations (Bednarik 1996b). What our experiences over the last three or four years (during which we recovered from an initial euphoria) should have shown us is that there are no shortcuts in this discipline. Spectacular discoveries, claims or results have been useful in focusing public attention upon our work. Sometimes they even withstood critical assessment. But bold and adventurous forays into uncharted territory are essentially opportunistic; they need to be augmented, if not replaced, by a systematic approach. Our scientific base in rock art research remains diminutive; it needs to be increased many times if our discipline is to operate in the orderly way of scientific pursuit. A determined collective effort of the type envisaged here is necessary for this development.

I end this paper with a cordial appeal to all colleagues: if you are aware of a petroglyph replication experiment that has been conducted in your country or research region, would you please record the details available to you and send them to the IFRAO Archive at the address below. The very minimum necessary is precise location of the replica (as defined above), and the year the motif was created; details of the tool used would help greatly. All contributions will be acknowledged in future publications, but if you prefer to remain anonymous your information is still welcome.

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Résumé. *On examine des méthodes de production des gravures sur roche, à l'aide des traits caractéristiques dans l'art rupestre et des instruments utilisés pour créer cet art pariétal. On discute ces outils des perspectives ethnographiques et archéologiques, et on considère les limites de leur étude détaillée. Nous prêtons particulièrement attention à l'usage*

d'expériences reproductrices et à l'utilisation d'outils à graver sur roche récemment introduite en vue d'estimer l'âge de l'art rupestre. L'article conclut en demandant la création d'un projet non seulement pour étudier la production de gravures systématiquement, mais aussi pour maîtriser leur taphonomie sous des conditions contrôlées au cours d'une période très longue.

Zusammenfassung. *Petroglyphen-Herstellungsmethoden werden untersucht, durch charakteristische Spuren in der Felskunst ebenso wie die in der Schaffung dieser Felskunst verwendeten Geräte. Solche Werkzeuge werden von ethnographischen und archäologischen Gesichtspunkten erörtert, und der Bereich ihres detaillierten Studiums wird in Betracht gezogen. Besondere Beachtung erhält die Anwendung von Replikationsexperimenten, und die neu-eingeführte Verwendung von Petroglyphen-Herstellungswerkzeugen als ein Mittel, das Alter der Felskunst zu schätzen. Der Artikel schließt mit dem Vorschlag der Einführung eines Projektes, das nicht nur die Herstellung von Petroglyphen systematisch untersucht, sondern auch ihre Taphonomie, unter Beaufsichtigung über einen sehr langen Zeitraum.*

Resumen. *Se examinan métodos para hacer petroglifos, tanto a través de vestigios característicos en el arte rupestre como en los instrumentos usados en crear dicho arte rupestre. Herramientas para grabar las rocas son discutidas desde perspectivas etnográficas y arqueológicas, y el alcance de su detallado estudio es considerado. Se presta atención especial al uso de experimentos con réplicas y el recientemente adoptado uso de instrumentos para hacer petroglifos como un medio para calcular la edad del arte rupestre. El artículo concluye con un llamado para establecimiento de un proyecto, tanto para estudiar sistemáticamente petroglifos, y para monitorear su tafonomía bajo condiciones controladas sobre un período muy largo.*

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KEYWORDS: *Dust - Rock paintings - Conservation - Split Rock - Cape York*

COMPOSITION AND SOURCE OF DUST ON SPLIT ROCK PAINTINGS, AUSTRALIA

Alan Watchman

Abstract. Dust has always been regarded as a significant factor contributing to the deteriorating quality of rock paintings at Split Rock, Laura, Australia. Initially it was thought that dust particles from the floor of the shelter were responsible for masking the paintings, but results of work reported in this paper clearly demonstrate that the nearby road was the major source. This study reconfirms the need, prior to site development, for both the documentation and assessment of factors affecting the conditions of rock surfaces and paintings and the implementation of appropriate and timely conservation measures.

Introduction

Split Rock is a group of Aboriginal painting sites 13 kilometres south-east of Laura on Cape York peninsula (Figure 1). The main painted rock surface is in a natural rockshelter formed by cavernous weathering on the eastern side of a massive sandstone block that has split in half, hence the European name. For a long time many people have recognised that one of the significant problems affecting the painted surfaces at Split Rock is dust. The situation came to a head when Brown (1990) mentioned in his report 'Stepping in at Split Rock', that dust from the floor of the shelter was not only a problem, but traffic on the nearby dirt road was also contributing significantly to the deterioration of the paintings. However, his comment did not lead to anything being done to stop the road dust problem, although R. Bednarik had petitioned the responsible Minister in 1992 to have the road sealed near the site.

In 1994, as an aside to rock art field work planned with Noelene Cole and focusing on a pigment sampling program in the Hann River area, west of Laura, she and I were asked by Victor Stephenson (an Aboriginal Ranger based at Laura), if we could do some research into the suspected road dust problem at Split Rock. Stephenson was expressing a major concern of the Aboriginal people about the degrading quality of the Split Rock paintings despite the presence of a board walk. To prevent dust from the archaeological deposit from being stirred up because of visitor foot traffic a board walk had been built, but after several years the paintings still seemed to be visually degrading. It therefore appeared to Stephenson and the Aboriginal people that the problem of dust at the site had not ceased, in fact, the paintings seemed to be getting worse. They therefore suspected dust from vehicle traffic on the nearby road as the cause for the degrading brightness and loss of clarity in the paintings. The question we addressed was to find out whether road dust particles were travelling as far as the painted surfaces at Split Rock. Most people who visited the site have observed the dust plumes created by trucks and cars travelling up and down the unbitumenised road, and have also seen that the great dust clouds blow up to the same elevation as the paintings.

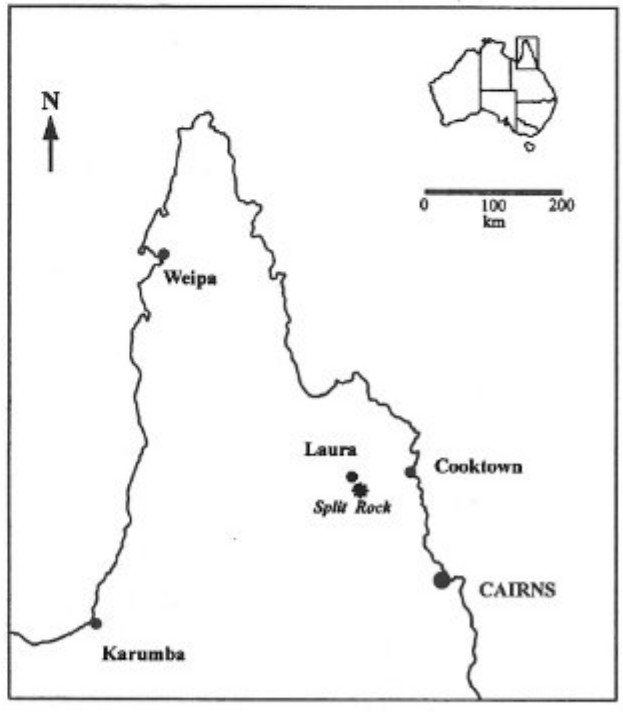

Figure 1. *Location map showing the Split Rock site on Cape York peninsula.*

Dust samples

We were not prepared to collect ideal dust samples and therefore needed to improvise. Masking tape and L-shaped metal brackets were used to collect samples of dust from different locations. The L-shaped brackets were tied to trees about 2 metres from the ground using the tape and fresh pieces of tape were applied to the bracket in such a way that the adhesive sides faced up, away from each trunk and oriented towards the road. Trees were selected at 10 metres and 50 metres from the road, on the eastern side of the main Split Rock painted panel, and on the western side of Split Rock (Figure 2). A sample of loose dust from the surface of the ledge beneath the paintings at Split Rock was also obtained using adhesive tape held for a short time against the surface. After a week the sticky tapes were collected from the trees, wrapped in aluminium foil to stop other dust entering and then placed in sealable plastic bags. Analyses of dust particles were made using a petrographic microscope and a scanning electron microscope fitted with an energy dispersive x-ray analyser.

Particles of reddish brown and pale dust less than 0.1 millimetre diameter were collected on the tape 10 metres from the road.

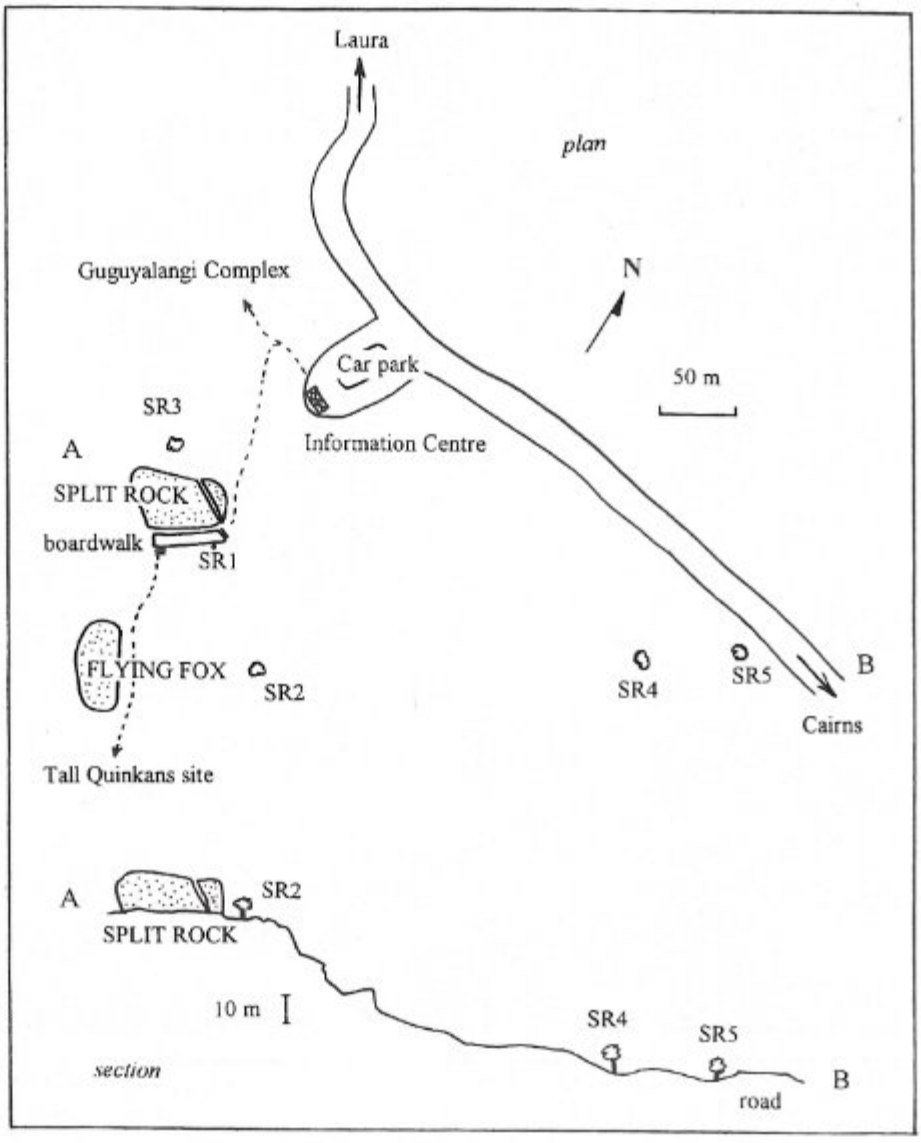

Figure 2. *Sketch plan and section of the Split Rock site, showing the approximate locations from where dust samples were collected.*

Component	SR5 10 m road	SR4 50 m road	SR3 West 10 m panel	SR2 East 50 m panel	SR1 East 10 m panel	SR6 Ledge paintings
quartz	XXX	XX	X	X	X	X
iron-quartz	X	X	X	X	X	XX
carbon-quartz	X	XX NaCl	XX	X	X	X
carbon-Al-silicate	XX	XXX	XXX	XX	X	XXX
feldspar	X	XX NaCl	X	X	XX NaCl	XX
carbon-feldspar	XX	X	X	XX	X	X
gypsum	N O	N O	N O	N O	X	X

Table 1. *Summary of the relative abundances of various components on sticky tapes (XXX very abundant, XX abundant, X present, N O not observed, Al-silicate includes clay, NaCl = sodium chloride).*

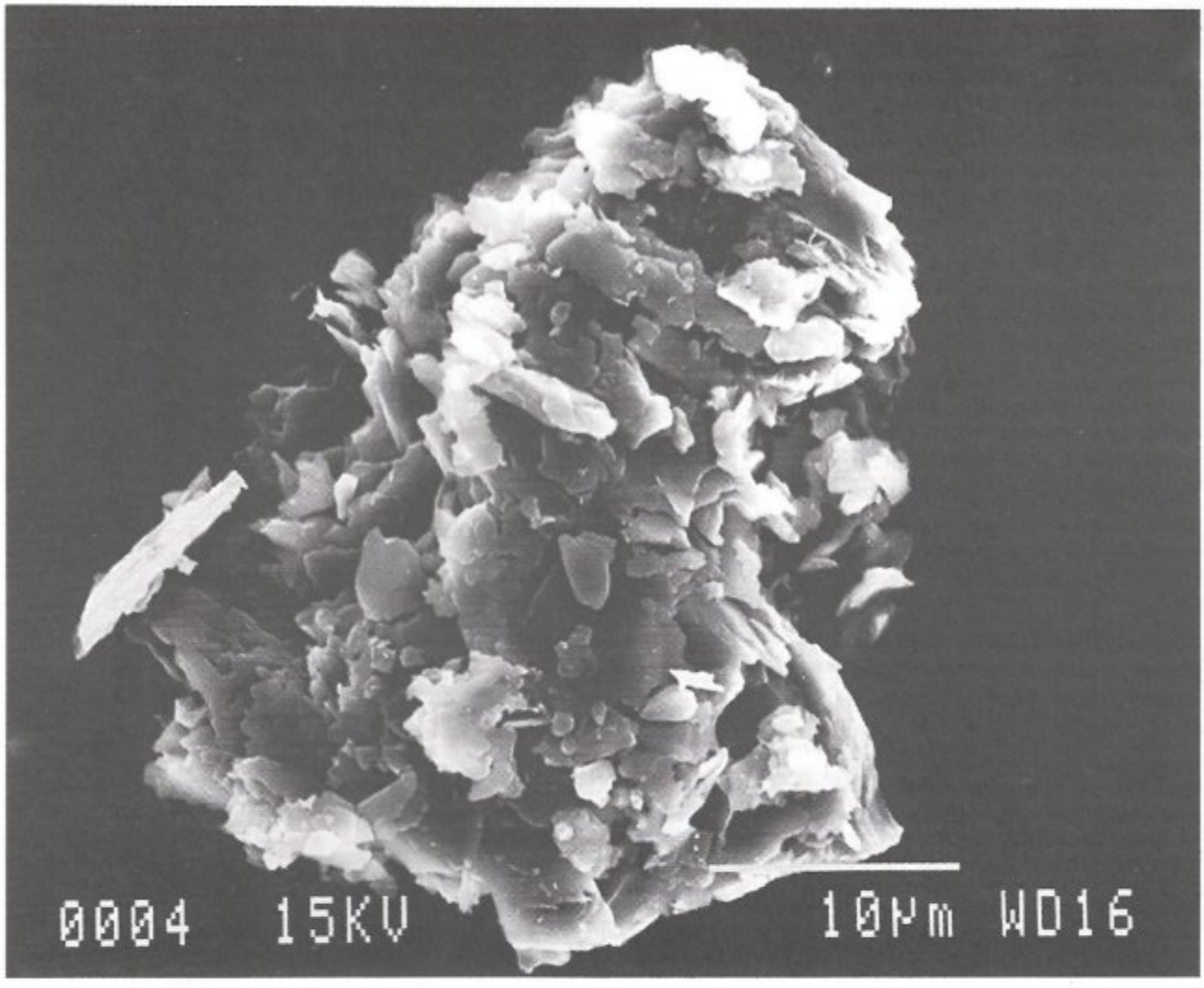

Figure 3. (Above) Highly magnified view of a composite dust particle found attached to a tape used to collect road dust at Split Rock.

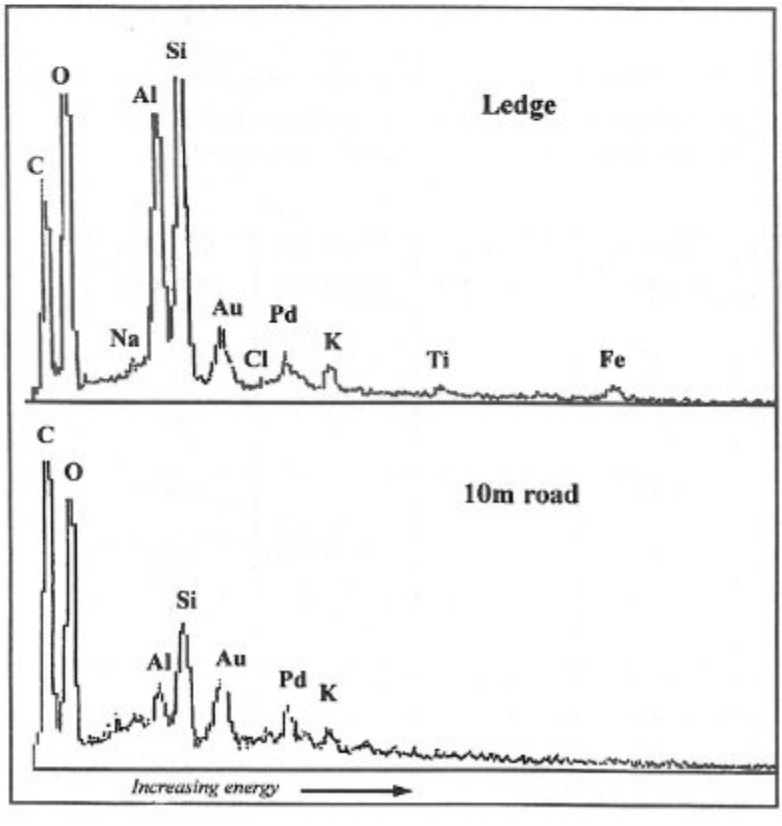

Figure 4. (Left) Typical SEM/EDXA spectra of composite dust particles from Split Rock (left hand axis is intensity). The presence of carbon (C) on the ledge beneath the paintings and in road dust confirms visual observations suggesting carbonised vehicle exhaust particles were transported from the road to the site. Aluminium (Al), silicon (Si), oxygen (O) and potassium (K) are the major minerals of clay. Salt (NaCl) and titanium (Ti)-iron (Fe) oxides are also present in settled dust. Gold (Au) and palladium (Pd) peaks are from the scanning electron microscope coating medium.

Smaller particles with less size range were observed on the tape at the location 50 metres from the road. Only a few particles were found adhering to the other tapes. The mineralogy of the particles on the tapes was estimated using the characteristic energy spectra obtained from the SEM/EDXA system. Many grains consisted of composite platy, angular and globular components, while others were single mineral particles (Figure 3).

Platy particles contained elemental populations consistent with clay (i.e. Al, Si, O) whereas small coarse grains were composed of either Si and O (quartz) or Si, Al, Ca, O (feldspar or some other aluminosilicate mineral; Figure 4). Great interest centred on those particles that not only had inorganic components, but also contained abundant carbon (C), suggesting either carbonate or organic molecules. Several particles essentially contained only carbon and oxygen, and these had complex contorted shapes. These amorphous carbon-bearing particles were adhering to all tapes (Table 1), and their physical appearance suggested that they were organic molecules, not carbonate.

Discussion

Quartz, iron stained quartz, feldspar and clay grains were found on all tapes indicating a relatively uniform occurrence of these inorganic components in dust. Carbon-bearing components are present on all tape samples; from close to the road, all the way up to and including the particles on the ledge. Sodium chloride occurs in particles near the road and just east of the Split Rock site, indicating that this marine salt either travels considerable distance as an aerosol or that it is present in road making materials. In some particles, spectra of carbon and oxygen could indicate carbonate, but this is not considered as a likely explanation because the particles appear amorphous and contorted, not crystalline and angular. Instead they probably reflect carbonyl particles produced by the combustion of fuel, especially diesel, and they are more likely derived from engine exhausts. Near the Flying Fox site, about 50 metres east of Split Rock, calcium and sulphur occur together with oxygen in a few grains. This elemental combination is probably indicative of gypsum ($CaSO_4.2H_2O$), and like sodium chloride provides evidence for aerosol transport of salts, although their origins are unknown.

Conclusions

The presence of carbon and oxygen associated with, and attached to, quartz and clay particles is consistent on all tapes from locations near the road up to the Split Rock paintings. These carbon-rich compounds are probably created in diesel exhausts and while still hot become attached to dust particles. They are transported as aerosols in wind from the dirt road and eventually settle on the painted panel and rock ledge. These results confirm the observations and suspicions that road dust is the likely source of painting degradation at Split Rock. It is therefore recommended that the road in front of the Split Rock site be bitumenised to mitigate the long-term deleterious impact of road dust on the paintings.

A lot of work over many years has been done to develop Split Rock as a tourist attraction and a considerable amount of money has been invested in building a board walk. Constructing the board walk has reduced the impact of local dust, but the major problem was always road dust and this concern needed urgent attention. In April 1997 the road between the Split Rock car park and the Ang-Gnarra Festival Grounds (a few kilometres to the east) was bitumenised with obvious consequential benefits to the painted surfaces. In hindsight, the problem of dust from the road should have received more attention earlier on in site development. This case study demonstrates that detailed observations of all aspects of heritage sites should be undertaken before they are developed for tourism (Watchman 1996). Clearly, site conditions and sources and processes of deterioration must be documented and evaluated before developing management strategies for protecting rock art sites.

The Split Rock case provides an excellent example of the value of applying geoanalytical methods to rock art studies. Such relatively simple sampling and analytical procedures can have enormous benefit in assessing conditions of rock surfaces and paintings before developing management plans. They are also valuable tools when applied in monitoring sites after implementing changes to site access and structures once tourism has begun.

The conditions of paintings at Split Rock still have not been assessed systematically and no baseline data are available for comparative evaluation — although Brown (1997) has recommended that this be done — and so long-term monitoring can only be subjective. For Split Rock and other frequently visited sites the factors contributing to the deterioration of paintings and petroglyphs should be investigated so that appropriate conservation measures can be taken. Ideally, such condition reports should be done in the early stages of planning for site development rather than after damage has occurred. Where management and conservation strategies have been implemented it is still necessary to monitor conditions using high-quality baseline data. Condition assessment at rock art sites is therefore a fundamental obligatory step in the planning and management process, not an optional extra.

Acknowledgments

The Ang-Gnarra Aboriginal Corporation in the Laura area gave permission for the work to be carried out and I thank them for their co-operation and support. The work would not have been possible without Victor Stephenson and Noelene Cole. Analyses were conducted in the Geology and Metallurgy Department and in the Centre d'Études Nordiques, Laval University, Québec. The Queensland Department of Environment provided funds to cover the costs of the scanning electron microscope analyses. This paper is a modified version of a presentation given at the Inter-AURA Congress, Melbourne, February 1997 and I thank David Lambert and Robert Bednarik for their constructive comments.

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Résumé. *On a toujours considéré que la poussière est un facteur important qui affecte la qualité des peintures rupestres à Split Rock, près de Laura, en Australie. Initialement, on croyait que les particules de poussière provenant du sol causaient le masquage des peintures, mais les résultats du travail présenté dans cet article démontrent clairement que la route à proximité était la source principale. Cet étude réaffirme le besoin d'évaluer les facteurs qui affectent la condition des surfaces rocheuses ainsi que d'appliquer des mesures de préservation convenables et opportunes avant de développer un site.*

Zusammenfassung. *Staub ist schon immer als ein wichtiger, zur Verschlechterung der Qualität der Felsmalereien von Split Rock bei Laura, Australien, beitragender Umstand betrachtet worden. Ursprünglich glaubte man, Staubkörner vom Boden des Abris seien für den Überzug auf den Malereien verantwortlich, doch Resultate, die im obigem Artikel berichtet werden, zeigen deutlich, daß die nahe Straße die Hauptquelle war. Diese Studie bestätigt wieder die Notwendigkeit der Dokumentation und Feststellung der Umstände, und zwar vor dem Ausbau einer Station, welche die Bedingungen von Felsoberflächen und Malereien beeinflussen, sowie die Durchführung passender und zeitgerechter Konservationsmaßnahmen.*

Resumen. *El polvo siempre ha sido considerado como un factor significativo afectando la calidad de las pinturas rupestres en Split Rock, Laura, Australia. Inicialmente, se pensaba que partículas de polvo del suelo del abrigo eran responsables por haber cubierto las pinturas, pero los resultados del trabajo presentados en este artículo demuestran claramente que el camino cercano era la mayor fuente. Este estudio reconfirma la necesidad, tanto de la evaluación de factores afectando las condiciones de la superficie de la roca, como la implementación de apropiadas y oportunas medidas de conservación antes de desarrollar el sitio.*

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KEYWORDS: *Petroglyphs - Groove shape - Analysis - Statistics - Geometry*

A MULTIVARIATE APPROACH TO CHARACTERISE THE GROOVE SHAPE OF THE LINEAR PARTS OF PETROGLYPHS

Franco Urbani

Abstract. A method based in the measurement of five variables of the grooves from linear parts of petroglyph images allows the quantitative characterisation of cross-sectional shape. With the data matrix several univariate and multivariate statistical techniques can be used to evaluate and classify such shapes and depending on the results, the rock art specialist will be able to derive interpretations.

Introduction

The shape of the grooves of the linear sections of petroglyph images is usually studied by measuring depth, width and qualitatively taking note of the shape: U or V shapes, symmetric, asymmetric etc. (Sujo 1975).

In recent years much interest has arisen in the scientific study of rock art, therefore several works have appeared suggesting techniques for its documentation (e.g. Milstreu 1996; Swantesson 1995). In some petroglyph panels containing several images made up mainly of engraved curved or straight lines, and not of wide low-relief parts, different images may show grooves with different sizes and shapes, therefore to quantitatively study and compare them, a statistically multivariate data-processing approach was developed which uses the measurement of five variables of the groove cross-section that reasonably characterises it.

Data acquisition

The basis of the method is to carefully record on paper in a 1:2 scale several cross-sections of the different images whose grooves need to be characterised, preferably around ten or more cross-sections per image, depending on its size and complexity.

Different workers, depending on what they have available, may use different methods to record the groove cross-sectional shape accurately. Two of them are:

(a) A medium-hardening plastic moulding clay is applied with slight pressure on the groove and then carefully removed, and a section perpendicular to the rock surface is cut with a razor blade. This is then laid down on the note book and the shape of the groove is carefully followed, and traced with a very fine-pointed pen onto the paper. With care these measures can be obtained with an error of about 0.5 mm. *Since this method may leave unwanted residue on the rock it must be used only on petroglyphs that have been subjected to anthropic damage, e.g. that have already been painted.*

(b) By a comb-like tool used by machine and lathe operators that consist of a series of pins that move independently up and down, but parallel one to another, adapting to the shape of the object being examined. This tool comes in different sizes and the accuracy depends on the diameter of the individual pins. Once the tool has been applied perpendicular to the groove, the shape must be carefully traced onto the note-book with a fine-pointed pen.

With the cross-sections recorded on paper, once at the office, the top line of each is defined from rim to rim and drawn as *A-B*, and the deepest point (*C*) is located (Figure 1). A line perpendicular to *A-B* and reaching *C* is also drawn (*C-D*); the line *E-F*, parallel to *A-B* and at midpoint of the *C-D* line is defined. The distances *a, b, c, d* and *e* are then measured and transferred to a PC spreadsheet computer program (e.g.: *Ecxel, Lotus, QPRO*) (Table 1).

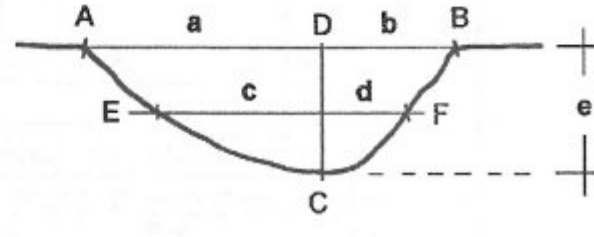

Figure 1. Diagram of groove cross-section variables.

Image	Cross-section	a	b	c	d	e
a	a1	22.0	14.0	12.0	9.5	7.0
a	a2	22.5	21.0	15.0	12.5	7.0

Table 1. *Examples of measurements of petroglyph groove (in mm).*

Data processing

Depending on the rock art worker and the research design, several mathematical and statistical calculations can be performed once the data table is available, as follows.

Size characterisation

With any spreadsheet program the average, minimum, maximum and standard deviation can be calculated for each of the five variables, or any ratio between them (Table 2). With the averages of the five variables the mean shape of the groove cross-section can be defined. Univariate statistical tests can be performed, comparing such variables from different images (e.g. the *t*-test).

Shape characterisation

Several parameters are proposed to characterise the shape of the groove. They will be named symmetry, sharpness, V-shape and flatness indexes. The explanations and formula deductions appear on the Appendix.

Multivariate statistics

For the purpose of the proposed method, a suitable PC package to perform such statistical analysis is necessary. We have used *Statgraphics Plus*® version 2.0 for Windows®.

One of the most convenient and easy-to-interpret graphic methods is the Q-mode cluster analysis, a classification method that presents the relationship of different samples in a tree-like graph (dendrogram). Some examples of the use of this technique in anthropology are the study of the graphic elements of Venezuelan petroglyphs (Sujo 1978), classification of Roman lance point shapes (Orton 1988: 57), and Venezuelan bat-shaped pectoral plaques (Perera 1976). Other statistical processing methods, such as discriminant functions or factor analysis, can also be performed.

As an example, two petroglyph images are used from Piedra del Indio at Galindo Creek (Ávila National Park, Caracas, Venezuela), carved in quartz-feldspar-biotite gneiss of Precambrian age. The rock is adjacent to the creek and erosive/weathering agents seem to have acted in the same intensity on both images. Figure 2 shows both images schematically and the locations of the measured cross-sections.

Figure 3 shows the Q-mode dendrogram obtained, using twenty samples (cross-sections) with five variables (measurements *a, b, c, d* and *e*), and the left-asymmetric normalised data as explained in the Appendix. It can be seen that the measured cross-sections are classified into two distinct clusters based on the phenetic distance coefficient — one with ten samples from image 2a and two of image 2b, and a second cluster with seven samples from image 2b and one of image 2a. This diagram and other statistical processing of the data matrix show that

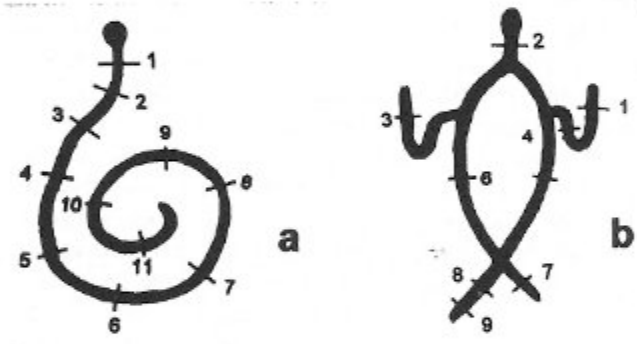

Figure 2. *Two petroglyphs from Piedra del Indio, Venezuela, with measured groove sections.*

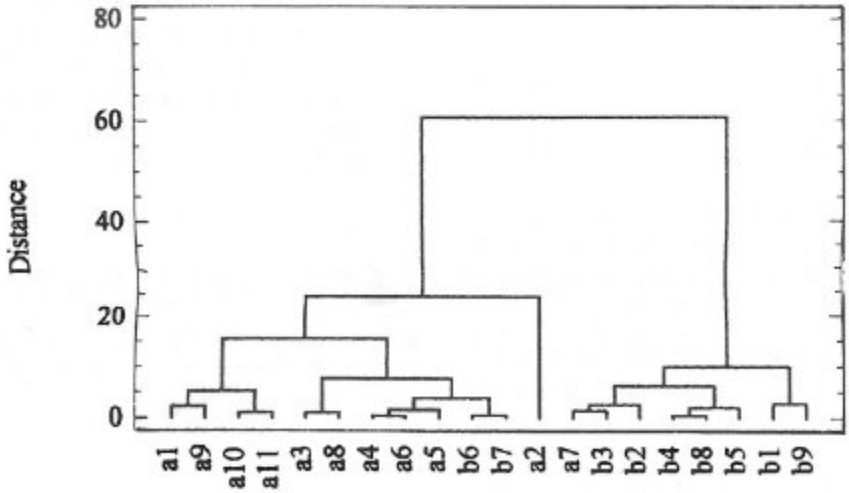

Figure 3. *Dendrogram produced by the Q-mode cluster analysis of the cross-sections of the images in Figure 2.*

ID	Im	<-------- original data (mm) --------> a	b	c	d	e	<---- left assymetric normalized data (mm) ----> a'	b'	c'	d'	e'	<---- sums (mm) ----> a+b	c+d	a+b +c+d	<---------- ratios data ----------> [e/(a+ b)]*100 (SH1%)	[0.5e/(c+ d)]*100 (SH2%)	[(c+d)/ (a+b)] *100	[(a+b)/ 2a]*100 (SY1)	[(c+d)/ 2c]*100 (SY2)	<- angles ° -> < ACB (SH1°)	< ECF (SH2°)	<---- shape indexes ----> SY	SH%	SH°	VS	FI
a1	a	22.0	14.0	12.0	9.5	7.0	22.0	14.0	12.0	9.5	7.0	36.0	21.5	57.5	19.4	16.3	59.7	81.8	89.6	136	144	86	18	140	95	24
a2	a	22.5	21.0	15.0	12.5	7.0	22.5	21.0	15.0	12.5	7.0	43.5	27.5	71.0	16.1	12.7	63.2	96.7	91.7	144	151	94	14	148	95	20
a3	a	15.0	18.5	11.0	13.0	5.0	18.5	15.0	13.0	11.0	5.0	33.5	24.0	57.5	14.9	10.4	71.6	90.5	92.3	146	156	91	13	151	94	17
a4	a	19.5	16.0	12.0	10.0	6.0	19.5	16.0	12.0	10.0	6.0	35.5	22.0	57.5	16.9	13.6	62.0	91.0	91.7	142	149	91	15	146	95	21
a5	a	17.0	20.0	10.0	13.5	6.5	20.0	17.0	13.5	10.0	6.5	37.0	23.5	60.5	17.6	13.8	63.5	92.5	87.0	141	148	90	16	145	95	21
a6	a	18.5	16.5	12.5	10.0	6.0	18.5	16.5	12.5	10.0	6.0	35.0	22.5	57.5	17.1	13.3	64.3	94.6	90.0	142	150	92	15	146	95	21
a7	a	19.0	16.0	10.5	10.0	5.5	19.0	16.0	10.5	10.0	5.5	35.0	20.5	55.5	15.7	13.4	58.6	92.1	97.6	145	150	95	15	147	97	20
a8	a	18.0	16.0	11.5	12.0	5.0	18.0	16.0	11.5	12.0	5.0	34.0	23.5	57.5	14.7	10.6	69.1	94.4	102.2	147	156	98	13	152	94	17
a9	a	21.0	15.0	14.0	9.5	7.0	21.0	15.0	14.0	9.5	7.0	36.0	23.5	59.5	19.4	14.9	65.3	85.7	83.9	137	146	85	17	141	94	24
a10	a	16.5	25.0	9.5	12.0	7.0	25.0	16.5	12.0	9.5	7.0	41.5	21.5	63.0	16.9	16.3	51.8	83.0	89.6	141	144	86	17	142	99	22
a11	a	23.5	17.0	12.0	10.0	6.5	23.5	17.0	12.0	10.0	6.5	40.5	22.0	62.5	16.0	14.8	54.3	86.2	91.7	144	147	89	15	145	98	21
Avr.		19.3	17.7	11.8	11.1	6.2	20.7	16.4	12.5	10.4	6.2	37.0	22.9	60.0	16.8	13.7	62.1	89.9	91.6	142	149	91	15	146	95	21
Min.		15.0	14.0	9.5	9.5	5.0	18.0	14.0	10.5	9.5	5.0	33.5	20.5	55.5	14.7	10.4	51.8	81.8	83.9	136	144	85	13	140	94	17
Max.		23.5	25.0	15.0	13.5	7.0	25.0	21.0	15.0	12.5	7.0	43.5	27.5	71.0	19.4	16.3	71.6	96.7	102.2	147	156	98	18	152	99	24
S.D.		2.7	3.2	1.6	1.5	0.8	2.3	1.8	1.3	1.0	0.8	3.3	1.9	4.3	1.6	1.9	5.9	5.0	4.9	4	4	4	2	4	2	2
b1	b	14.0	15.5	8.0	9.0	4.8	15.5	14.0	9.0	8.0	4.8	29.5	17.0	46.5	16.3	14.1	57.6	95.2	94.4	144	148	95	15	146	97	21
b2	b	15.6	17.2	9.5	9.0	5.8	17.2	15.6	9.0	9.5	5.8	32.8	18.5	51.3	17.7	15.7	56.4	95.3	102.8	141	145	99	17	143	97	23
b3	b	20.0	15.0	11.5	9.5	5.0	20.0	15.0	11.5	9.5	5.0	35.0	21.0	56.0	14.3	11.9	60.0	87.5	91.3	148	153	89	13	150	96	18
b4	b	17.5	15.5	10.0	9.0	4.0	17.5	15.5	10.0	9.0	4.0	33.0	19.0	52.0	12.1	10.5	57.6	94.3	95.0	153	156	95	11	154	98	15
b5	b	17.0	16.5	10.0	8.0	4.0	17.0	16.5	10.0	8.0	4.0	33.5	18.0	51.5	11.9	11.1	53.7	98.5	90.0	153	155	94	12	154	99	16
b6	b	20.0	19.0	12.0	10.0	6.0	20.0	19.0	12.0	10.0	6.0	39.0	22.0	61.0	15.4	13.6	56.4	97.5	91.7	146	149	95	15	148	98	20
b7	b	19.0	20.0	11.0	10.0	5.5	20.0	19.0	10.0	11.0	5.5	39.0	21.0	60.0	14.1	13.1	53.8	97.5	105.0	148	151	101	14	150	99	18
b8	b	17.5	16.5	9.5	10.0	4.0	17.5	16.5	9.5	10.0	4.0	34.0	19.5	53.5	11.8	10.3	57.4	97.1	102.6	153	157	100	11	155	98	15
b9	b	12.0	17.5	8.0	10.0	4.0	17.5	12.0	10.0	8.0	4.0	29.5	18.0	47.5	13.6	11.1	61.0	84.3	90.0	149	155	87	12	152	96	17
Avr.		17.0	17.0	9.9	9.4	4.8	18.0	15.9	10.1	9.2	4.8	33.9	19.3	53.3	14.1	12.4	57.1	94.1	95.9	148	152	95	13	150	98	18
Min.		12.0	15.0	8.0	8.0	4.0	15.5	12.0	9.0	8.0	4.0	29.5	17.0	46.5	11.8	10.3	53.7	84.3	90.0	141	145	87	11	143	96	15
Max.		20.0	20.0	12.0	10.0	6.0	20.0	19.0	12.0	11.0	6.0	39.0	22.0	61.0	17.7	15.7	61.0	98.5	105.0	153	157	101	17	155	99	23
S.D.		2.7	1.7	1.4	0.7	0.8	1.6	2.2	1.0	1.1	0.8	3.4	1.7	5.0	2.0	1.8	2.4	4.9	6.0	4	4	5	2	4	1	3

Abreviations: S.D.= standard deviation, SH= sharpness index, SY= symmetry index, VS= V-shape index, FI = flatness index

Table 2. Examples of measurements in two images of Piedra del Indio, El Ávila National Park.

there is significant statistical evidence that the groove cross-sections of the two images studied are different.

The multivariate analysis can be carried out with any of the following data sets: original, left-asymmetric normalised, or using only ratios (Appendix, Table 2). The left-asymmetric normalised data are preferred over the original data if both size and shape are to be taken in consideration, or with the five ratios if only the shape of the cross-section is wanted to be taken in consideration, regardless its absolute size.

Discussion

With the univariate and multivariate data processing of the five measured variables as proposed above, the groove cross-sections of two example images form Piedra del Indio, Venezuela, are quantitatively characterised as being significantly different. With these results it is up to the rock art worker to interpret the meaning of these data: do they relate to different ages, or to the images having been made by different human groups, perhaps using different tools and techniques; or have they been influenced by the rock type and its degree of weathering, etc. However, this is beyond the scope of the present note. The results could also be used for other purposes, such as image classification, weathering quantification, and others.

The main limitation of this method is that it can be accurately used only on rather deep, linear, straight or curved parts of petroglyphs, and not on the quite common wide low-relief parts of images.

The author is willing to freely perform the statistical analysis to any worker if the data matrix is provided.

*

APPENDIX

Proposed formulas for shape characterisation

1. Symmetry index

As can be seen in Figure 1, both the ratios *a/b* or *c/d* are measurements of the symmetry of the groove, so a value near 1 arises from fully symmetric shapes while departing values (greater or smaller than 1) will be shown by asymmetric shapes.

Depending on the direction in which an asymmetric cross-section is looked at, it could be recorded as left-asymmetric ($a>b$ as in Figure 1) or right-asymmetric ($b>a$), therefore it is necessary to normalise the *a, b, c* and *d* variables so that all the cross-sections be either left or right. We selected a left asymmetry for the normalisation.

By normalising the data so that the *a, b* and *c, d* variables are always in the order so that the first one of each set is greater than the second, all cross-sections will be left-asymmetric. From variables *a* and *b*, we can name the larger dimension *a'* for of both situations and the smaller *b'*. The same is done with *c* and *d*, calling *c'* the larger and *d'* the smaller.

Example:

Original data

a	b	c	d	e
14.0	22.0	9.5	12.0	7.0
22.5	21.0	15.0	12.5	7.0

Left-asymmetric normalised data

a'	b'	c'	d'
22.0	14.0	12.0	9.5
22.5	21.0	15.0	12.5

This new data matrix will be called 'left-asymmetric normalised data' (Table 2). The formulas are as follows:

$$\text{Symmetry 1} = \text{SY1} = [(a' + b')/2.a'].100 \quad (1)$$
$$\text{Symmetry 2} = \text{SY2} = [(c' + d')/2.c'].200 \quad (2)$$
$$\textit{Symmetry index} = \text{SY} = (\text{SY1} + \text{SY2})/2 \quad (3),$$

in which a value of 100% represents the maximum symmetry attainable while lower values represent lower symmetry.

2. Sharpness index

The ratios of width to depth as (a+b)/e or (c+d)/½e represent the sharpness of the groove cross-section. Two ways proposed to characterise this property are:

(1) As with symmetry, the following formula will give an estimate of the mean sharpness index (SH) in % units.

$$\text{Sharpness 1} = \text{SH1} = [e/(a + b)].100 \quad (4)$$
$$\text{Sharpness 2} = \text{SH2} = [½e/(c + d)].100 \quad (5)$$
$$\textit{Sharpness index}\ (\%) = \text{SH}\% = (\text{SH1} + \text{SH2})/2 \quad (6),$$

in which a value of 100% is given by a cross-section with the same values for width and depth. Values lower than 100% are for grooves with a width greater than depth which is the usual case, and values greater than 100% are for sections with a greater depth than width, which the author has never seen in petroglyphs, or for very asymmetric grooves. In other words, low values represent low sharpness.

(2) Another way to visualise the sharpness of a groove is to calculate the value of the angle at point *C* on the ideal triangle formed by the upper rims and the lower point (angle at C in triangle *A-B-C*, Figure 1), but it can also be calculated for the middle triangle *E-F-C*. Therefore:

$$\text{Angle ACB} = \text{SH1}^\circ = \text{tg}^{-1}(a/e) + \text{tg}^{-1}(b/e) \quad (7)$$
$$\text{Angle ECF} = \text{SH2}^\circ = \text{tg}^{-1}(c/½e) + \text{tg}^{-1}(d/½e) \quad (8)$$
$$\textit{Sharpness index}\ (^\circ) = \text{SH}^\circ = (\text{SH1}^\circ + \text{SH2}^\circ)/2 \quad (9)$$

To visualise the magnitudes of the numbers involved in the two methods of sharpness calculation, some examples are given for ideal V-shaped cross-sections:

Width	Depth	SH%	SH°
1	1	100	53
2	1	50	90
3	1	33	113
5	1	20	136
6	1	17	143

3. V-shape index

For a groove with a cross-section of ideal V-shape, the angles ACB and ECF would have to be the same. Since a perfect V-shape is very difficult to attain, the usual shapes found in the field will show different degrees ranging between V and U or curved shapes.

An index of the departure of the V-shape could be devised by the comparison of
the above angles:

Angle ACB = SH1° (calculated by formula 7)
Angle ECF = SH2° (calculated by formula 8)

So the following formula can be used:

V-shape index = VS = (SH1° / SH2°).100 (10),

in which a value of 100% represents an ideal V-shape and lower values are more curved and U-shapes.

4. Flatness index

In grooves with a very flat bottom, the width measures (a+b and c+d) will be similar and much larger that the depth (e). Therefore the ratio of average of both width measures to the depth will be an index of the bottom flatness. [This index is not to be confused with the granulometric flatness indexes of Cailleux and Lüttig. Ed.] This parameter is similar to the sharpness index (formula 6).

Flatness index = FI = 100.[2.e/(a + b + c + d)] (11),

in which a 100% value will be produced for cross-sections in which width and depth are equal, and values lower for a flatter bottom.

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Résumé. *Une méthode fondée sur le mesurage de cinq variables du sillon de segments linéaires d'images gravées sur roche permet la caractérisation quantitative de la forme d'une coupe transversale. Avec la matrice de données, on peut utiliser plusieurs techniques univariantes et multivariantes de statistiques pour évaluer et classifier telles formes et selon les résultats obtenus les spécialistes en art rupestre pourront donner leurs interprétations.*

Zusammenfassung. *Eine Methode, die auf Messungen von fünf Variablen der Furchen linearer Teile von Petroglyphen beruht, ermöglicht die quantitative Beschreibung der Querschnitts-Form. Mit solchen Ergebnissen können mehrere univariate und multivariate statistische Methoden angewandt werden, um diese Formen auszuwerten und zu klassieren, und je nach den Ergebnissen wird der Felskunstforscher imstande sein, Interpretierungen zu entwerfen.*

Resumen. *Se propone un método para la caracterización cuantitativa de la forma de las secciones transversales de los surcos de tramos lineares (rectos o curves) de las imágenes de petroglifos. Con la medición de cinco variables que definen la forma de la sección se obtiene una matriz de datos que puede ser procesada con técnicas estadisticas uni- o multivariables, posteriormente y dependiendo de los resultados obtenidos, el especialista en arte rupestre podrá extraer las interpretaciones que considere apropiadas para cada caso particular.*

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RAR DEBATES

Shamanism and Upper Palaeolithic art: a response to Bahn

By J. D. LEWIS-WILLIAMS and J. CLOTTES

We are pleased to see that Bahn and the editor of *RAR* think our book (Clottes and Lewis-Williams 1996) merits six pages of comment (Bahn 1997; hereafter parenthetical page numbers refer to this review); few, if any other, books have ever been accorded such extensive coverage. Yet, if the book is as patently foolish as Bahn believes, one wonders why it was necessary for him to point out its failings at such great length. Readers who make it through to the end will realise that his critique is highly repetitive: he pads it out by quoting passage after passage out of context and then incorrectly declaring that what we have written is an assumption without supporting evidence. Those who have read the book and our other publications will, of course, know better. As we show below, Bahn's misrepresentations do not reflect the truth of the matter.

Invoking an altogether inappropriate analogy with music (p. 67), Bahn says that, for him and for 'many researchers', the art does not stand in need of explanation; all that it asks of us is admiration and mindless contemplation — an obscurantist, comfortable and not very taxing view. We think it is best to state our position unequivocally. We believe that it is the task of archaeology to *explain* phenomena; understanding, even if it is partial, is, in our view, preferable to idle reverie. 'Science', if archaeology be, in a general sense, so categorised, means, at least in part, knowledge, understanding, and the discernment of otherwise invisible connections and causes. Readers who, with Bahn, argue that it is not the task of researchers to explain but simply to record and marvel need not trouble themselves with what follows.

A shying away from rigorous thought in favour of dramatic assertion is also evident in Bahn's excessive use of exclamation marks. His book, *Images of the Ice Age* (Bahn and Vertut 1988) is similarly peppered with them; they are part of his rhetorical stock-in-trade. Known by some as 'hysterical punctuation', this trick is an attempt to paper over cracks in logic: the exclamation mark is supposed to suggest, sarcastically, that a statement is self-evidently preposterous. But, place your thumb over the mark and the denigratory phrase that often precedes it, and, taken in context, the sentences that Bahn quotes are not at all absurd.

The emotional element in Bahn's writing leads to so distorted and tendentious a recension of our work that readers will find it impossible to judge the matter for themselves. It is therefore necessary for us to outline, in sequence and as briefly as possible, the framework of our argument. This outline will show that it is not, as Bahn claims, an inverted pyramid, a succession of unsupported assumptions, and it will make it possible for us subsequently to address some of his grosser distortions and illogicalities. We proceed from three preliminary observations, or premises, that provide a foundation for our hypothesis:

A. Human consciousness is complex and shifting; it includes a variety of 'alert' states and a range of 'altered' states, such as day-dreaming, dreaming, and deep 'trances' in which people hallucinate. Because they grade into one another, states of consciousness are difficult to define precisely. Yet each society has no option but to divide up the spectrum of mental states in its own way and, in doing so, to define the sort of states that in English are called 'close attention', 'visions', 'madness', 'ecstasy', 'revelation' and so on, each state having its own historically and culturally specific value. Further, the range of states so defined is open to contestation; some people challenge the norms imposed on them by 'society'.

B. We accept that the people of the Franco-Cantabrian Upper Palaeolithic were fully human (a point that Bahn does not contest) and that they, too, were obliged to divide up the spectrum of consciousness and place values, positive or negative, on the categories that they established.

C. Despite what Bahn thinks, we believe that world ethnography (and in places he uses it in a pretty cavalier manner; e.g., the Blackfoot bison drives, p. 65) shows that most hunter-gatherer communities allocate positive values to the states that we call 'trance'. People in these societies who achieve altered states have the opportunity (they do not all take the opportunity) to appropriate them for various purposes, such as healing, divination, controlling the movements of animals, changing the weather, and travelling to realms inhabited by spirits. In some hunter-gatherer societies, access to such states and attendant social statuses are comparatively open and many people become ritual practitioners; in other societies,

access is more contested, and only a few people, even only one person, may practise. In some societies, these practitioners assume political as well as religious roles; in others, this is not so. We believe that these divers manifestations may be grouped under the word in common use — 'shamanism'. What we have so far said makes it clear that we do not believe that an altered state of consciousness automatically makes a person a shaman; it is the social setting that provides the potential to do that.

These are our premises. The first two, at any rate, seem to be generally acceptable. On the third, all we can say is that if some hunter-gatherer shamanic societies do not have institutionalised altered states of consciousness, the majority clearly do. We therefore believe it reasonable to put forward the hypothesis that *the Upper Palaeolithic people of Franco-Cantabria had some form, or forms, of shamanism and that shamanic beliefs and rituals are expressed in divers evidence from that period.*

It needs to be clearly understood that, despite what Bahn implies, neither of us has ever claimed novelty for this hypothesis; on the contrary, we have cited many of those who have previously suggested it. As is well known, it has been around for a long time, and not, we believe, for no reason. What we try to do is to present a more detailed argument and, moreover, one that draws on and co-ordinates evidence from different fields.

Importantly, it should be noted that the shamanic hypothesis needs to be set against data. This, as far as we can make out, is where Bahn encounters most of his problems. He freely admits the possibility, even likelihood, that 'beliefs of this kind existed and played a role in the production of some Palaeolithic art' (p. 62), but when the hypothesis is taken seriously and set against a whole range of data, he illogically cries off. Indeed, it is this stage of our argument that most surely drives Bahn to his excessive use of exclamation marks. He does not understand the difference between assessing the explanatory power of a hypothesis and what he calls 'pure speculation' (p. 64), 'sheer fantasy' (p. 64), 'pure supposition' (p. 64), 'remarkable fantasies' (p. 66), 'this barrage of unsupported speculations' (p. 60) and so on. In fact, we take our hypothesis beyond the vague generalities that too often reduce the force of explanations of Upper Palaeolithic art and show that it makes good sense of many specific features and contexts. In doing so, we address some features of the art that, to the best of our knowledge, have not previously been considered relevant to the shamanic explanation. Two key questions need to be asked. One is: does the hypothesis provide a reasonable explanation for the features we address or does it not? The other is no less important: does the hypothesis bring the diverse data so explained into a coherent pattern, one that could reasonably be supposed to be the product of purposeful human activity?

Before we proceed to answer these questions, it is necessary to note that a hypothesis does not have to explain everything. All that is necessary is that observations not drawn into the explanation do not invalidate it. For instance, in the present debate, Upper Palaeolithic art in open sites does not cancel out the existence of art in deep caves. The way in which the hypothesis deals with open-site art may well be tentative, but that does not invalidate tighter arguments about cave art (a much larger body of evidence). It is indeed possible to explain something without explaining everything. If this were not so, there would be no archaeology.

Our testing of the shamanic hypothesis is comparable to the way in which Darwin worked (for him, too, the general idea was already in the air). He wrote,

> I believe in the truth of the theory, because it collects, under one point of view, and gives a rational explanation of, many apparently independent classes of facts (Darwin 1893: 13-14).

We now show, very briefly, how some 'independent classes of facts' are rationally explained and co-ordinated by the shamanic hypothesis.

First, shamanic societies commonly believe in a tiered cosmos: at its simplest, there are three levels (that of material life, and spirit realms above and below); more complex, multi-tiered concepts also exist. Of course, it is not only shamanic societies that believe in a tiered cosmos: for example, Christianity (*pace* modern theologians) also speaks of earth, heaven and hell. But such manifestations of a tiered cosmos do not negate or lessen the importance of the shamanic conception. We therefore believe it reasonable to argue that Upper Palaeolithic people probably believed that the caves led down into a nether realm.

Secondly, such a belief would, very likely, mean that the walls of the caves were an interface between those who ventured in and the beings and spirit animals of a shamanic underworld. To evaluate this proposition, we examine some features of Upper Palaeolithic images. We argue that images of animals that are created by shadow, convolutions of the rock surface and a few added details were, in a sense that we explain, being coaxed through the walls of the caves.

Thirdly, the seeking of animals by light, touch and sight suggests a shamanic vision quest, though, as will become apparent, we argue for a diversity of rituals in the caves. The sought visions were, we argue, sometimes 'fixed' on the surfaces of the caves.

Fourthly, the placing of animal bones and teeth in cracks and niches, another of the 'independent classes of facts', is explained by the same shamanic hypothesis: there was a two-way traffic between people and the underworld.

Fifthly, the diversity of shamanism, as demonstrated by world ethnography, together with the way in which parts of caves are differently decorated (some chambers have large, elaborate panels; others have 'simpler', apparently swiftly drawn images), suggests that rituals of different kinds (not just vision quests) were performed in different parts of the caves (Lewis-Williams 1995). Further, Upper Palaeolithic shamanism was not a simple, monolithic belief system that lasted unchanged for 20 000 years. How it changed is a question that will be addressed as dating becomes more accurate.

Sixthly, we note that altered states of consciousness

may be induced by many means; pathological conditions, ingestion of hallucinogenic drugs, rhythmic dancing and audio-driving are but some. Another is sensory deprivation — a condition experienced in the dark, silent caves. The caves themselves would, as modern speleologists confirm (Fénies 1965; Renault 1995-96), have had the power to induce visions. Psychic and physical entry into the underworld were, we argue, inextricably linked.

We could go on, but we have made our point: the shamanic hypothesis does indeed provide 'a rational explanation for many apparently independent classes of facts'. Bahn attempts to discredit each correlation between hypothesis and data by using exclamation and insult. Readers will find more of the explained observations in *Les chamanes de la préhistoire* and, for those whose French may not be up to it, in the English edition when it appears. So, rather than continue to explore the explanatory power of the hypothesis now, we move on to a round ten of Bahn's grosser errors; it is impossible to deal with them all. Neither these ten nor the others that he raises are original with him; they are all culled uncritically from old debates and, though he gives no hint of it, they have all been answered.

1. In the light of the framework that we have briefly outlined, it will be clear that Bahn has simply 'got it wrong' about the role of San rock art in our argument. He writes, 'The book's approach is based entirely on claims about southern African rock art ...'. Given the clarity of the book and numerous other publications (e.g. Lewis-Williams 1991; Lewis-Williams and Dowson 1993) that deal explicitly with the structure of the argument, this is nothing less than blatant misrepresentation. In any event, we ask why Bahn spends so much space attempting to discredit the use of neuropsychology in our argument if it 'is based entirely on claims about southern African rock art'. The kindest explanation is that he does not distinguish between *analogous* and *argument by analogy*. San rock art, though different in many respects, is, we believe, *analogous* to Upper Palaeolithic art in that it was largely associated with a form of shamanism; but we do not argue *by analogy* from San art to Upper Palaeolithic art, as the framework we have given above clearly shows. We base our argument on other points altogether. The analogous status of San rock art is in fact made clear in *Les chamanes*, and the section on it was accordingly printed as a separate 'box' on a tinted background.
2. On the vexed question of how much San rock art is shamanic (an issue that is irrelevant to the testing of the shamanic hypothesis against Upper Palaeolithic evidence), a couple of points need to be made to redress Bahn's distortions. The way in which the hypothesis that San rock art is essentially shamanic developed historically clarifies the matter and, moreover, shows how important it is to test a hypothesis against evidence. When one of us was writing *Believing and seeing* (Lewis-Williams 1981), he found that girls' puberty rituals, boys' first-kill observances and marriage rituals, along with various shamanic rituals and experiences, were all associated with the eland antelope, and that they were therefore prominently implicated in the art. (In many parts of southern Africa the eland is the most frequently painted antelope.) But when he came to collect illustrations of rock paintings relating to each of the chapters devoted to these areas of belief and ritual, he found hardly any paintings that clearly relate to the first three, but more than he could use that indisputably relate to shamanism by virtue of ethnographically well established postures, gestures, artefacts and clearly hallucinatory images. This experience led the author to conclude that the practice of rock painting and the rock surface itself (see Lewis-Williams and Dowson 1990) were informing contexts that focused on shamanic rituals and the shamanic segment of the eland's symbolic spectrum. The other rituals, also associated with eland, were not foregrounded; they probably acted as an empowering penumbra to the painted images (Lewis-Williams and Dowson 1989; Lewis-Williams 1990). Polysemy, yes — but focused polysemy (cf. Turner 1967). We ask that readers consult the publications we have cited and then make up their own minds about the weight of evidence, for there is a great deal of evidence. To accept Bahn's emotional review as a true reflection of our work would obviously be unwise.
3. 'Bleek and Lloyd ... made absolutely no mention of trance' (p. 63). This is one of Bahn's misleading half-truths. It is in fact a point that one of us (DLW) has himself repeatedly made. The Bleek and Lloyd texts are verbatim transcriptions of often lengthy statements recorded phonetically in the /Xam language from nineteenth-century informants. Of course, these informants did not mention 'trance'. But they did describe behaviour and experiences that comparisons with those of twentieth-century Kalahari San shamans (who indisputably do enter trance: Marshall 1962, 1969; Lee 1968; Katz 1982) unquestionably show that they were speaking about trance.
4. Bahn goes on to say that no ethnographic accounts suggest that San rock artists 'at work' were 'in any other than a normal state of consciousness'. No such claim has, to our knowledge, ever been made; certainly neither of us has made such a claim. On the contrary, San shamans in trance tremble too violently to hold a small brush and to achieve the fine, smooth lines of the art. This point, too, has been made repeatedly. Indeed, San rock art has been explicitly likened to Wordsworth's 'powerful emotion recollected in tranquillity' (Lewis-Williams and Dowson 1989: 35). Bahn is an unreliable guide to the literature.
5. Such misunderstandings, one is tempted to think wilful misreadings, emerge repeatedly. In another instance, Bahn writes that entoptic phenomena (for a discussion of this word *vis-à-vis* Bahn's 'phosphenes' see Tyler 1978; cf. Lewis-Williams and Dowson

1988: 202) are 'subconscious images' (p. 63). There is, in fact, no reason to bring in a concept of the 'subconscious'; these visual percepts are neurological. Nor is it damaging to the shamanic explanation to allow that entoptics may be seen in a variety of mental and physical conditions; the range of circumstances has been emphasised again and again and is in fact part of our argument (Lewis-Williams and Dowson 1988; Lewis-Williams 1991). It is the social setting, not entoptics themselves, that establish a shamanic context.

6. Bahn continues: the presence of an entoptic element 'tells one absolutely nothing of its meaning' (p. 63). Again, this is a key point in, and not a criticism of, the shamanic hypothesis; it has been made repeatedly. The meanings of mental images are socially informed, and it seems unlikely that we shall ever know the meaning of many of the Upper Palaeolithic 'signs' (Lewis-Williams and Dowson 1988; Reichel-Dolmatoff 1978).
7. In the example just given and in so many others, Bahn's debating trick is to present fragments of the writing of those who favour the shamanic hypothesis as if they were criticisms of that position. Moreover, he presents these fragments as if no one has ever discussed them. For example, he remarks that 'the modern Kalahari San ... have no knowledge of any painting tradition and ... are far removed in space and time from the Drakensberg'. This is virtually a quotation from one of us (DLW). A close reading of the Bleek and Lloyd nineteenth-century verbatim manuscripts together with detailed discussions with researchers, such as Megan Biesele (see, for instance, Biesele 1978, 1980, 1993) and Lorna Marshall (cf. Marshall 1962, 1969), reveal a significant point: despite the absence of a painting tradition (there are very few rocks in the sandy desert), important rituals and beliefs, including those that are shamanic, were, despite separation in time and space, common to the twentieth-century Kalahari !Kung and the southern nineteenth-century Colonial /Xam (Lewis-Williams and Biesele 1978; Lewis-Williams 1981, 1992). This point has been made in considerable empirical detail, but evidence is of little interest to Bahn.
8. A second example of Bahn's ignoring of evidence: he writes of 'the bald assumption' that the rock face was, for the San, an interface between the material and spiritual realms. In fact, the divers evidence adduced for this conclusion shows that the phrase 'bald assumption' is simply a distortion of the facts that is designed to hoodwink those who have not had an opportunity to read the real sources; the evidence has been published (e.g. Lewis-Williams 1990; Yates and Manhire 1991). Bahn may not agree with the conclusion drawn from it, but the evidence does exist.
9. Bahn claims that our definition of shamanism is idiosyncratic. The definition of shamanism is, of course, a contentious question; today there is rightly a greater emphasis than previously on social settings rather than psychological states. (For up-to-date reviews see Vitebsky [1995] and articles in the March 1997 issue of *Natural History*.) In *Les chamanes*, we recognise this emphasis and argue that the social setting can lead to contestation of definitions and social appropriations of states of consciousness (see A and C above). Bahn seems to have missed this part of our argument. It is simply not true that we reduce shamanism to psychological states. At the same time it must be said that, at present, researchers do not know a great deal about Upper Palaeolithic social conditions, and they therefore have little option but to write in general terms. It is this inescapable generality that leads to charges of reductionism. In the future, it may well be possible to achieve finer grained regional and temporal identifications of Upper Palaeolithic shamanism, but one cannot do everything at once. Again, not explaining everything does not mean than nothing has been explained. Atkinson's (1992) useful review of the literature on shamanism (cited by Bahn) emphasises specific historical and social contexts, but, despite her admonitions, she certainly does not deny the importance of altered states of consciousness and, in the end, retains the word 'shamanism', albeit in the plural. *Pace* Atkinson (1992: 311), we do not *aim* to produce a universalised 'shamanism', a general model that obscures local content and context. Some generalisation is, however, a necessary step as we move towards examining Upper Palaeolithic evidence (the only alternative to generalisation is to remain with one, inevitably restricting, ethnographic example). Then, when some broad themes emerge (as *Les chamanes* amply demonstrates), it will, we believe, be possible to identify regional and temporal Upper Palaeolithic *shamanisms*, though in what detail remains to be seen (for a start on this problem see Lewis-Williams 1997). It is highly unlikely that Upper Palaeolithic shamanism was identical to any single, ethnographically recorded instance of shamanism.
10. One final example of Bahn's distortions. When Lewis-Williams and Dowson first proposed their form of the shamanic explanation, they pointed out that all Upper Palaeolithic 'signs' (e.g. claviforms) were *not* homologous with entoptic forms. This distinction, they argued, rendered 'invalid the potential criticism that virtually any mark can be interpreted as having been derived from a geometric mental percept' (Lewis-Williams and Dowson 1988: 208). Bahn comments: 'In other words, this theory simply cannot lose. If it explains all the images, it wins; if it doesn't, it still wins!' (p. 65). On the contrary, the fact that some Upper Palaeolithic 'signs' are not formally comparable with entoptic images shows that the applicability of the model can be invalidated: it can be shown that the model does not fit certain classes of data. The 'signs' of Upper Palaeolithic art, as usually conceived, constitute a heterogeneous

category.

We conclude this response by noting that Bahn uses phrases such as 'increasing vogue', 'the latest attempt' (p. 62) and 'just another stage' (p. 67) as if all explanations are no more than passing fashions, and as if it is a foregone conclusion that researchers are merely witnessing a parade of equally untenable hypotheses, each doomed to pass on its way to oblivion. The same could, of course, have been said when many other explanations for a wide range of phenomena (astronomy is a case in point) were put forward — but, as we know, many of them did not fall by the wayside. Instead, researchers refined and developed them. There is absolutely no intrinsic reason why Upper Palaeolithic art should not be, at least in part, explicable. Because *previous* explanations failed, it does not follow that *all* explanations will fail. This is a flawed form of reasoning that some philosophers call argument by 'naive inductivism'. No wonder that it leads Bahn to the pusillanimous position that advocates comtemplation above explanation. By contrast, we argue that the shamanic hypothesis explains more features of Upper Palaeolithic art than any explanation, and, moreover, it shows those features to be parts of a co-ordinated, rational whole. We expect the hypothesis to be refined and developed in the future.

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RAR 15-447

EDITORIAL NOTE

This discussion of the shamanic interpretation of certain rock art would be fascinating, but it is marred by some of its tone. It will not be continued in *RAR*.

In a more general sense, we have always avoided censuring spirited discussion as much as possible, but we cannot accept acrimony for its own sake. Submitters will acknowledge with their submission that the decision of what is acceptable tone is an editorial one. For instance, there should be more latitude in matters concerning the survival or integrity of rock art than in debates of interpretive hypotheses such as the one discussed here. rgb

REVIEWS

Rock art and the prehistory of Atlantic Europe: signing the land, by RICHARD BRADLEY. 1997. Routledge, London. xiv + 238 pages, 40 plates and 57 figures. $A51.95 (paperback). ISBN 0 415 16535 0 (hard cover), 0 415 16536 9 (paperback).

Rock art and the prehistory of Atlantic Europe aims to uncover relationships between Neolithic to Bronze Age rock art, settlement, ritual sites, burials and the configuration of the natural landscape of coastal areas from the Straits of Gibraltar in the south to the Shetland Islands in the north. This region incorporates western Portugal, northern and western Spain, western France and Britain, and Ireland. The ultimate aim is to discover 'reasons for adopting rock art at a regional scale' (p. 15). This is the third of a series of books by Bradley addressing these issues, the first two concentrating on hoards and votive deposits (Bradley 1990), and the origins of monuments (Bradley 1993).

Bradley considers human constructions such as monuments that mark the land a part of the experienced landscape. Therefore, he argues, it is both logical and necessary to analyse rock art as part of the landscape if we wish to adequately understand and appreciate it. This requires investigating thematic and spatial relationships between different elements of that landscape. This is what Bradley's book does, concentrating on five analytical levels: (1) the character and relationship of motifs on rock surfaces; (2) the nature of those decorated surfaces; (3) spatial relationships with monuments (e.g. tombs); (4) spatial relationships with settlements; and (5) spatial relationships with the natural topography (including animals that frequent the landscape). It concludes with an elicitation of general patterns and their implications for understanding the art and a marking of the land during this time, especially in Britain, Ireland and western Portugal. More specifically it concludes that, wherever adequate analysis has been undertaken, the distribution of rock art in Atlantic Europe follows remarkably consistent geographical 'rules'. These patterns include a use of limited numbers of non-figurative designs (focused around the cup-and-ring, simple and concentric circles, sometimes linked with lines), and a tendency for the art to be located in strategic places along natural pathlines, at vantage points where particularly extensive sightings can be made of the surrounding landscape (e.g. valley openings), or on the edges of settlements. Bradley also concludes that some motifs, in particular 'abstract' ones, may depict specific places or paths in this landscape (e.g. waterholes). The evidence pointing to these conclusions is presented in a series of chapters specifically designed to address these relationships.

This was a most enjoyable book to read. The arguments were well reasoned, and the analyses well presented. Bradley has a most welcome, smooth writing style that makes his works always a pleasure to read. Indeed, unlike many studies of pre-Historic rock art aimed at recovering 'meaning', I finished the book largely convinced of Bradley's general arguments. However, there are two exceptions, both of which are passing ideas in the book, neither of which are critical to this work: (1) that some of the art may have originated in 'entoptic phenomena' (while this possibility is briefly contemplated, it is not necessary in this work and indeed is not investigated at all); and (2) that the dominance of the circle may symbolise a vision of the world in open environments (interesting, but again does not affect the general arguments). Two more significant problems are, firstly, that the central arguments made all rely on an informed, but none-the-less insecure, assumption that the rock art considered is broadly contemporaneous and accurately (but not necessarily precisely) dated. Bradley is well aware of the difficulties of dating rock art, and does the most with what he has. Secondly, he concentrates on discovering rules of association between motif forms/art panels and other parts of the landscape (i.e. design grammars), which show convincing similarities throughout the study area. But at the same time he underplays major differences in the motif forms themselves (graphic vocabularies) between those same regions. If, as Bradley suggests, some common information exchange systems operated four to five thousand years ago, so that rock art was created under a more or less unified symbolic framework, why are the motif forms so different in the north (Britain, Ireland), where the art is nearly exclusively abstract, and the south (Portugal, Spain), where animals are commonly represented? This problem is not fatal to Bradley's arguments, which directly confront this issue (only) six pages from the end of the book. His solution is that while landscapes are symbolised in similar ways throughout the region as a result of close inter-regional interaction, different peoples do so via their own, potentially different regional traditions. Nevertheless, this taints with unease the general conclusions of a more or less *unified* system of marking and symbolising people's relationships with their surroundings (or their metaphysical realities).

All in all, this is a wonderful rock art-landscape-prehistory book. I particularly like the landscape approach, enabling the reader to 'experience' the settings and relationships that are discussed. The details may be somewhat too detailed and geographically unfamiliar for some, but this notwithstanding, I strongly recommend this book to the professional archaeologist and layperson alike, and especially to rock art specialists and others interested in landscape approaches aimed at revealing something about *people*, *society* and *culture* in the past.

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RAR 15-448

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The Cambridge illustrated history of prehistoric art, by PAUL G. BAHN, with Foreword by Desmond Morris. 1998. Cambridge University Press, Cambridge. 302 pp., 306 illustrations (line drawings, half tone and colour plates), maps, glossary, index, references. Hardcover, £stg24.95, ISBN 0-521-45473-5.

This richly illustrated volume surveys the history of research into pre-Historic art, with an emphasis on the history of concepts which rise and fall within it. As Bahn puts it, it is thematic in perspective, taking ideas about pre-Historic art and testing them on a global scale. This is radically different from the usual geographic focus, an approach which has effectively dominated general studies of pre-Historic art over the 20th century. Bahn often identifies himself as a 'writer'. This is certainly true, with his prodigious record of publications to back up the claim. However, Bahn is, in fact, an archaeologist with a Ph.D. from Cambridge University where be studied under one of the great minds of 20th century archaeology, Glyn Daniel.

It should go without saying that this background would influence the content and direction of his newest book. Basically, the emphasis falls upon rock art, that part of pre-Historic art which is found engraved or painted onto stone, whether on cave walls, or rock formations, or on stone objects recovered in layered deposits from which timing and context can be inferred. Bahn includes bone, shell and metal objects but they constitute only a very minor percentage of the whole. The overwhelming majority of the illustrations are of rock art.

The volume is initiated with a rich, analytical history of research into (essentially) rock art. This section brings together a diverse assortment of obscure information, very aptly placed into perspective. In explaining the loss of ancient art, not many would know that some of this art was purposely destroyed by Christian church people because of 'The Idols Eradication Policy' established in the City of Kings (Lima, Peru) in 1567. This precisely explains the Jesuit destruction of decorated monoliths along the historically critical Fox River of Wisconsin in the 17th century. The book is full of these little nuggets. Bahn's summary of the history of rock art research is very probably the most thoughtful and penetrating effort of its kind to date.

On the thematic orientation, readers will find themselves immersed in body painting and tattooing, incisor ablation, the world's earliest sculpture, and the role of sound in rock art siting. Bahn covers just about anything one can imagine, and some, like the 'pornographic' ceramics of Peru (illustrated), which certain readers might have difficulty in imagining!

Bahn also deals with what certainly seems to be the full gamut of theory in rock art, starting with a review of what he calls 'splintering' (p. 67-68) the result of late 20th century discoveries of very early rock art all round the world, not just in Europe. Bahn has no time for single-mindedness in theory, stating that 'strict adherence to a single theory is a prophylactic against thought' (p. 243)! He wonders, as many of us do, what 'shamanism' actually is, and uses the term 'shamaniac' in assessing entoptic theory as critically linked to 'shamanism' (p. 244-247). He blasts the universal application of entoptic theory, especially as it is applied in the American Southwest (p. 245). Bahn takes aim at any and all 'simple solutions', or 'literal interpretations', reflecting a form of pessimism traditionally common to archaeology since at least the 1940s. In something as mushy as rock art, this is probably a good thing.

One might see this volume in two parts — one the basic text, and another the illustration captions and special illustrated units ('boxes') apart from the text. These are rich in data pertaining to many subjects, and could be read with considerable profit, without ever reading the text.

It seems valid to say that this book could form a very decent introductory text for a rock art course. Its purported focus, pre-Historic art in general, would only enhance its use in such a way. This would see rock art in it appropriately placed right where it belongs.

The shortcomings of this volume are not many, and they are minor in relation to the whole. While many of the coloured illustrations are superb, a few black and white ones are difficult to see or interpret. For example, a photo of petroglyphs on Gabriola Island, British Columbia, is very difficult to make out. Perhaps this was intended since carvings in dense vegetation and with heavy lichenation are very hard to see at times in this locality. The photo of Azilian painted pebbles on p. 88 would have been much better in colour. The clay bear of Montespan (p. 104) could be anything at all in the black and white photo provided, and a vigorous imagination would be needed to see anything related to the caption about Easter Island *moai* on p. 124. None of this, however, detracts greatly from the magnificent array of perfectly selected illustrations for illumination of the text's key points.

Finally, it is important to point out that the general theme of pessimism fulfils a critical need in our approach to research into pre-Historic art. Theoretical excesses, all amounting to 'single answers', need restraint. Bahn is arguing for a better balance, not slavish attention to one finding or approach. From either the humanistic or clinical direction, a judicious and moderate posture will at least not find one way out on a limb.

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RAR 15-449

Human evolution, language and mind. A psychological and archaeological inquiry, by WILLIAM NOBLE and IAIN DAVIDSON. 1996. Cambridge University Press, Cambridge. 272 pages, 47 line drawings and monochrome plates, bibliography and index. Hardback ISBN 0 521 44502 7, paperback ISBN 0 521 57635 0.

In this book the authors have taken on board some of the criticisms that were levelled at their several past attempts to address the origins of the human mind and language. This has resulted in some improvements of their original hypothesis, but on the whole it still remains seriously flawed. There are two basic reasons for this: firstly, the authors are still trying to *prove* their hypothesis by emphasising confirming evidence, rather than considering all relevant evidence equally or trying to *falsify* their pet theory. Secondly, they remain unaware of some significant lacunae in their relevant knowledge several years after these have been pointed out to them.

The original proposition of Professors Davidson and Noble was that the advent of language was essentially contingent upon the production of figurative art. Since there is no figurative art known in the world prior to perhaps 32 000 years, it had to follow that there was no evidence of 'reflective speech' before that time. The existence of non-figurative art of earlier periods, as early as the Lower Palaeolithic, was either rejected by the authors, or it was not considered relevant to the question of language origins. The production of beads, which are conceptually complex symbolic artefacts, also begins in the Lower

Palaeolithic, as I have recently reported in this journal. To suggest that symbolic artefacts such as rock art and beads were produced in the absence of language seems equivalent to taking a very extreme position.

Nevertheless, Davidson and Noble conceded that the first landfall in Australia represents the first archaeological evidence of language use, because trans-oceanic colonisation would postulate the existence of effective language, and it was achieved by Middle Palaeolithic hominids from Indonesia. But they maintained categorically that speech was limited to 'anatomically modern humans', and could therefore not have emerged earlier than 100 000 years ago.

This cornerstone argument remains the core of the present volume also, and for this reason alone the book's ultimate findings simply have to be rejected. Hominids crossed the sea to colonise new islands in the Lower Palaeolithic, and apparently even in the Early Pleistocene. Thus, on the basis of the authors' own criteria, these hominids must have possessed language of some form. According to what we presently know about the physical evolution of hominids, these first seafarers must have been of *Homo erectus* morphology. If that species had language, and thus was capable of symboling, than it is entirely pointless to speculate why speech and related abilities appeared so late in the Pleistocene. It is unfortunate that Noble and Davidson were unaware of this, because considerable efforts went into the book's preparation and on the whole it is well argued and presented.

One of the aspects that concern me about this book, and several others of its type, are the ways in which certain terms are used, such as 'mind' or 'intentionality'. There is also that all-pervading inclination to emphasise the distinctiveness of humans. Perhaps I am over-cautious, but I feel it is good practice to be wary of any endeavour to search for or define that which separates humans from other animals. Western scholars, for instance, still seem to be under the influence of their metaphysical system created by religious doctrines, as expressed in the ever-popular search for the origins of 'modern humans'. This nonsensical, trivial and irrelevant Holy Grail of palaeoanthropology seems a great deal more popular than really valid research topics, and yet I have never heard of a palaeontologist who gets so enthused about the question where the anatomically modern fruit-fly is supposed to have appeared first. When it comes to *Homo sapiens*, a totally different set of values takes over. And whatever inspires it, this seems to be detrimental to the objectivity of the discipline.

In the end, Noble and Davidson's hypothesis of language origins is not qualitatively different from those others we have seen appear and disappear since last century. They include the infamous 'bow-wow', 'ding-dong' and 'heave-ho' theories, and they became so rampant in nineteenth-century Europe that in 1866 the Société de Linguistique de Paris banned the topic altogether from its meetings and publications. Perhaps banning the present hypothesis would be a bit too drastic — I trust informed peer review will take care of it in the long term. But in the meantime, perhaps the authors would care to consider a few points that negate their views rather forcefully. For instance, other mammals have separate pathways for breathing and feeding, but in the adult human, the peculiar structure of the supralaryngal tract has considerable disadvantages. For instance, thousands of people choke to death each year from their food. The architecture of the human palate and both jaws has been less efficient for the past couple of million years than those of non-human primates, reducing the space available for teeth. The only benefit these awkward features brought us are the superb conditions for producing a great variety of vocal sounds. It is sensible to assume that the high evolutionary price we paid for these features was more than offset by an evolutionary benefit, which can only have been the use of language. What Noble and Davidson propose, and without any actual evidence, is similar to saying that the enormous costs involved in having large brains (obstetric limitations together with significantly prolonged infancy) were not compensated for by some equally significant benefit, such as improved intelligence.

Not only did humans long before 100 000 years ago possess the laryngeal structure for speech, they also had the requisite cortical equipment, which could have only added to the volume of an already oversized brain. Again, are we expected to believe that humans evolved the structures to produce and process language, but never actually benefited from them for two million years? Since attending Professor Bickerton's lecture at the 1983 UISPP Congress in Vancouver it has been obvious to me that children are born with a mental structure into which language is 'mapped', and that such a structure would not have evolved in a few tens of millennia. Since then I have rejected all 'recent origin' models of language, and the indisputable fact that hominids of Java had language of some sort at least 800 millennia ago only serves to reinforce an already self-evident truism. If the authors of this book are incapable of taking on board this view, or at least discuss it fairly, I think the reader has the right to ignore every unsupported hypothesis in their volume.

Nevertheless, Noble and Davidson's latest effort offers a wealth of relevant information and it is well worth reading. As long as the reader bears in mind that there are considerably more plausible opposing views, and that they are much closer to what really must have happened in the past. The authors begin their book with a statement by Darwin, so in conclusion I offer another aphorism by Darwin:

> ... man has an instinctive tendency to speak, as we see in the babble of our young children; while no child has an instinctive tendency to brew, bake, or write. Moreover, no philologist now supposes that any language has been deliberately invented; it has been slowly and unconsciously developed by many steps.

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RAR 15-450

Reconstruction of Homo erectus *constructing a bamboo raft in the islands of Indonesia. (Artwork by P. Welch.)*

RECENT ROCK ART JOURNALS

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International Newsletter of Rock Art. Newsletter of the Association pour le Rayonnement de l'Art Pariétal Européen (ARAPE). Edited by JEAN CLOTTES. Tri-annual newsletter, bilingual (French and English).

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CLOTTES, J.: The Pyrenean Park of Prehistoric Art.
BLAIN, A.: The rock engravings of the eastern and western Swiss Alps.
BINDA, F.: Notes on the archaeology of the rock art of Italian Switzerland.
ZÜCHNER, C.: Rock art research in Germany.
BELTRÁN, A.: Recent results from Spain (1994-1995).
YOSHIDA, N.: Japanese rock art in 1993-1994-1995.
NORDBLADH, J.: Rock art in Sweden.
MASAO, F. T.: The rock art of Tanzania: status of conservation and research.

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CHAZINE, J.-M.: The discovery of the first painted caves in Borneo (Kalimantan).
FAULKNER, C. H. and J. F. SIMEK: Mud Glyphs: recently discovered cave art in eastern North America.
KHAN, M.: A new discovery in Saudi Arabia.
GALLARDO-IBAÑEZ and F. VILCHES-VEGA: An original rock art style in the Atacama Desert (northern Chile).
SANSONI, U.: Three rock art discoveries in Valcamonica.
SANSONI, U. and S. GAVALDO: Sondrio Mountain - major archaeological discoveries.
TEIRA, L. and R. ONTAÑON: New schematic rock art finds in the Monte Hijedo region (Cantabria-Burgos, Spain).
LINARES MALAGA, E. and M. STRECKER: Let us save Toro Muerto.
SOGNNES, K.: Current rock art issues in Norway.
BEDNARIK, R. G.: Recent developments in Australian rock art research.

Australian rock paintings, recorded by David Welch.

Numbers 16, 17 and 18 (1997):
SOLEILHAVOUP, F.: A major 'Tazina' style site in the western Sahara.
LI XIANG SHI: Discovery of pictographs at Helanshan, Mt Ningxia, China [sic].
BOULAY, J.-P. and R. GRAS: Guyana. The inselberg, always a source of human interest.
BOSTWICK, T. W.: Urban development destroys ancient rock art.
DEACON, J.: A regional management strategy for rock art in southern Africa.
WHITLEY, D. S.: Rock art in the U.S.: the state of the states.
TARUVINGA, P.: Rock art in Zimbabwe.
TSEVEENDORJ, D., E. JACOBSON and V.-D. JUBAREV: Newly recorded petroglyphic complexes in the Altay Mountains, Bayan Olgiy Aimag, Mongolia.
Anonymous: Footprints galore.
RIPOLL LOPEZ, S.: New Paleolithic images in Extremadura: the cave of La Mina de Ibor.
BRUNET, J., E. GUILLAMET and J. PLASSARD: The elimination of graffiti at Rouffignac.
PERJAKOVA, T. and M. SKLYAREVKI: From the experience of the Centre of Preservation of Irkutsk Historical and Cultural Heritage.
BIRCHALL, J.: The cave drawings in the 'Blue Caves' of Mongolia.
JAUBERT, J. and P. H. GISCARD: The decorated cave of Hoït Tsenkher Agui (Hovd, the Mongol Altai Mongolia).
PESCHLOW-BINDOKAT, A.: The first prehistoric rock paintings of western Turkey.
RUSAKOVA, I.-D. et al.: Surveys of the 'Tomskaya Pisanitsa' Museum team near the village of Abakano-Perevoz in 1996.
MARTYNOV, A.-I. et al.: Research at the Sulek rock art site in 1996.
BERNARD, A.: A new discovery in the Fontainebleau Massif (France).
MIKLASHEVITCH, E.: The images on the boulders of the Barscaun River (Kirghizia).
LOUBSER, J. H. N.: The use of Harris diagrams in recording, conserving, and interpreting rock paintings.
BROMBLET, P. and J. BRUNET: A study of the feasibility of and necessary conditions for taking impressions from sculptured walls: with the example of the Bourdois Shelter at Roc-Aux-Sorciers (Angles-sur-l'Anglin, Vienne, France).
MOURE ROMANILLO, A. et al.: New absolute dates for pigments in Cantabrian caves.

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Pictogram. Journal of the Southern African Rock Art Research Association (SARARA). Edited by SHIRLEY-ANN PAGER. Recent issues include the following research and review papers:

Volume 8 (1996), Number 2:
WALKER, N.: The rock paintings of north eastern Botswana.
MASSON, J. R. and S. F. MASSON: Apollo 11 Cave revisited.
BEDNARIK, R. G.: 'Incongruities' in palaeoart.
WOODHOUSE, H. C.: The Dordrecht rock painting of a boar hunt.
REINBACHER, W. R.: Is there humour in rock art or rock artists?
WOODHOUSE, H. C.: Re-discovery of the Dordrecht rock painting of an elephant.
SEGLIE, D.: Report on SARARA international rock art conference.

Volume 9, Numbers 1 and 2 (1997):
PARKMAN, E. B.: Applying Internet technology to historic reservation: an example from California.
SWARTZ, B. K.: Standards for the recording of petroglyphs

and pictographs.

PAGER, S.-A.: When can the destruction of rock art sites be justified?

BEDNARIK, R. G.: Taphonomy for Reinbacher.

GENGE, P.: Comments.

BEDNARIK, R. G.: Changing perceptions in rock art conservation and management.

SWARTZ, B. K.: Opinions of general rock art management policy and their possible application to Namibia and elsewhere.

PAGER, S.-A.: Protection of rock art in Namibia.

GORDEN, M.: Grass roots conservation: placing a personal face on preservation.

STEINBRING, J.: Successful rock art conservation projects: two cases.

VOUVÉ, J., J. BRUNET and P. MALAURENT: Extensive preparatory research for environmental protection of decorated caves: case of Combarelles site (Les Eyzies, France).

SOLEILHAVOUP. F.: Evaluation du potentiel d'alterabilite de l'art rupestre a l'air libre.

LEE, G.: Problems of petroglyph conservation, Hawaiian islands.

DEVLET, E. G.: Rock art protection in Russia.

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SIARB Boletín. Journal of the Sociedad de Investigación del Arte Rupestre de Bolivia (SIARB). Edited by MATTHIAS STRECKER. Recent issues include the following papers:

Volume 9 (1995):

MARYMOR, M. L.: Estudios de arte rupestre: una base computarizada de datos bibliográficos.

SCHOBINGER, J.: Valcamonica Symposium 1994.

STEINBRING, J.: Arte rupestre temprano en Norte América.

SCHOBINGER, J.: El arte rupestre más antiguo de América del Sur: una ojeada sintética.

PODESTÁ, M. M.: Documentación y preservación de arte rupestre Argentino.

LUCAS, K.: El arte rupestre en el litoral del estado de Santa Catarina, Brasil.

RIVERA CASANOVAS, C. and M. MICHEL LÓPEZ: Arte rupestre en el Valle de Cinti, Chuquisaca, Bolivia.

Volume 10 (1996):

BEDNARIK, R. G.: La calibración computerizada a color en las fotografías de arte rupestre.

CLOTTES, J.: Los facsímiles de Niaux y Réseau Clastres en Parque Pirineo de Arte Prehistórico.

STANLEY PRICE, N.: Conservación y administración de sitios de arte rupestre en la Sierra de San Francisco, Baja California, México.

FERNÁNDEZ DISTEL, A.: El Congreso Internacional de Arte Rupestre NEWS 95 (Torino, Italia, 30 de agosto - 6 de septiembre de 1995).

QUEREJAZU LEWIS, R.: Simposio Internacional de Arte Rupestre Andino.

CHACAMA, J. M. and L. E. BRIONES M.: Arte rupestre en el Desierto Tarapaqueño, norte de Chile.

STRECKER, M.: Diez años SIARB.

TABOADA, F., C. RIVERA C. and M. MICHEL. L.: Las pinturas rupestres de Quime, Provincia Inquisivi, Departamento de La Paz.

Volume 11 (1997):

This volume consists of symposium summaries of the International Rock Art Congress held in Cochabamba, Bolivia, 1-6 April 1997.

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Almogaren. Journal of the Institutum Canarium. Edited by WERNER PICHLER. Recent issues included the following palaeoart papers:

Volume 26 (1995):

PICHLER, W.: Neue Ostinsel-Inschriften (latino-kanarische Inschriften).

PICHLER, W. and L. PICHLER: Das Phänomen der "Rillensteine" auf Fuerteventura.

Volume 27 (1996):

PICHLER, W.: Lybisch-berberische Inschriften auf Fuerteventura.

PICHLER, W.: Die "Spiele-Darstellungen" unter den Felsbildern Fuerteventuras.

PICHLER, W.: Die podomorphen Darstellungen unter den Felsbildern Fuerteventuras.

BEDNARIK, R. G.: Übersicht der Methodik direkter Felskunstdatierung.

ULBRICH, H.-J.: Neue Felsbildstationen auf der Kanareninsel Lanzarote (II).
TOPPER, U.: Neue Feldforschung im Hohen Atlas.
WYRWOLL, T. W.: Wilde nordafrikanische Wasserbüffel und ihre Darstellung auf Felsbildern — einige grundsätzliche Bemerkungen.
WYRWOLL, T. W.: Feldbilder saharischer Khoisan — der ethnische Hintergrund "ungewöhnlicher" Felsbildstile.
ULBRICH, H.-J.: Der "Zanata"-Stein von Tenerife — ein Drama ohne Ende.

Volume 28 (1997):
ULBRICH, H.-J.: Sexualität und Scham bei den Altkanariern.
BERGER, F.: Alte Darstellungen von Mühlebrettern in Deutschland.
BERGER, F.: Paviane im Fezzan.
PICHLER, W.: Neue Aspekte zum Thema "latino-kanarische Inschriften".

Volume 29 (1998):
BEDNARIK, R. G.: Über die Urkunst der Welt.
BERGER, F.: Der Bredenstein im Solling.
SPRINGER BUNK, R.: Los grabados del Ksar Barebi (Taghit, Argelia).
ULBRICH, H.-J.: Neue Felsbildstationen auf der Kanareninsel Lanzarote (III).
STEINER, H. E.: "Los Signos" über der Punta de los Saltos. Neue Felsbildstätte bei La Restinga auf El Hierro.
PICHLER, W.: Die Schiffsdarstellungen unter den Felsbildern Fuerteventuras.

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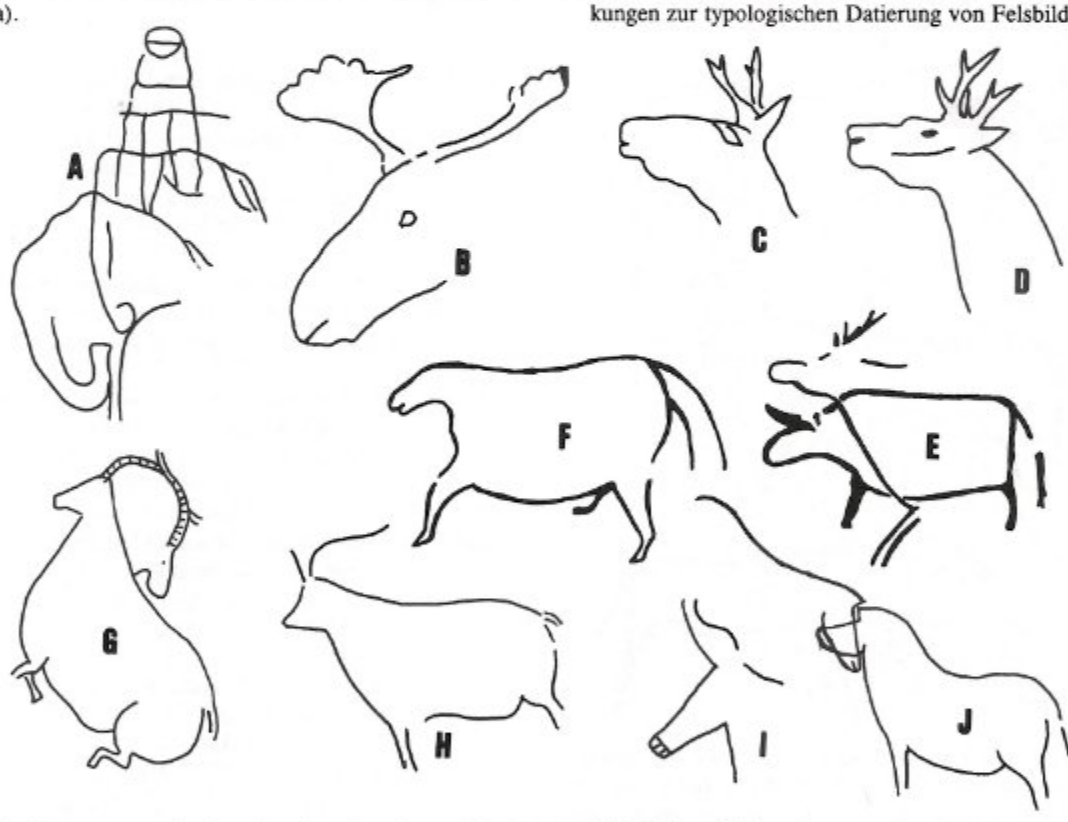
Mitteilungen der Anisa. Journal of the Verein Anisa. Edited by GÜNTER GRAF, HANS KANDOLF and HERTA MANDL-NEUMANN. A recent issue contains the following palaeoart papers:

Volume 17 (1996):
BEDNARIK, R. G.: Mehr über die Datierung von Felsbildern.
GLEIRSCHER, P.: Schalensteine in einem späthallstattzeitlichen Häuptlingsgrab in Waisenberg bei Völkermarkt (Unterkärnten).
MANDL, F.: Felsritzbildstation Kollersbach/ Hochkogel/ Kartergebirge by St. Wolfgang.
MANDL, F.: Kinderzeichnungen und Felsritzbilder. Bemerkungen zur typologischen Datierung von Felsbildern.



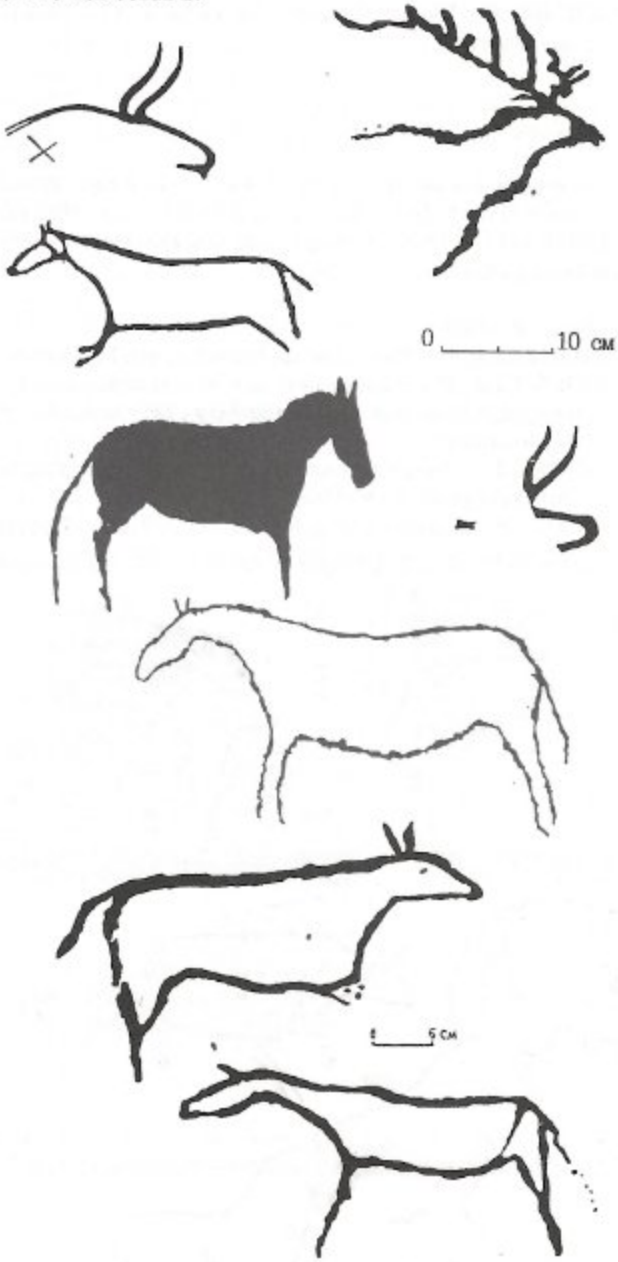
Petroglyphs of European and Asian sites that have been claimed to be of the Palaeolithic period on the basis of style, but are either late Holocene or thought to be so. Examples from Almogaren, *Volume 27. After R. G. Bednarik.*

RECENT BOOKS OF INTEREST

Aboriginal rock art of the Kimberley, edited by K. F. KENNEALLY, M. R. LEWIS, M. DONALDSON and C. CLEMENT. 1997. Proceedings of a seminar held at the University of Western Australia, Perth, 8 March 1997. Kimberley Society Occasional Paper 1, 83 pages, illustrated, 11 contributions and a panel discussion.

Rock art research - Moving into the twenty-first century, edited by SHIRLEY-ANN PAGER. 1997. Part I, Proceedings of the SARARA Conference, held 11-16 August 1996 in Swakopmund, Namibia. Southern African Rock Art Research Association. 120 pages, illustrated, 22 contributions representing six sessions.

Наскальное искусство Азии (Rock art of Asia), edited by the Museum Editorial Board 'Tomskaya Pisanitsa'. 1997. 136 pages, illustrated, 25 contributions. Kemerovo, ISBN 5 202 00212 2.



Petroglyphs from the Kalguty river, south-eastern Gorniy Altai. These figures have been attributed to the Stone Age in 1993. V. D. Kubarev demonstrates this to be false, and determines that they are most likely of the Bronze Age. Recordings by V. D. Kubarev, a contributor of the above book.

Los motivos de fauna y armas en los grabados prehisóricos del continente europeo, edited by F. J. COSTAS GOBERNA and J. M. HIDALGO CUÑARRO. 1997. Serie Arqueológica Divulgativa 3, Asociación Arqueológica Viguesa. 153 pages, richly illustrated, seven contributions. Vigo (Spain), ISBN 84 605 3877 X.

African pictograms: Namibia rock art and archaeology, by the Centro Studi e Museo d'Arte Preistorica Pinerolo, Italy. 1997. 56 pages, exhibition catalogue with colour and monochrome plates, published by CeSMAP.

Indian rock art and its global context, by KALYAN KUMAR CHAKRAVARTY and ROBERT G. BEDNARIK. 1997. Motilal Banarsidass, Delhi, and Indira Gandhi National Museum of Man, Bhopal. 228 pages, 198 plates, mostly in colour, appendixes (maps, date list and glossary), index. Hard cover, ISBN 81 208 1464 9.

Rock painting at Pengavan, Raisen, Madhya Pradesh, India.

RECENT PAPERS OF INTEREST

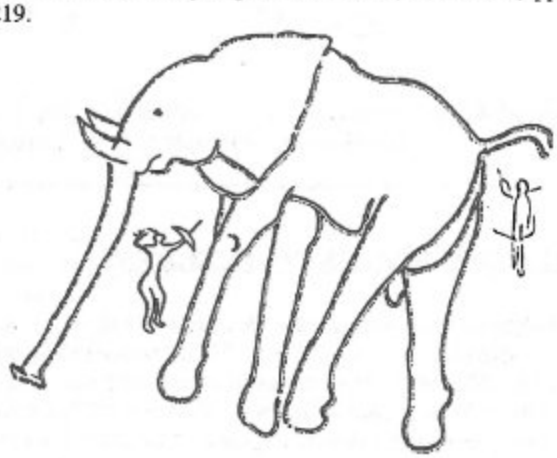
Rock art of north Karnataka, by RAYMOND ALLCHIN and BRIDGET ALLCHIN. 1994/95. Bulletin of the Deccan College Post-Graduate and Research Institute, Volumes 54-55, pp. 313-339.

Modelling the production and consumption of rock art, by J. D. LEWIS-WILLIAMS. 1995. *South African Archaeological Bulletin*, Volume 50, Number 162, pp. 143-154.

Neglected rock art: the rock engravings of agriculturist communities in South Africa, by TIM MAGGS. 1995. *South African Archaeological Bulletin*, Volume 50, Number 162, pp. 132-142.

Spiritual and political uses of a rock engraving site and its imagery by San and Tswana-speakers, by SVEN OUZMAN. 1995. *South African Archaeological Bulletin*, Volume 50, Number 161, pp. 55-67.

Considerations on Saharan rock art symbolism, by JAN JELÍNEK. 1995. *Anthropologie*, Volume 33, Number 3, pp. 213-219.



Petroglyphs at Wadi Buzna, Sahara, recorded by J. Jelínek.

The impact of direct dating on Palaeolithic cave art: Lascaux revisited, by PAUL G. BAHN. 1995. *Anthropologie*, Volume 33, Number 3, pp. 191-199.

Les deux époques dans la trame symbolique des figurations rupestres Sahariennes, by ALFRED MUZZOLINI. 1995. *Anthropologie*, Volume 33, Number 3, pp. 221-230.

Symbolisme de position et art rupestre au Messak (Libye), by JEAN-LOÏC LE QUELLEC. 1995. *Anthropologie*, Volume 33, Number 3, pp. 231-267.

Isco — rock art site in Hazaribag District: an ethno-archaeological profile, by SOMNATH CHAKRAVERTY. 1996. In R. K. Sharma and K. K. Tripathi (eds), *Recent perspectives on prehistoric art in India and allied subjects*, pp. 74-99. Aryan Books International, New Delhi.

El V° y IV° milenios en Andalucía central: la Cueva de los Murciélagos de Zuheros (Córdoba). Recientes aportaciones, by B. GAVILÁN CEBALLOS, J. C. VERA RODRÍGUEZ, L. PENA CHOCARRO and M. MAS CORNELLÀ. 1996. *Rubricatum - Revista del Museu de Gavà*, Volume 1, pp. 323-327.

A Middle Palaeolithic symbolic composition from the Golan Heights: the earliest known depictive image, by ALEXANDER MARSHACK. 1996. *Current Anthropology*, Volume 37, Number 2, pp. 357-365.

Thematic changes in Upper Palaeolithic art: a view from the Grotte Chauvet, by JEAN CLOTTES. 1996. *Antiquity*, Volume 70, pp. 276-288.

Mégalithes et traditions populaires la hache et le marteau de vie et de mort, by JEAN-LOÏC LE QUELLEC. 1996. *Bulletin de la Société Préhistorique Française*, Volume 93, Number 3, pp. 287-297.

Cultural areas and interregional relations: the case of the Egyptian and Libyan theriomorphs, by JEAN-LOÏC LE QUELLEC. 1996. In *Interregional contacts in the later prehistory of northeastern Africa*, pp. 51-59. Poznan.

Crisis in Palaeolithic art studies, by ROBERT G. BEDNARIK. 1996. *Anthropologie*, Volume 34, Numbers 1-2, pp. 123-130.

Praus in Marege: Makassan subjects in Aboriginal rock art of Arnhem Land, Northern Territory, Australia, by GEORGE CHALOUPKA. 1996. *Anthropologie*, Volume 34, Numbers 1-2, pp. 131-142.

À l'ombre du plaisir: à propos d'un site du Messak (Libye), by JEAN-LOÏC LE QUELLEC. 1996. *Anthropologie*, Volume 34, Numbers 1-2, pp. 161-183.

Les équidés des figurations rupestres sahariennes, by ALFRED MUZZOLINI. 1996. *Anthropologie*, Volume 34, Numbers 1-2, pp. 185-202.

Contenido arqueológico y etnográfico de los sitios de interés espeleohistórico del Orinoco medio, Bolívar, Venezuela, by FRANZ SCARAMELLI and KAY TRABLE. 1996. *Boletín de la Sociedad Venezolana de Espeleología*, Vol. 30, pp. 20-32.

The myth of ritual origins? Ethnography, mythology and interpretation of San rock art, by ANNE SOLOMON. 1997. *South African Archaeological Bulletin*, Volume 52, pp. 3-13.

Recent developments in radiocarbon and stylistic methods of dating rock-art, by ANDRÉE ROSENFELD and CLAIRE SMITH. 1997. Antiquity, *Volume* 71, pp. 405-411.

Constraining the age of the Côa valley (Portugal) engravings with radiocarbon dating, by RONALD I. DORN. 1997. *Antiquity*, Volume 71, pp. 105-115.

Managing a new rock art site, by JANE KOLBER. 1997. *Trabalhos de Antropologia e Etnologia*, Volume 37, Numbers 3-4, pp. 119-124.

The monsters of Pergouset, by MICHEL LORBLANCHET and ANN SIEVEKING. 1997. *Cambridge Archaeological Journal*, Volume 7, Number 1, pp. 37-56.

Bradshaws: the view from Arnhem Land, by DARRELL LEWIS. 1997. *Australian Archaeology*, Number 44, pp. 1-16.

'Bent knee' anthropomorphous rock paintings of Welch's Type II, Kimberley. Recorded by David Welch.

Luminsecence dating of rock art and past environments using mud-wasp nests in northern Australia, by RICHARD ROBERTS, GRAHAME WALSH, ANDREW MURRAY, JON OLLEY, RHYS JONES, MICHAEL MORWOOD, CLAUDIO TUNIZ, EWAN LAWSON, MICHAEL MACPHAIL, DOREEN BOWDERY and IAN NAUMANN. 1997. *Nature*, Volume 387, 12 June 1997, pp. 696-699.

Some 'palace caves' of the Bushman chiefs, by H. C. WOODHOUSE. 1997. *South African Journal of Ethnology*, Volume 20, Number 2, pp. 93-103.

Comparatisme et horizon archaïque des gravures du Nil au Sahara central, by JEAN-LOÏC LE QUELLEC. 1997. *Archéo-Nil*, Number 9, pp. 43-48.

Cathedrals of prehistory: rock art sites of the Northern Plains, JACK STEINBRING and ANTHONY P. BUCHNER. 1997. *American Indian Rock Art*, Volume 23, pp. 73-84.

Ear-rings in the rock art of South Africa, by H. C. WOODHOUSE. 1997. *South African Journal of Etnology*, Volume 20, Number 3, pp. 152-155.

Agency, art and altered consciousness: a motif in French (Quercy) Upper Palaeolithic parietal art, by J. D. LEWIS-WILLIAMS. 1997. *Antiquity*, Volume 71, pp. 810-830.

On human blood, rock art and calcium oxalate: further studies on organic carbon content and radiocarbon age of materials relating to Australian rock art, by RICHARD GILLESPIE. 1997. *Antiquity*, Volume 71, pp. 430-437.

'Strange paintings' and 'mystery races': Kimberley rock-art, diffusionism and colonialist constructions of Australia's Aboriginal past, by IAN J. McNIVEN and LYNETTE RUSSELL. 1997. *Antiquity*, Volume 71, pp. 801-809.

Cupule engravings from Jinmium-Granilpi (northern Australia) and beyond: exploration of a widespread and enigmatic class of rock markings, by PAUL S. C. TAÇON, RICHARD FULLAGAR, SVEN OUZMAN and KEN MULVANEY. 1997. *Antiquity*, Volume 71, pp. 942-965.

Archaeological signatures of the social context of rock art production, by ANDRÉE ROSENFELD. 1997. In M. Conkey, O. Soffer, D. Stratmann and N. G. Jablonski (eds), *Beyond art: Pleistocene image and symbol*, pp. 289-300. Memoirs of the California Academy of Sciences Number 23.

Commentaire à la note de Nadjib Ferhat, Karl Heintz [sic] **Striedter et Michel Tauveron**, by JEAN-LOïC LE QUELLEC. 1997. *Comptes Rendus de L'Académie de Sciences Paris*, Volume 324 (série IIa), pp. 75-77.

Sexualität und Scham bei den Altkanariern, by HANS-JOACHIM ULBRICH. 1997. *Almogaren*, Volume 28, pp. 7-88.

Alte Darstellungen von Mühlebrettern in Deutschland, by FRIEDRICH BERGER. 1997. *Almogaren*, Volume 28, pp. 97-114.

Paviane im Fezzan, by FRIEDRICH BERGER. 1997. *Almogaren*, Volume 28, pp. 235-238.

Neue Aspekte zum Thema 'latino-kanarische Inschriften, by WERNER PICHLER. 1997. *Almogaren*, Volume 28, pp. 293-242.

Stumbling in the footsteps of St Thomas, by PAUL BAHN. 1998. *British Archaeology*, p. 18, February 1998 issue.

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ORIENTATION

Minutes of the 1998 AURA MEETING Canberra, 7 February 1998

The 1998 annual meeting of the Australian Rock Art Research Association was held at the Ursula College, Australian National University, Canberra. The meeting commenced at 9.15 a.m. and was attended by thirty members. It was chaired by the President of AURA, Mike Morwood and covered the following major items:

1. WELCOME

2. MEMBERS PRESENT

The following AURA members were present: Elfriede Bednarik, Robert Bednarik, Margaret Bullen, Hugh Cairns, John Clegg, Noelene Cole, Bruno David, Iain Davidson, Warren Day, Julie Drew, Nevin Ellis, Josephine Flood, Ursula Frederick, Ben Gunn, Nicholas Hall, Margaret Harper, Cathrin Palmer, Howard Morphy, Mike Morwood, John Mulvaney, Ken Mulvaney, Kelvin Officer, Carol Patterson, Malcolm Ridges, Andrée Rosenfeld, Di Smith, Paul Taçon, Charles Warner, Alan Watchman, Meredith Wilson.

3. MINUTES OF THE 1997 MEETING

The minutes of the meeting in Melbourne (as published in *RAR* 14, pp. 69-70) were considered to have been read and were accepted. No matters arising from them were discussed except as listed below.

4. CORRESPONDENCE

The Secretary reported receiving a large volume of correspondence, and singled out a few letters relating to the tone of debate in a recent issue of *RAR*. He reported that action had been taken concerning the matter in question.

5. TREASURER'S REPORT

The Treasurer reported a steady increase in AURA's funds since the last Annual General Meeting as there had been no major expenditure. Referring to the financial report published in *AURA Newsletter* (September 1997 issue), she noted total expenditures of $1870.25 and a total income of $4704.10 from the start of the financial year to the end of January 1998. Consequently AURA's publishing fund stands currently at $14 367.21. The Treasurer reported that her target of increasing the fund to $20 000 by the end of 2000, to provide the funding of the AURA 2000 proceedings, seemed realistically achievable. The financial report for 1997-98 will appear in the first *AURA Newsletter* after June 1998.

6. CAIRNS DECLARATION

The President pointed out the need for a formal response to the declaration of the indigenous participants of the Second AURA Congress. After debate it was moved (G. Ward) and seconded (J. Flood) that members of the Executive Committee of AURA should constitute a subcommittee for the purpose of preparing a response for the membership's approval, and that additional individuals be co-opted as required. This was approved by the members.

7. THIRD AURA CONGRESS

7.a The Secretary reported that R. G. Kimber had been consulted, as suggested at the previous AGM, and that competing bids were currently under preparation by Alice Springs and Adelaide.

7.b He called for specific suggestions concerning the academic format of the Congress, and J. Clegg suggested extensive use of workshop-style meetings, mentioning the need for infrastructure.

7.c J. Drew mentioned the Aruluan Centre in Alice Springs as a prospective venue, but the city's limited capacity in accommodating a large conference and the ability of sites in coping with a strong influx were also mentioned (A. Rosenfeld). J. Flood pointed out that the city was well orientated towards tourism, with a system of Aboriginal guides in place.

7.d Concerning the issue of costs, B. Gunn mentioned that registration fees at the AURA congresses are exceptionally low by comparison to similar events, and the topic of subsidisation was discussed in some detail (e.g. casino fund, major multinational corporation or similar).

7.e The need to consult during choice of site with local Aboriginal groups in both prospective venue sites and field trip destinations was mentioned (G. Ward).

8. AURA HOME PAGE

The Secretary pointed out that the home page was well visited since last November, and that there was no good reason to set up a second home page, as had been suggested at the previous AGM. J. Flood moved to commend C. Ogleby for his efforts as the site's co-ordinator. There was general agreement that more material needed to be posted, as the Web is an important resource that disseminates material most effectively. C. Ogleby called for more submissions, R. Bednarik suggested the establishment of a rock art discussion board on the Web site. N. Hall requested the publication of calls for submissions to the AURA Home Page.

9. GENERAL AND NEW BUSINESS

9.a N. Hall inquired whether letters mentioned at the previous AGM were submitted, and the Secretary reported that any letters made available to him were officially sent.

9.b J. Drew displayed a T-shirt with Australian rock art motifs, produced by the Museum of Man in San Diego, and suggested that the question of indigenous copyright be raised with the Museum. After discussion the meeting decided that the Museum be invited to comment.

10. FORTHCOMING EVENTS

The Secretary reported that the academic program of the IRAC 98 (Portugal) will be circulated shortly, and that the 1999 event would be held at Ripon, Wisconsin. To a question concerning two other events he explained that these were more local events that are not organised by members of IFRAO.

11. AURA AGM 1999

No venues were suggested by the members. The Secretary proposed that, in preparation for the Third AURA Congress in 2000, no academic program be held in 1999. It was decided that a small AGM would be held in Melbourne, probably in November 1999, to satisfy the legal requirements of an incorporated organisation.

12. ADJOURNMENT

The AGM was adjourned at 10.15 a.m.

R. G. Bednarik
AURA Secretary
RAR 15-451

Making a mark: the AURA Inter-Congress Symposium 1998

The Australian Rock Art Research Association (AURA) conference of 1998 was held at the Australian National University in Canberra. The conference began on February 6 with a day session entitled 'Where Have We Come From? Where Are We Going?' The aim of the session was to explore past and current avenues of rock art research by commemorating the enormous contribution Dr Andrée Rosenfeld has made to the discipline throughout her twenty years of research and teaching in the Department of Archaeology and Anthropology. Session participants drew on a number of areas in which Rosenfeld has made significant contributions and which continue to be a source of interest, investigation and discussion within the discipline including: the rock art and archaeology of the Cape York Peninsula, the dating of rock art, Australia's history of rock art conservation and management, stylistic approaches to the study of rock art and examinations of contact rock art in central Australia.

After a full day of papers, conference delegates proceeded to the foyer of the Classics Department where we were joined by former colleagues of Rosenfeld's at the ANU to enjoy drinks. The evening was sponsored by the Mulvaney Fund of the Department of Archaeology and Anthropology. The occasion was opened by Professor Spriggs and Emeritus Professor Mulvaney who offered a short speech and toast in celebration of the event. Followed by a few words from Rosenfeld, participants proceeded to dinner at the Cellar Bar of University House.

The second day of the conference consisted of three sessions: Multiple Approaches to the Discipline (MAD), Cross-Cultural Encounters, and Contemporary Issues. The proceedings may best be described in terms of the diversity of theoretical and disciplinary approaches advanced in the papers; and an emphasis on the rock art of the Kimberley.

A number of papers addressed issues relating to the Kimberley region, including an examination of the archaeological context of art production, and different ways of analysing and interpreting the rock art, ranging from a statistical analysis of 'Bradshaw' figures to an exploration of rock art production as an expression of social and spiritual associations to land.

The day concluded with a lively discussion of the issues raised from the three sessions and with the first Australian screening of 'The Ngarinyin Secret Pathway Project'. This film is a work in progress which aims to visually document rock art sites and their associative stories and meanings through the words and actions of Ngarinyin. This screening was sponsored by the Australian Institute of Aboriginal and Torres Strait Islander Studies. The conference dinner was held at Vivaldi's.

Sunday commenced with a series of papers which presented methodological and theoretical frameworks for comparing rock art and other material culture. The content of the papers derived from a diverse range of regions, including India, Australia, Vanuatu and Peru.

The following session included three papers on the 'nuts and bolts' of rock art, including dating, rock art recording, and the application of digital technologies to rock art studies. These were followed by two announcements from Nicholas Hall and Alan Watchman on an upcoming heritage management training course at Uluru, and a rock art recording course being offered at James Cook University, Townsville.

The final session for the day was chaired by John Clegg on the theme of 'boundaries'. Its focus was on how and why we construct boundaries, covering issues of style, symbolism, and perception in rock art research. A lively discussion followed which centred on the importance of recordings, the recorder's perceptions, and

who has access to and ownership of recordings.

Following academic proceedings, participants were transported to the Department of Archaeology and Natural History to attend a Book Browse at ANH Publications. As well as being given the opportunity to purchase books at discount prices, Ann Andrews treated everyone to an ice-cream from a Mr Frosty van. We are told that this strategy had a positive effect on sales! Everyone then returned to Ursula College for a BBQ.

On Monday, the remaining conference delegates participated in a field excursion to Yankee Hat rock art site at Namadji National Park. We were introduced to the site by Matilda House from the local Ngunnawal Aboriginal Community who shared her feelings about the site and the Namadgi area. Both Kelvin Officer and Josephine Flood were present and were able to offer their perspectives and interpretations of the site based on their respective work on the rock art and archaeology of the region. Kelvin's work, in particular, has been central to the design of site management procedures for the rock art sites in the Park.

After lunch we proceeded to the Namadgi National Park Visitor's Centre where Trish Macdonald presented a brief history of the research, visitation and the management of the rock art sites in the area. Trish's talk was followed by the final paper of the conference presented by Katharine Sale which outlined a rock art management program at Yaddonba, Victoria.

The four days of the conference were successful in bringing people together from around Australia to discuss issues and it provided us with a taste of some of the exciting projects underway between now and the next meeting in 2000.

Ursula Frederick and Meredith Wilson
RAR 15-452

CROSSING FRONTIERS

6-12 September 1998, Vila Real, Portugal

Call for papers — Portugal

ROCK ART AND SCIENCE

Co-ordinated by Robert G. Bednarik, AURA, P.O. Box 216, Caulfield South, Vic. 3162, Australia. Fax 61-3-95230549. E-mail: *aurawww@sli.unimelb.edu.au*

The use of science as a way of exploring rock art involves systematic pursuits based on reproducible observations, measurements and experiments, whose results can be presented as falsifiable or refutable propositions. This includes a very wide range of possibilities, most of which have attracted little if any sustained research work so far. Some of the types of work that have received attention are the composition of paint residues, the natures of their recipes, incidental inclusions (e.g. brush fibres), and the research issues posed by paint preparation; the production of percussion petroglyphs and the tools or techniques involved; the estimation of the time when rock art was produced, by a variety of scientific methods; the study of the weathering and other modification processes rock art is subjected to; the discrimination of rock art from similar phenomena that may resemble rock art; the microscopic study of abrasion petroglyphs through tool-related features, such as striations; other applications of light and electron microscopy; the study of mineral accretions over or under both petroglyphs and paintings, and of inclusions found in them. Also relevant are techniques such as replication studies, nano-stratigraphy in rock art and accretionary deposits, the application of taphonomic logic in rock art science, valid applications of statistics, semiotic theory, computerised image manipulation (colour correction or re-constitution), and the application of such scientific methods to portable art as well. Scientific approaches are related to a variety of issues, such as conservation and management, age estimations, and the reconstruction of the circumstances of rock art production.

Your contribution to this symposium is invited. Please provide the title of your paper and a 100 to 150-word abstract to the co-ordinator as soon as possible.

Call for papers — Portugal

ROCK ART OF ASIA AND AUSTRALIA

Co-ordinated by Robert G. Bednarik, AURA, P.O. Box 216, Caulfield South, Vic. 3162, Australia. Fax 61-3-95230549. E-mail: *aurawww@sli.unimelb.edu.au*

This symposium is to consider the rock arts of the largest and smallest continents together, as a single region. Papers are invited about rock art in the two continents, as well as from New Zealand and other islands in general region. Any topic related to pre-Historic or rock art is welcome, and new finds and developments are of particular interest. The symposium may include technical studies, such as the dating of regional corpora, regional syntheses, ethnographic studies of rock art, the roles of indigenous custodians and owners of rock art, new sites or major overviews — any topic that helps in defining the current status of rock art research in the vast area of Asia and in the region to the south-west of Asia, into which Palaeolithic seafarers ventured, bringing with them very early art systems from Asia.

Your contribution to this symposium is invited. Please provide the title of your paper and a 100 to 150-word abstract to the co-ordinator as soon as possible.

CALL FOR SESSION PROPOSALS

1999 INTERNATIONAL ROCK ART CONGRESS IFRAO-ARARA-MAGF

RIPON, WISCONSIN, U.S.A.
MAY 23 - 31, 1999

General

The 1999 International Rock Art Congress will take place on the campus of Ripon College, Ripon, Wisconsin, U.S.A. from May 23 to 31. The Congress is sponsored by The International Federation of Rock Art Organisations. The national host is the American Rock Art Research Association and the local/regional host is the Mid-America Geographic Foundation. Other participating organisations include the University of Wisconsin-Oshkosh, the University of Wisconsin Center-Fond du Lac, the Eastern States Rock Art Research Association, the University of Minnesota, the Minnesota Historical Society and the Mid-West Rock Art Association.

There will be two days of pre-congress field trips (May 22 and May 23), and two days of post-congress field trips (May 30 and May 31). The costs of post-congress field trips are included in registration (or requiring only a nominal fee). Dormitory accommodations will be available at Ripon College. A package of room and board (meals) has been fixed at US$35.00. Meal tickets for any combination of meals (dinner only, lunch and breakfast, etc.) can be purchased by those staying off-campus. A list of 25 motels in the immediate area is available, conference rates are being negotiated. There are approximately 100 motel units available in Ripon, and the college can accommodate 1000. A complete motel (32 units) within easy walking distance will be reserved. Distances to other accommodations range from 2 miles to 17 miles. These include all price ranges.

Air connections from Chicago, Milwaukee, and Minneapolis to Appleton, Wisconsin are the most convenient. Ripon College will provide shuttle service from and to Appleton (45 minutes) on peak arrival and departure days. Chicago is 185 miles from Ripon, Milwaukee is 80 miles away. Road connections are by freeway, except for 18 miles.

The Congress format will follow that of the Flagstaff Congress of 1994. There will be several concurrent sessions in the mornings, and General Sessions (symposia), in the afternoons. There will be public presentations in the evening. Registration will be from 5:00 to 9:00 p.m. Sunday, May 23 and from 7:30 - 8:45 on Monday, May 24. Registration will take place in the Rotunda of Harwood Memorial Union. Late arrivals may register throughout the week. Information boards (approx. 75 × 75 cm) for participating organisations will be mounted in the registration area. These may include the history, nature and goals of your organisation. You may include addresses, membership fees, and publication policies.

Efforts are under way to conduct some of the sessions in Spanish (with English translations as well as English to Spanish translations). To facilitate such communication, an innovation for slide presentations is being initiated. Presenters will be asked to produce translated

captions for their slides for dual projection. One screen will contain the view, the other a caption for it (English if a Spanish presentation, Spanish if an English presentation). This will significantly reduce the problem of doubling the time in translated papers. The organisers are hoping that these arrangements will form a successful precedent for future congresses, and that a significant number of Hispanic contributors will avail themselves of this service.

Session invitations

All organisations and individuals interested in rock art are invited to make proposals for sessions, either specialised or general. These proposals must be received by 1 AUGUST 1998.

Please note this deadline. Proposals should be limited to 300 words, with a list of prospective presenters. The presenters need not be confirmed. The results of the proposal review will be made available as soon as possible. Successful candidates will be responsible for the formal recruitment of presenters and the complete organisation of their symposium or session.

Unless otherwise specified later in the planning phase, papers will be strictly limited to 20 minutes (including question time). A longer formal paper (using the *American Antiquity* Style Guide) may be submitted for publication in the Congress proceedings. Presenters are asked to have first (typed) drafts available at the time of delivery. Requirements for translation, audio-visual equipment or other needs must be made at the time the presentation is proposed.

Planning for the publication of the proceedings is under way. Session chairpersons will be responsible for initial editing, and the final compilation will be undertaken by the American Rock Art Research Association, in collaboration with the International Federation of Rock Art Organisations and the Mid-America Geographic Foundation.

Organisations are encouraged to provide well mounted, secure posters for gallery exhibition. Ample well-lighted space has been allocated for these. It is expected that the focus of these posters will be rock art, or relevant aboriginal themes. Groups not in attendance at the Congress are welcome to arrange for the exhibition of posters. Further details will be provided during 1998.

If you have any questions, they may be directed to:

Dr Jack Steinbring
Department of Anthropology
Ripon College
P.O. Box 248
Ripon, WI 54971
U.S.A.

E-mail: *steinbringj@mac.ripon.edu*
Fax: 920-748-7243
Phone: 920-745-2937

APPEL D'OFFRE DE SYMPOSIUMS
Congrès International d'Art Rupestre 1999

Général

Le Congrès International d'Art Rupestre 1999 aura lieu sur le campus du Ripon College, Ripon, Wisconsin, USA, du 23 au 31 mai. Ce Congrès est sponsorise par l'IFRAO (la Federation Internationale d'Organisations d'Art Rupestre). L'hute national est l'ARARA (Association Américaine de Recherche en Art Rupestre) et l'hute local/régional est la Mid-America Geographic Foundation. Parmi les autres organisations participantes, on peut citer l'Université de Wisconsin-Oshkosh, l'Université de Wisconsin Center-Fond du Lac, l'Eastern States Rock Art Research Association, l'Université de Minnesota, la Minnesota Historical Society, et la Mid-West Rock Art Association.

Deux journées d'excursions sont prévues avant le congrès, les 22 et 23 mai, ainsi qu'après le congrès, les 30 et 31 mail. Les frais concernant les excursions d'après congrès sont compris dans le prix d'inscription (ou nécessiteront seulement un prix nominal). Des chambres en dortoir seront disponibles au Ripon College. Un forfait chambre/repas a été fixé au tarif de $35 (US) par jour. Des tickets permettant n'importe quelle combination de repas (doner uniquement; déjeuner et petit déjeuner, etc.) pourront itre achetés par ceux qui logent bors du campus. Une liste de 25 motels dans le voisinage immédiat est disponible — des tarifs spéciaux pour le congrès sont en cours de négociation. Il y a approximativement 100 chambres de motel disponibles Ripon, et le college peut loger 1000 personnes. Un motel entier (32 chambres), l'on peut aisément se rendre pied, sera reéervé. Les distances des autres logements varient de 3 - 27 km du siège du congrés, et comprennent toute une gamme de prix.

Les services aériens les plus pratiques sont ceux qui vont de Chicago, Milwaukee et Minneapolis à Appleton, Wisconsin. Le Ripon College fournira un service de navettes entre Appleton et Ripon (45 minutes) pour les jours d'arrivées et de départs maximais. Chicago se trouve 296 km de Ripon, et Milwaukee, 128 km. Les connections de surface se font par autoroute, saul sur une distance de 26 km.

Le format du congrès suivra celui du congrès de Flagstaff en 1994. Il y aura plusieurs sessions simultanées le matin, et des Sessions Générales (symposia) l'après-midi. Il y aura des conférences publiques le soir. L'inscription aura lieu le dimanche 23 mai, entre 17 et 21 h; et le lundi 24, entre 7.30 et 8.45, à la Rotonde de l'Harwood Memorial Union. Les retardataires pourront s'inscrire pendant toute la semaine. Des panneaux de renseignements (approx. 75 × 75 cm), pour les organisations participantes, seront dressés dans l'aire d'inscription. On pourra y expliquer l'histoire, la nature et les buts de son organisation, ainsi que les adresses, les frais d'adhésion et la politique de publication.

Nous espérons que certaines des sessions seront dirigées en espagnol (avec des traductions en anglais, ainsi que des traductions d'anglais en espagnol). Afin de faciliter les communications, une initiative va itre prise en ce qui concerne les présentations de diapositives. Les intervenants seront invités préparer des légendes traduites pour leurs diapos, afin de permettre une double présentation. Un écran aura l'image, l'autre sa légende (en anglais pour une présentation en espangnol, et vice versa). Ceci réduira considérablement les temps d'intervention liés aux problèmes de double traduction. Les organisateurs espèrent que ces dispositions établiront un précédent réussi pour les congrès futurs, et qu'un nombre important d'intervenants hispaniques

profiteront de ce nouveau service.

Invitation

Toutes les organisations et tousles individus qui s'intéressent l'art rupestre sont invités proposer des sessions, spécialisées ou generales. Ces propositions devront arriver avant le let août 1998. Veuillez noter cette dae limite. Les propositions ne doivent pas dépasser 300 mots, et devraient inclure une liste de participants éventuels. Il n'est pas encore nécessaire de confirmer les noms des intervenants. Les résultats de la révision des propositions seront présentés dès que possible. Les candidats choisis seront dès lots responsables du recrutement formel des intervenants et de l'organisation complète de leur sumposium ou session.

Saul avis contraire et ultérieur, pendant cette phase d'organisation, les interventions seront strictement limitées 20 minutes (questions comprises). Une intervention formelle plus 1ongue (en utilisant le 'Style Guide' *d'American Antiquity*) peut itre soumise pour la publication de actes du congrès. Les intervenants sont priés d'avoir des premiers jets (dactylogrphiés) disponsibles au moment de leurs présentations. Il faudra indiquer ses besoins en traduction, équipement audio-visuel, etc, lors de la proposition e présentation.

Nous sommes en train de projeter la publication des actes. Les directeurs des sessions seront responsables de la rédaction initiale, et la compilation finale sera entreprise par l'ARARA, en collaboration avec l'IFRAO et la Mid-America Geographic Foundation.

Nous encourageons les organisations fournir des affiches bien réalisees et solides pour permettre une exposition en galerie. Un grand espace bien illuminé leur sera réservé. Le sujet de ces affiches concernera l'art rupestre, ou des thèmes aborigènes pertinents. Les groupes qui ne peuvent pas assister au congrès pourront néanmoins constituer une exposition d'affiches. D'autres détails seront fournis en 1998.

Si vous avez des questions, veuillez les transmettre:

Dr. Jack Steinbring, Department of Anthropology, Ripon College, 300 Seward Street, Ripon, WI 54971, U.S.A.
Fax: 920-748-7243
Phone: 920-745-2937
E-mail: *Steinbringj@mac.ripon.edu*

LLAMADO PARA UNA SESIÓN DE PROPUESTAS
El Congreso Internacional del Arte Rupestre 1999

General

El Congreso Internacional del Arte Rupestre de 1999 se llevará a cabo en el campus de Ripon College, Ripon, Wisconsin, E.U., de 23 a 31 de Mayo. El Congreso está auspiciado por el International Federation of Rock Art Organizations. El anfitrión nacional es el American Rock Art Research Association y el anfitrión local/regional es el Mid-America Geographic Foundation. Otros organizaciones participarán incluyendo la University of Wisconsin-Oshkosh, el University Centry-Fond du Lac, el Eastern States Rock Art Research Association, el University of Minnesota, el Minnesota Historical Society y el Mid-West Rock Art Association.

Habrá dos diás anteriores al congreso (22 y 23 de Mayo) y dos días postariores al congreso (30 y 31 de Mayo) con excursiones al campo. El costo de estas excursiones está includuído en la registración o podrán pagar un pequeño costo extra. El Ripon College dispondrá de dormitorios para acomadar a los participantes. El precio de la habitación y las comidas ha sido fijado en $35. Los boletos para qualquiera de las comidas (cena, almuerzo y desayuno) podrán ser comprados par aquellos que están afuera del campus. Una lista de 25 hoteles cerca de la zona del congreso está disponible. Los precios de la conferencia están siendo negociados. Hay aproximadamente 100 habitaciones de hoteles (moteles) disponibles en Ripon y la universidad puede acomodar 1000 personas. Un motel completo de 32 unidades a una distancia fácil de caminar será reservado. La distancia a los otros moteles oscila entre 2 milas a 17 milas. Estos tienen diferentes precios.

Las conecciones aéreas de Chicago, Milwaukee y Minneapolis a Appleton, Wisconsin son las más convenientes. Ripon College proveerá un servidio para recojer y llevar desde y hasta Appleton a los pasajeros (a 45 minutos de distancia). Chicago está a 185 milas desde Ripon, Milwaukee está a 80 milas. Las conecciones por tierra son atravez de las carreteras.

El congreso se regira por el congreso de Flagstaff de 1994. Habrá varias sesiones en las mañanas y unas sesiones generales por las tardes. Habrá unas presentaciones publicas en la noche. La registración será el domingo 23 de Mayo desde las 5 a la 9 de la noche y el lunes 24 de Mayo desde 7:30 a la 8:45. La registración se llevará a cabo en la Rotunda de Harwood Memorial Union. Los que llegan tarde pueden registrarse durante la semana. Pizarras de aproximedemente 75 × 75 cm para la organización de participantes seran instaladas en la zona de registración. Esta puede incluir la historia naturaleza y las metas de su organización, el costo de engreso y sus reglas.

Se Harán los efuerzos necesarios para conducir algunas de sesiones en español con traducciones del inglés al español. Para facilitar la communicación se usarán una presentación con dos projectores de transparencias. Una pantalla mostrará la imagenos y la otra traducira dol inglés al español. Esto reducira signficentemente el problema de tiempo en la traducción de los papeles. Las organizadores esperan que estos arreglos formen parte de un exitoso precedente para futuros congresos, y que estos arreglos formen parte de un exitoso precedente para futuros congresos, y que un numéro significante de contribuyentes de Hispanos aprovechen éste servicio.

Invitaciones a las sesiones

Todas las organizaciones y los individuos interesados en arte rupestre están invitaados a hacer propuestas para las sesiones especialos o generales. Esas propuestas serán recibidas hasta el 1 de agosto, 1998.

Las propuestas se limitarán a 300 palabras con una lista de posibles participantes. Los participantes no necesitan estar confirmados. Los resultados de las propuestas estarán disponibles tan pronto como sea posible. Las candidatos exitossos deben ser responsables por el formal reclutamiento de los participantes y la organización completa de su sesión. Al menos que haya otra especificación on la face planeada los participantes estarán limitados a 20 minutos de charla incluyendo tiempo de preguntas. Si el papel es más larga que la presentación pueden someterlo por medio de una publicación. Se les pedirá a los participantes que tengan un borrador disponible. En el momento de la presentación deberán solicitar la traducción, los equipos audiovisuales u alguna otra necesidad que tongan. El planeamiento para el procedemiento de la publicación está en camino.

Las personas acargo de sesion seran responsables por la edicion initial y la recomilacion final sera hecha por el American Rock Art Research Association en colaboracion con el International Federation of Rock Art Organizations y la Mid-American Geographic Foundation.Las organizaciones serán alentadas a proveer el buen montaje para la exhibición en la

galeria. Los espacios estarán bien iluminados. Se espera que el centro de interés de los carteles sea arte rupestre o temas referidos a los aborigines. Los grupos que no participan del congreso serán bienvenidos para exhibir sus carteles. Futuros detailles serán provistos en 1998.

Su usted tiene preguntas a cerca del congreso puede dirigirse a:

Dr. Jack Steinbring, Department of Anthropology, Ripon College, Ripon, Wisconsin, E.U. 54971
e-mail: *steinbringj@mac.ripon.edu*
FAX: 920-748-7243
Telefono: 920-745-2937
RAR 15-453

Call for papers

1999 International Rock Art Congress at Ripon College to be held at Ripon College, Ripon, Wisconsin, USA - May 23-31, 1999

ROCK ART EDUCATION

Session chaired by Matthias Strecker (SIARB, La Paz/Bolivia), Dario Seglie (CeSMAP, Pinerolo/Italy) and Ellen Martin (ARARA, Tempe/U.S.A.)

Education of the public on rock art is 'preventive conservation', it may prevent vandalism and other destructive actions at sites. Furthermore, it should be seen as one of the principal objects of the researcher to communicate the results of investigations in such a form that the general public benefits from this experience and accepts rock art as an important part of the cultural heritage.

Rock art education plays a prominent role in activities of rock art associations world-wide, and has been treated in sessions held at the international congresses at Pinerolo/Italy (1995), Swakopmund/Namibia (1996) and Cochabamba/Bolivia (1997). ARARA is one of the pioneers in this field through its Education Committee, but unfortunately no North American representative participated in the last (1997) education symposium. The new session, held at the 1999 IRAC at Ripon, will be the opportunity to present the considerable experience acquired in North America in a forum which also encompasses ideas from other parts of the world providing guidelines for efficient educational work on rock art in the 21st century.

Papers presented in this symposium should:

- focus on long-term work instead of isolated activities, taking into account publications for the general public, permanent exhibitions, lectures, hands-on activities with children etc.;
- detail collaboration with teachers' training centres, with museums, and with administrators of rock art sites which are open for visits by the public;
- consider group-specific approaches to rock art, such as different educational programs for specific age-groups;
- if possible, exemplify work with indigenous groups making them conscious of rock art as their cultural heritage;
- evaluate the results of educational programs by providing some parameters such as: comparison with areas where no rock art education has taken place, investigation of visitor behaviour at sites before and after educational programs were initiated, etc.

Possible contributors: ARARA members active in the Education Committee, investigators who have undertaken educational projects on rock art in other parts of the world: South America, Europe, Africa, Asia and Australia.

Please send the title and brief summary of your proposed paper to:

Matthias Strecker, SIARB Secretary, Casilla 3091, La Paz, Bolivia (Fax: 591-2-711809)
Dario Seglie, CeSMAP, Viale Giolitti, 1, 10064 Pinerolo, TO, Italy (Fax: 121-75547)
Ellen Martin, ARARA Education Chair, P.O. Box 27622, Tempe, AZ 85285-7622, U.S.A. (Fax: 602-820-1474)

AURA 2000

The Third AURA Congress

The Third AURA Congress will be held in the very heart of Australia, close to the 'Centre of the World', Uluru. The academic symposia are to be held in Alice Springs from Monday, 10 July to Friday, 14 July 2000, at the Rydges Plaza and Aruluen Centre, a perfect setting for a memorable scientific and academic event. They will be preceded and followed by about one month of field trips covering the continent of Australia. Proposals are now invited for about a dozen symposia.

CALL FOR SYMPOSIUM PROPOSALS

Rock art researchers and scholars from related disciplines are invited to propose symposium topics. The Third AURA Congress will be a large event celebrating the end of a century, indeed a millennium, and the start of a new, and will bear the sub-title 'Millennium: a fresh start'. Symposia should therefore focus on how rock art research has historically developed to this point in time, and on what the future may hold for it. Also, symposia should facilitate discussion, and symposium chairs will be expected to actively encourage constructive debate rather than bland paper presentation. Innovative symposium proposals are invited. Each academic symposium should have two or three co-chairpersons.

The AURA Congress has developed a reputation of providing the discipline with direction. Many practitioners believe that the First AURA Congress (Darwin 1988) marked the birth of this discipline, and that the Second AURA Congress (Cairns 1992) demonstrated the resolve of indigenous people to claim indigenous cultural heritage. Thus the AURA Congress has a reputation to live up to, and the 2000 Congress, in particular, is expected to be a watershed — a symbolic milestone in the development of this field of research. Symposium topics should contribute to making this a memorable and outstanding event. The event's setting, location and logistical plans all promise that the Congress will be an important occasion.

Please submit a symposium proposal or any other ideas you might have concerning this auspicious event to the *RAR* Editor, P.O. Box 216, Caulfield South, Vic. 3162, Australia.

Forthcoming events

Visiting the sacred sites. Cerveno, Italy, 22-25 July 1998. These rock art field trips to sites in the Italian and Swiss Alps are conducted by the Archaeological Co-operative Society 'The Footsteps of Man'. For details and costs, contact the Society, Piazzale Donatori di Sangue n. 1, 25040 Cerveno (BS), Italy, or e-mail: *rupestre@10.mb.com*

Sixth General Conference of the Pacific Arts Association. Port Moresby, Papua New Guinea, 17-21 August 1998. Theme: art, environment and gender. Contact Mark Busse, PNG National Museum, P.O. Box 5560, Boroko, NCD, Papua New Guinea.

Real Codex, Portugal; or e-mail: *msabreu@utad.pt*

Fourth Annual Meeting of the European Association of Archaeologists. Göteborg University, Sweden, 23-27 September 1998. One of its 19 sessions deals with rock art as social representation. For information and registration form, write to Meeting Secretariat of the EAA Annual Meeting 1998, Department of Archaeology, Göteborg University, S-412 98 Göteborg/Gothenburg, Sweden.

Prehistory and tribal art: shamanism and myth. Valcamonica, Italy, 24-29 September 1998. The Valcaomica Symposium 1998 will be held at the Centro Camuno di Studi Preistorici in Capo di Ponte, northern Italy. For information write to the Centro, 25044 Capo di Ponte (BS), Italy, or e-mail: *ccsp@globalnet.it*

Tracing the past. Rock art workshop in Valcamonica, Italy, 28 September to 3 October 1998. This workshop will be organised by the Archaeological Co-operative 'The Footsteps of Man'. For details contact Dr Angelo Fossati at the Society, Piazzale Donatori di Sangue n. 1, 25040 Cerveno (BS), Italy, or e-mail: *rupestre@10.mb.com*

Eighth International Conference on Hunting and Gathering Societies (CHAGS 8). Osaka, Japan, 26-30 October 1998. Contact CHAGS 8 Project Office, c/o Dr S. Koyama, 4th Research Dept., National Museum of Ethnology, 10-1 Senri Expo Park, Suita City, Osaka 565, Japan.

31st Annual Chacmool Conference. University of Calgary, Canada, 12-15 November 1998. The topic is 'On being first: cultural innovation and environmental consequences of first peoplings'. For information, contact Chacmool Conference Committee, Department of Archaeology, University of Calgary, Calgary AB, Canada T2N 1N4.

World Archaeology Congress 4. Cape Town, South Africa, 10-14 January 1999. Theme: 'Global archaeology at the turn of the Millennium'. Contact Carolyn Ackerman, WAC4 Congress Secretariat, P.O. Box 4455053, Claremont 7735, South Africa.

Ripon 1999 International Rock Art Congress. Ripon College, Wisconsin, 23-30 May 1999. For details, see announcements above, in this issue. This is the principal rock art event of 1999. For information and registration, please contact Dr Jack Steinbring, Department of Anthropology, Ripon College, P.O. Box 248, Ripon, WI 54971, U.S.A.; or e-mail: *steinbringj@mac.ripon.edu*

AURA 2000: the Third AURA Congress. Alice Springs, Australia, 10-14 July 2000. The concluding rock art event of the millennium.

*

Note: due to the large AURA Congress in 2000 there will be no Annual Meeting of AURA held in 1999.

Notices

Rock art vandalism conviction in the U.S.A.

Dr Graeme Ward has drawn our attention to the following report on the World Wide Web, which is reproduced as it appears there:

Two juvenile females were recently convicted in state court for damaging a rock art site in the park with graffiti written in charcoal last August 23rd. The rock art dates from 5000 to 7000 years ago; although the culture is not known, the technique is significant enough to warrant its own style name — Pecos rock art. Part of the site was also in Seminole Canyon State Park. The estimated cost for repair of the damage was placed at $3000. Under a new Texas law, graffiti that causes damage in excess of $1500 is a felony. The mother of the juveniles was ordered to pay $2400 in restitution to cover the actual cost of professional mitigation of the damage. The girls were also ordered to perform 240 hours of community service, placed on eight-months' probation, and barred from the park during the period of their probation. This is the first local case in which vandalism was prosecuted as a felony under the new law. [Rod Danner, CR, AMIS, 2/18 and 2/23]

Archaeology, Anthropology and History of the American Southwest, Southwestern Archaeology (SWA) — http://www.swanet.org/telnet://aztec2.asu.edu
Brian W. Kenny; P.O. Box 61203 Phoenix AZ 85082-1203; *kenny@getnet.com*

Rock art dictionary

Our recent call for help in compiling a dictionary for rock art research has resulted in several most enthusiastic responses. The greatest efforts were those by Dr Charles Warner, who supplied a list of well over two hundred useful terms, selected from work by J. Flood, G. Walsh, R. Layton, P. G. Bahn and J. Vertut, P. J. Ucko, G. Chaloupka, *RAR* and the *Occasional AURA Publications*. R. G. Kimber prepared another long list of terms he would like to have included, and Jane Kolber presented a 12-page 'Guide to rock art terminology' by Virginia Upton, which she uses at the Cochise College. The editor thanks these and all other contributors, whose collaboration will be acknowledged in due course.

Rock Art Books

Monograph series of OCCASIONAL AURA PUBLICATIONS

Number 4, 1991: ***Rock art and posterity: conserving, managing and recording rock art***, edited by Colin Pearson and B. K. Swartz, Jr. Proceedings of Symposia M ('Conservation and site management') and E ('Recording and standardisation in rock art studies') of the First AURA Congress, with contributions by 31 authors. 160 pages, 40 plates, 22 line drawings, 21 maps, 19 tables, paperback, RRP $A26.00. ISBN 0 646 03751 X.
Special offer to members, 50% discount: including postage and packing **$A20.70** in Australia, **US$22.30** elsewhere.

Number 5, 1992: ***Rock art and ethnography***, edited by M. J. Morwood and D. R. Hobbs; proceedings of Symposium H ('Rock art and ethnography'). Bound with ***Retouch: maintenance and conservation of Aboriginal rock imagery***, edited by Graeme K. Ward; proceedings of Symposium O ('Retouch: an option to conservation?') of the First AURA Congress. With contributions by 21 authors. 140 pages, 60 plates, 23 line drawings, 2 maps, 2 tables, paperback, RRP $A34.00. ISBN 0 646 04920 8.
Special offer to members, 50% discount: including postage and packing **$A25.00** in Australia, **US$25.30** elsewhere.

Number 6, 1992: ***State of the art: regional rock art studies in Australia and Melanesia***, edited by Jo McDonald and Ivan P. Haskovec. Proceedings of Symposia C ('Rock art studies in Australia and Oceania') and D ('The rock art of northern Australia') of the First AURA Congress, with contributions by 23 authors. 240 pages, 33 plates, 147 line drawings, 51 maps, 36 tables, paperback, RRP $A48.00. ISBN 0 646 09083 6.
Special offer to members, 50% discount: including postage and packing **$A32.00** in Australia, **US$30.60** elsewhere.

Number 8, 1993: ***Time and space. Dating and spatial considerations in rock art research***, edited by Jack Steinbring, Alan Watchman, Paul Faulstich and Paul Taçon. Proceedings of Symposia F ('The dating of rock art') and E ('Spatial considerations in rock art'), Second AURA Congress, Cairns 1992. 134 pp., RRP $A28.00. ISBN 0 646 15617 9.
Special offer to members, 50% discount: including postage and packing **$A22.00** in Australia, **US$22.00** elsewhere.

Number 9, 1996: ***Management of rock imagery***, edited by G. K. Ward and L. A. Ward, bound with ***Preservation of rock art***, edited by A. Thorn and J. Brunet. Proceedings of Symposia G and H of the Second AURA Congress, with contributions by 56 authors. 240 pages, 110 plates, 47 line drawings, 16 maps, 20 tables, extensive bibliographies, paperback, RRP $A48.00. ISBN 0 9586802 0 5.
Special offer to members, 50% discount: including postage and packing **$A32.00** in Australia, **US$30.60** elsewhere.

Orders and correspondence to:
The Editor, AURA, P.O. Box 216, Caulfield South, Vic. 3162, Australia

IFRAO Report No. 20

CROSSING FRONTIERS

International Rock Art Congress 1998 and '98 IFRAO Meeting
6-12 September 1998, Vila Real, Portugal

This congress will be held at the University of Trás-os-Montes and Alto Douro in Vila Real, north-western Portugal. Rock art researchers from all continents are encouraged to attend, and to break through boundaries to explore new ground in rock art research.

The event will involve five days of academic paper presentations, round table discussions, workshops, poster presentations, video and slide sessions, a computer science centre, a book fair, exhibitions, artists' gallery, and various excursions and field trips. The 1998 IFRAO Meeting will be held during the Congress.

ACADEMIC PROGRAM

List of symposia and co-ordinators (in alphabetical order):

Aesthetics and rock art
Co-ordinator: Thomas Heyd, Department of Philosophy, University of Victoria, Victoria B.C. V8W 3P4, Canada. Tel. +1 (250) 381 2239, Fax: + (250) 721 7511. E-mail: *theyd@uvvm.uvic.ca*

Animals in rock art - biotic representations
Co-ordinator: Thomas Wyrwoll, Albert-Schweitzer-Strasse 52, D-60437 Frankfurt am Main, Germany. Fax: +49 69 95000210.
E-mail: *wyrwoll@stud.uni-frankfurt.de*

Astral figures in rock art
Co-ordinators: Léo Dubal, Laboratory for Archeometry, P.O Box 5914. CH - 3001 Berne, Switzerland. Fax: + 41313811334. E-mail: *rchleo@bluewin.ch*
Donald L. Cyr, Stonehenge Viewpoint. 2261 Las Positas, Santa Barbara, CA 93105-4416, U.S.A.
E-mail: *Stonevue@aol.com*

Computers and rock art
Co-ordinator: Andrea Arcà, Società Cooperativa Archeologica "Le Orme dell'Uomo", Piazzale Donatori di Sangue, 1 - 25040 Cerveno (Brescia), Italy. Tel. +39 364 433983. Fax. +39 364 434351.
E-mail: *aarca@inrete.it*

Dating of rock art
Co-ordinators: Marian Hyman and Marvin Rowe, Department of Chemistry, A&M University, College Station, TX 77843-3355, U.S.A. Tel. +(409)8451929. Fax: +1(409) 8454719.
E-mail: *Rowe@chemvx.tamu.edu*

Geology and rock art
Co-ordinators: Carlos Coelho Pires and Artur Abreu Sá, Secção de Geologia, UTAD, Apartado 202 - 5001 Vila Real Codex, Portugal. Tel. +59 32020, Fax: +59 326146. E-mail: *asa@utad.pt*

Landscape and rock art
Co-ordinators: Sven Ouzman, Rock Art Department, National Museum, P.O. Box 266, Bloemfontein 9300, South Africa. E-mail: *rockart@nasmus.co.za*
George Nash, Department of Archaeology, University of Wales Lampeter, Bristol BS6 5NA, United Kingdom Tel. +44 (0)1222-383922.

Managing rock art
Co-ordinators: Bert d'Arragon, 'Il Poggio', Via del Poggio 5, 50018 San Vincenzo a Torri, Italy. Tel. +39 3473460064, Fax: +39 55769147.
John Clegg, Department of Anthropology A14, University of Sydney, N.W.S. 2006, Australia. Tel. 61-2-6923792, Fax: 61-2-8184528.
E-mail: *john.clegg@antiauity.usyd.edu.au*

Megalithic art
Co-ordinator: Vitor Oliveira Jorge, FLUP, Rua Anibal Cunha, 39 3º, sala 7. 4050 Porto, Portugal.
E-mail: *vojsoj@mail.telepac.pt*

Recording and preventive conservation
Co-ordinators: Ben Swartz, ACSPP, Department of Anthropology, Ball State University, Muncie, IN 47306, U.S.A. E-mail: *01bkswartz@bsuvc.bsu.edu*
Jane Kolber, ARARA, Box 1844, Bisbee, Arizona 85603, U.S.A. E-mail: *jkolber@theriver.com*

Rock art of Asia and Australia
Co-ordinators: Robert G. Bednarik, AURA, P.O. Box 216, Caulfield South, Vic. 3162, Australia. Tel./Fax: 61-3-95230549. E-mail: *aurawww@sli.unimelb.edu.au* or *robertbednarik@hotmail.com*; URL: *http://sunspot.sli.unimelb.edu.au/aura/Welcome.html*
Yashodhar Mathpal, Museum of Folk Culture, Geetadham - P.O. Box 14, Bhimtal Dish - Nainital (U.P.) 263136, India.

Rock art from Brazil
Co-ordinators: Pedro Ignázio Schimtz, Institito Anchietano de Pesquisa/Unisinos, C.P. 275, São Leopoldo, RS, Brazil. E-mail: *anchieta@@nelios.unisinos.teche.br*
Maria Gabriela Ávila, Universidade Federal de Pernambuco, Av. Boa Viagem, 5740, apt. 1602, Recife, Brazil. E-mail: *gamar@elogica.com.br*
Anne-Marie Pessis, Fundação Seridó, Av. Boa Viagem, Ana Nery, 816 Recife 51030-000, Brazil. E-mail: *serido@elogica.com.br*

Rock art of North America
Co-ordinator: Jack Steinbring, Mid-American Geographic Foundation, Dept. of Anthropology, Ripon College, P.O. Box 248, Ripon, Wisconsin 54971, U.S.A. E-mail: *SteinbrinaJ@mac.ripon.edu*; URL: *http://www.pclink.com/cbailey/IRAC99*

Rock art of the Sahara
Co-ordinator: Jean-Loïc Le Quellec, AARS, Brennessard, F-85540 St.-Benoist-sur-Mer, France. Fax: +33 2 51 974367. E-mail: *jlq@hol.fr*

Rock art of southern Africa
Co-ordinator: Manuel Gutierrez, Laboratoire de Recherches sur L'Afrique Orientale, 1, Place Aristide Briand - 92195 Meudon Cedex, France. Tel. +01 45075267, Fax: +01 45075140. E-mail: *polet@cnrs-bellvue.fr*

Rock art in the world of the school
Co-ordinators: Dario Seglie, Centro Studi e Museo d'Arte Preistorica (CcSMAP), Museo Civico di Archeologia e Antropologia, Viale Giolitti, 1 - 10064 Pinerolo, Italy. Tel. +39 121 794382, Fax. +39 121 75547. E-mail: *CeSMAP@cesmap.it*; URL: *http://www.cesmap.it/index_e.html*
Mary Gorden, P.O. Box 44066, Lemoncove, CA 93244, U.S.A. E-mail: *magorden@msn.com*

Rupestrian archaeology
Co-ordinator: Angelo Fossati, Soc. Cooperativa Archeologica 'Le Orme dell'Uomo', Piazzale Donatori di Sangue, 1 - 25040 Cerveno (Brescia), Italy. Tel. +39 364 433983, Fax: +39 364 434351. E-mail: *rupestre@l0mb.com*
Rev. João Parente, Museu de Vila Real, Rua do Rossio, 58, 5000 Vila Real, Portugal. Tel. +351-59-325730/4.

Science and rock art
Co-ordinator: Robert G. Bednarik, AURA, P.O. Box 216, Caulfield South, Vic. 3162, Australia. Tel./Fax: 61-3-95230549. E-mail: *aurawww@sli.unimelb.edu.au* or *robertbednarik@hotmail.com*; URL: *http://sunspot.sli.unimelb.edu.au/aura/Welcome.html*

Symbolism, semiotics and cognitive theory
Co-ordinator: Majeed Khan, Assistant Deputy Ministry of Antiquities and Museums, P.O. Box 3734, Riyadh 11481, Saudi Arabia Kingdom. Tel. +96 61 4040860 / 4740149. Fax: +96 61 4041391.

OTHER EVENTS

Exhibitions:
Rock art in cartoons.
Rock art in stamps: philatelic exhibition co-ordinated by Artur Breu Sá.

Workshops:
Rock art and the Web - Andrea Arcà and José Bulas Cruz
Rock art preservation - Svein Indrelid
Rock art fund raising - William Vartorella
Photography and imaging techniques - Cliff Ogleby

Excursions:
There are four excursions, both before and after the Congress:
Trás-os-Montes grand tour
Alentejo grand tour
Douro valley tour
Arronches and Tagus tour

*

For general enquiries and registration forms, please contact:
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NOTES FOR CONTRIBUTORS

Manuscripts of major research papers should preferably be from 4000 to 8000 words. Longer articles will be considered on the basis of merit. Submissions should comprise the original together with two copies, typed in double-space, with a wide margin on one side of each page. Underline words to be italicised and identify each page by number and author's surname. The preferred method of submission is on an IBM compatible computer diskette, written either in MS Word or saved as an ASCII or RTF file, together with two hard copies. The content of the paper should be outlined by four to six keywords (e.g. 'Petroglyph - patination - ethnography - Pilbara') placed above the title. The manuscript must include an abstract of 50 to 100 words, summarising the article.

Spelling and punctuation in this journal follow the *Style manual for authors, editors and printers of Australian government publications* and the *Macquarie dictionary*; where the two disagree the former has precedence. Footnotes should not be used. The bibliography and references in the text should follow the IFRAO style as indicated in this issue.

If line drawings are included they must be larger than the intended published size (preferably by a factor of 1.5 to 2) and line thicknesses, stippling, lettering sizes etc. must be selected accordingly. Photographs should be black and white gloss prints of high contrast. Photographs of rock art that were obtained by physical enhancement or other interference will be categorically rejected, except for the purpose of critical discussion. In regions where traditional indigenous rock art custodians exist, their approval must be obtained before submission of any material relating to their culture, and where copyright applies the author must obtain the appropriate consent. Captions (on a separate sheet) are required for all illustrative material, together with an indication in the text as to where they, and any tables and schedules, are to be placed.

Announcements intended for a specific issue of this journal ought to be available at least two months before the month of intended publication. Text proofs are issued of all articles and must be returned promptly after correction by the author(s). Each author or group of authors receive thirty free copies of their article, additional reprints are available at cost.

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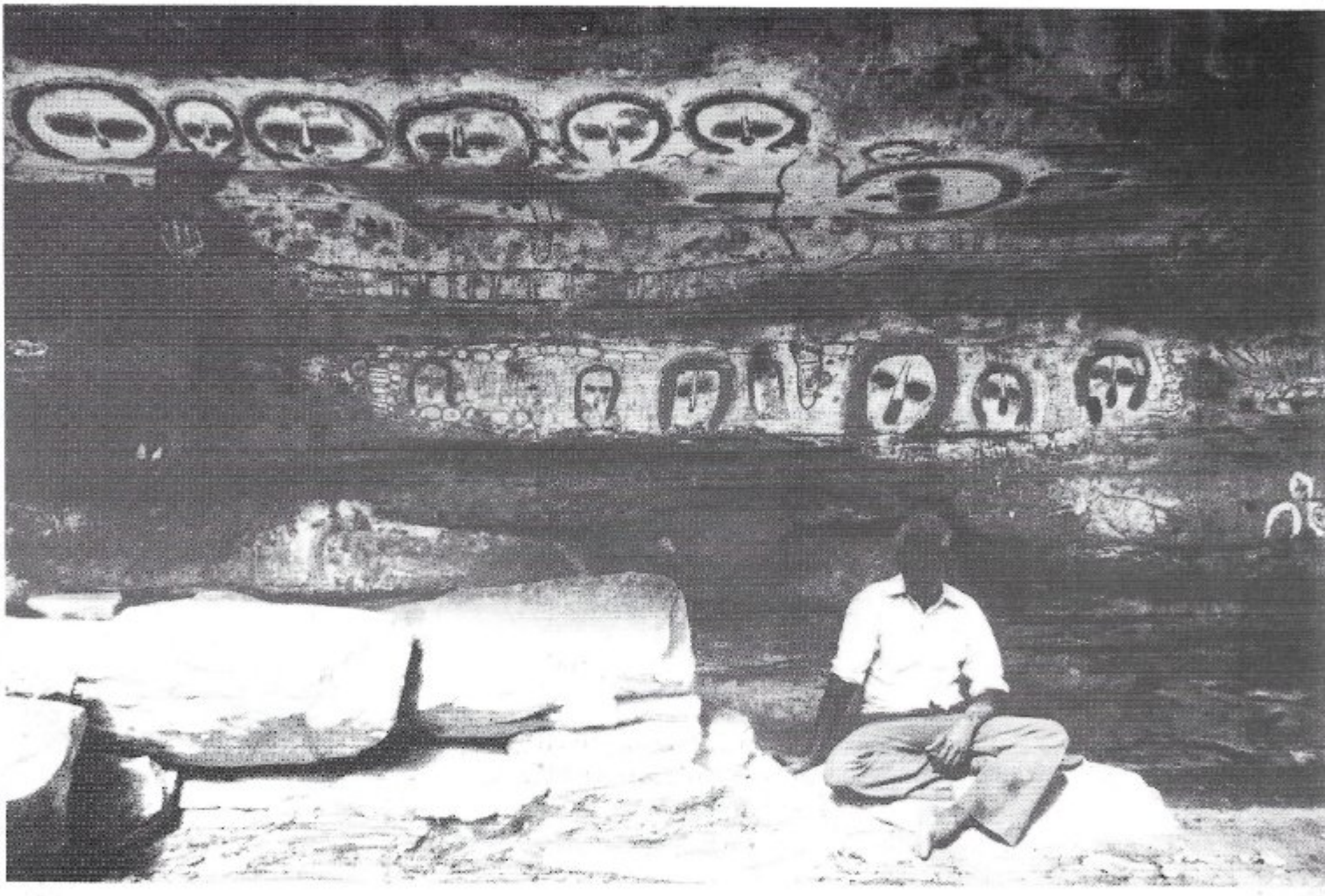
Third AURA Congress

10-14 July 2000, Alice Springs, Australia



Rowley Ginjannum, Custodian of Wannaliri. (Photograph by Howard P. McNickle.)