ANTHROPOLOGIE • LV/1–2 • pp. 101–117 • 2017

ROBERT G. BEDNARIK

PAREIDOLIA AND ROCK ART INTERPRETATION

ABSTRACT: Visual pareidolia occurs when meaningful patterns representing familiar objects are seen in what are in reality random or meaningless data. It is of significance to anthropology for two reasons: as a psychological phenomenon of the human visual system; and because of its important role in rock art interpretation. Once the brain has been conditioned to anticipate specific patterns, it tends to discover them with minimal stimulation, because most of the information processed by the human visual centre derives from within the brain. The creative pattern detection that constitutes rock art "interpretation" is effectively a projection of invented meaning onto mute marks on rock. The modern beholder's perception searches the motif for details resonating with his/her visual system, in the same way as pareidolia operates. It decides arbitrarily which aspects are naturalistic and which are not, and it adjudicates which of an image's aspects are diagnostic. Yet the brain of the modern beholder of rock art differs significantly from that of its creator, and the notion that rock art connoisseurs can somehow conjure up the emic meanings of rock art motifs from their own brains' past experiences is mistaken. This paper illustrates the involvement of pareidolia in rock art appreciation through a series of examples and attempts to explain these observations.

KEY WORDS: Pareidolia – Apophenia – Visual system – Picture rocks – Rock art – Petroglyph – Iconographic interpretation

INTRODUCTION

Pareidolia is a psychological phenomenon in which the human visual system perceives a figurative pattern where no image actually exists. The term is also applied to sounds, for instance when hidden messages are perceived in sound recordings (Vokey, Read 1985, Zusne, Jones 1989). The subject of pareidolic interpretation of rock art has been considered before (e.g. Bednarik 2013a) but, despite its great importance to the discipline of rock art science, has not been examined in any detail. A recent experience in Inner Mongolia has prompted this exploration of the issue.

Pareidolia is a form of apophenia (or patternicity; Shermer 2008), the human tendency to perceive meaningful patterns within random data (Brugger 2001). The "abnormal meaningfulness" defining apophenia is neurologically rooted in the ability of the brain to sift through the mass of sensory information received to detect significant signals, be they visual or

Received 18 January 2016; accepted 4 April 2016.

auditory. In the mental priming effect the brain and senses are prepared to interpret stimuli according to an expected model. This process, called "association learning", is fundamental to all animal behaviour, but in the case of the highly evolved human brain it "lacks an error-detection governor to modulate the pattern-recognition engine" (Shermer 2008). This has no negative effect on natural selection, because the cost of seeing a false pattern as real is significantly less than the cost of not detecting a real pattern; hence natural selection will favour patternicity. The deception of visual perception is "paradoxically an ambiguity of perception that would have had value during the Pleistocene" (Bednarik 1986, 202). It makes sense for natural selection to favour strategies that make incorrect causal associations in order to establish those that are essential for survival and reproduction. This is the basis of explaining apophenia and, more specifically, pareidolia: in the Pleistocene it made sense to switch to a flight response even when the perceived cave bear turned out to be just a rock shaped like a bear. Our visual system is very slow: no-one has ever seen the present, it takes hundreds of milliseconds to process its data in the brain, therefore time is of the essence and what the thalamus sends to the cortex is in effect a hastily drawn approximation. Veracity of the information was not necessarily of primary importance, just as the creation of human constructs of reality has little basis in truth:

> Provided that the internally consistent logical framework is not challenged by it, there is no reason to assume that an entirely false, cultural cosmology or epistemological model could not be formed and maintained indefinitely by an intelligent species ... evolutionary success is irrelevant to the objective merits or validity of such models (Bednarik 2011, 6–7).

Similarly, both apophenia and pareidolia have been advantageous in human evolution, despite being entirely erroneous beliefs, and have no doubt contributed to the formation of the false construct of reality we subscribe to today. Therefore they are not useful tools in rock art research, where the issue of veracity is of paramount importance and cause and effect reasoning needs to be applied instead of associative thinking. Their effects need to be examined closely and such a review may benefit from a systematic design. First, a number of examples need to be described and analysed, i.e. the elements or structure of the phenomenon need to be subjected to detailed examination. This will help in better appreciating the range of the effects of pareidolia, how they are manifested in practical experience in relation to palaeoart, and it will lead to the identification of the underlying factors. That process should then facilitate the formulation of a general synthesis of the impact of pareidolia on rock art recorders.

PICTURE ROCKS

As the editor of the journal *Rock Art Research* since its founding in 1984, we have received many dozens of submissions concerning rocks of iconic properties of one form or another, and witnessed numerous examples of fervent belief in pareidolic phenomena. Some of these experiences seemed quite bizarre. A woman reported that she found images within pebbles when she broke them apart, and she claimed that these pictures had been placed there deliberately by Aborigines. On another occasion we examined Cedar-by-the-Sea, a petroglyph site on Vancouver Island, on Canada's west coast (Hill, Hill 1974: 99). The owner tried very hard to convince us that in addition to the site's several excellent petroglyphs, there is also very intricate decoration on the intervening rock surface. We simply could not see what she meant and it took some time to realise that she perceived the general, sub-millimetre-scale weathering patterns on the rock pavement as having been created by humans. Explanation of the phenomenon as natural mineral accretions and their modifications was met with incredulity.

These are relatively unusual, rather extreme manifestations of pareidolic vision, in which no regard was given to logic or reason. By far the most common form concerns stones in whose morphology the subject perceives a likeness of an object. In the vast majority of cases the stones are said to resemble animals or faces. The stones may range from pebble sized to boulder sized; they may be from alluvial deposits and rounded or they may be fractured, in which case the fractures are perceived as anthropogenic and deliberate. Most if not all the claims in this category are that the objects date from Lower or Middle Palaeolithic periods (e.g. Matthes 1969, Benekendorff 2012). Several hundred people are engaged in collecting such stones, and some of them are connected to an international network. These aficionados are found particularly in northern France, Netherlands, England and northern Germany, often in regions where flint deposits are common. Flint has the

characteristic of being fractured easily by several natural processes, which often results in unusually shaped pieces that attract the attention of collectors. However, the phenomenon is not entirely limited to north-western Europe; it has also been noted in other parts of the world, such as the United States and Australia. We have met several of these gatherers of stones, and been in contact with many others who have sought to secure our support for their views. Many of them possess quite good archaeological knowledge; the majority are accessible to rational argument, but all insist that early hominins were capable of detecting iconic properties in stones and that what they are finding merely meets that expectation.

The issue is complicated by the fact that at least some Lower Palaeolithic hominins did indeed possess the ability of seeing the resemblance between a natural object and one it happens to resemble. Two naturally shaped stones have been modified to emphasise their figurative properties by people of the Acheulian. The Tan-Tan proto-figurine from Morocco is from an occupation deposit thought to be in the order of 400 ka (400,000 years) old (Bednarik 2003). It is a quartzite piece that was shaped by natural processes, but because it resembles a human body, that likeness was accentuated by adding several grooves, and then the object was coated in haematite. Another proto-figurine, from Israel, is a tuff and scoria pebble with the natural shape of a female head, neck, torso and arms, excavated from an occupation deposit that is older than 230 ka (Goren-Inbar 1986). It was found to have been superficially modified by adding grooves and abrading certain aspects, also highlighting the resemblance to a female figure (Marshack 1996, 1997). A third example is a fossil cuttlefish cast found in a dwelling site of the Late Acheulian at Erfoud Site A-84-2, Morocco (Bednarik 2002). Such fossils do not occur naturally in that region, and as a manuport this fragment has such a strong resemblance to a human penis that this was presumably also noticed by the hominin who deposited it in the shelter structure. Other relevant finds are fossil casts collected by Lower and Middle Palaeolithic hominins, which suggests that the resemblance between them and their living referents was recognised. The earliest specimen suggesting such recognition, however, is significantly older. The Makapansgat cobble was carried over a great distance and deposited in a South African dolomite cave 2.5 to 3 million years ago. It is completely unmodified, but it consists of an unusual and very hard red stone, jaspilite, and its resemblance of a head is so striking it is thought to have been appreciated by a hominin at the time of the very dawn of the human line (Bednarik 1998) (*Figure 1*).

Therefore the belief of [illegible] collectors of thousands upon thousands of "stone figurines", that such recognition of iconic properties in natural products was possible for people of the Lower Palaeolithic, is perfectly justified. However, the great majority of their collected stones were not found in demonstrated occupation sites; they are random finds, mostly from gravel beds containing no stone tools. Without an archaeological context there is no reason to attribute them to hominins, because the fact that they may faintly resemble biomorphs is simply attributable to chance: a certain percentage of all river cobbles could be construed as doing so, by people who have high susceptibility to pareidolia. The same would apply to naturally broken pieces of flint. This still does not mean that such an object from a genuine archaeological

FIGURE 1. The Makapansgat jaspilite cobble, a manuport from South Africa; scale in cm.

deposit, containing Palaeolithic stone tools and other evidence, must necessarily be a palaeoart object. It may be so, but the point needs to be demonstrated, and the two factors of significance are the forensic presence of work traces and the property of being of a material that cannot occur at the site by purely natural transport. None of the numerous items of this kind we have examined seems to meet these requirements.

OF EXTINCT ANIMALS

These examples of pareidolia have merely been presented to illustrate some pertinent effects of the phenomenon, but the purpose of this paper is to examine the effects of pareidolia in the interpretation of rock art. One of the most consequential such effects is when the age of rock art motifs is deduced from the purported depiction of extinct animals. Some recent and representative examples of this are listed here, but many others could be given.

The Upper Sand Island rock art site near Bluff, southern Utah, is a vertical sandstone cliff of several hundred metres length, featuring thousands of petroglyphs (Malotki, Wallace 2011). Among them are zoomorphs, anthropomorphs and various repeated symbols, such as double arcs and fully pounded circle segments. Because of the density of the rock art, which extends several metres above present human reach, superimpositions are common among motifs. In a location in the central part of the 20-m cliff, at a height of about 5 m above the berm at its foot, occurs a combination of several rock markings. The oldest is a vertical fissure, one of many on the same panel that has been subjected to accelerated granular erosion attributable to emerging interstitial moisture. Near its top is a petroglyph of an elongate outline with vertical barring. This is a motif type well-known from the Glen Canyon style of the general region (Turner 1963, 1971), and it is one of about five such faintly zoomorphic outlines arranged in a horizontal band. Superimposed over this is a densely pounded circle segment of the type occurring several times within a few metres of the location. Finally, near the natural groove is one of the several pairs of arcs found on this wall, but unconnected to the solution groove.

If this group of rock markings, three of them artificial and one natural, are seen as a deliberate composition, they appear to form the outline of a mammoth. However, they are of distinctly separate antiquities, which render it unlikely that they constitute a single arrangement. While it is theoretically possible that the original Glen Canyon zoomorph was modified deliberately by later adding the "topknot" and the "tusks", this is unlikely because both features occur elsewhere on the wall, without being connected to any other petroglyph. Nor are the "tusks" connected to the "trunkline", which is itself not an artefact. Moreover, there is another impediment to the pareidolic mammoth interpretation: the Glen Canyon style features are about four times the age of a nearby anthropomorph that is safely attributable to the Puebloan period, and thought to be around 800 years old (Bostwick 2001: 428, Malotki, Weaver 2002: Fig. 3). On that basis, an age of any of the 'mammoth' components, except the 'trunkline', of more than 4000 years BP can be safely excluded from consideration (Bednarik 2013b, 2015). This is confirmed by the estimate of the probable age of the Glen Canyon style, of being somewhere between 2400 and 5000 BP (Cole 2009: 45). Moreover, the Columbian mammoth (*Mammuthus columbi*) is thought to have become extinct by 12,500 years BP, and any dates younger than 11,000 are not viewed as credible (Meltzer, Mead 1983, Haynes 1987, 1991, Fisher 1996, Fiedel 1999, 2009, Barnosky *et al*. 2004, Martin 2005, Waters, Stafford 2007, Haynes 2008, Faith, Surovell 2009, Surovell, Grund 2012, Louguet-Lefebvre 2013). Not only is it geologically impossible for the surface of the friable and rather porous Navajo sandstone of the site to have survived from Pleistocene times; the geological setting of the site renders such great age of the rock panel highly unlikely (Gillam, Wakeley 2013). The valley of the San Juan River features a complex succession of river terraces related to previous river levels, some of which are preliminarily dated, rendering it impossible for the petroglyph site to be reached at certain times.

The determination of the meaning of this arrangement of rock markings rests on fortuitous positions of randomly arranged markings in close proximity, on a rock panel densely covered with both petroglyphs and natural markings. Until they were closely examined in May 2014, when Ekkehart Malotki managed to have a scaffold erected on the remote site, they were only seen from ladders and on photographs taken with pole-mounted cameras. This inadequate access (Malotki, Wallace 2011: Fig. 8) led to the view that the unrelated markings formed a single figure (*Figure 2*). Subsequently, during the examination of photographs, a second "mammoth" figure was discovered a few metres to the left of the first; and since then enthusiasts have found more potential mammoth

images on the cliff. This is of interest because it shows how, once the visual system of the searchers is conditioned to find mammoths, it is much more likely to succeed than without such prompting. It is also relevant to note that Malotki and Wallace were well aware of the danger of pareidolia, because they attribute several previous mammoth reports in the rock art of other parts of the United States quite correctly to pareidolia.

In an effort to better understand that phenomenon, another example will be examined, this time from Australia. Gunn *et al.* (2011) reported two aviform rock paintings from the side of a huge block of sandstone at the headwaters of the Katherine River, western Arnhem Land. One of them they thought depicts a magpie goose, a very common species in the region. The second, larger but in many ways similar image they suggested represents *Genyornis newtoni*, a large flightless bird that became extinct about 50 ka ago. In this they were guided by a number of features pareidolia suggested to be diagnostic of the ancient species, although there was no supporting evidence and such attribution would establish several world records. It would make the image not only the earliest known in Australia, but indeed the oldest known graphic depiction of an object in the world (except, perhaps, a possible stickman on a bone fragment from the German Eastern Micoquian; see Bednarik 2006); indeed, it would be the oldest known painting. In contrast to the presumed extinction dates of other Pleistocene species, that of *Genyornis* is particularly well established, because it derives not from a few chronologically scattered fossil remains of the creature in question, but it has been secured from a series of 505 eggshell fragments of this species, distributed in time. They coincide in their distribution with those of the extant species *Dromaius* (the emu), from 130 ka onwards and are still common between 60 ka and 50 ka ago, but those of *Genyornis* then stop occurring rather abruptly (Miller *et al.* 1999; cf. Gillespie 2004). Eggshells of the emu continue right through the last 50 ka. Bearing further in mind that there is no evidence that *Genyornis* ever occupied northern regions such as Arnhem Land, being a native only of southwestern Australia, the interpretation lacked a credible base. Moreover, the painting is poorly protected from precipitation and shows extensive rain damage as well as weathering by water seeping from the sandstone's bedding planes. Such exposed rock paintings are unknown to have survived from the Pleistocene or even from the early Holocene, anywhere in the world. The panel on which the bird-like motif occurs was formed when part of the block fractured and fell to the ground, and in fact the producer of the painting stood on this large rock fragment as he or she executed the pictogram. We suggested to Gunn that the painting would be only one or two thousand years old, and that a relatively easy way to determine its possible *terminus*

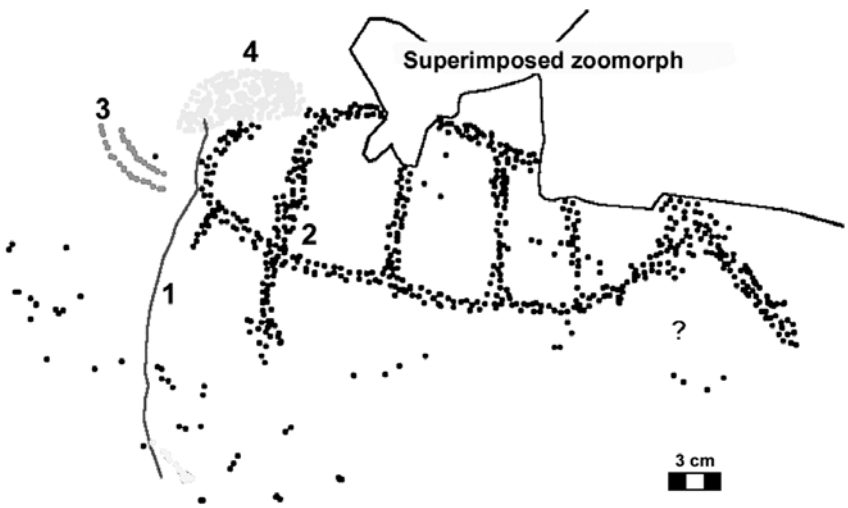

FIGURE 2. One natural groove (1) and unrelated petroglyphs (2, 3 and 4, in that sequence) forming a fortuitous arrangement giving the pareidolic impression of a mammoth image, Upper Sand Island, Utah. The individual peck marks are shown.

post quem date would be to establish when the fragment fell from the block, by excavating the sediment beneath it.

Gunn and colleagues, however, decided to proceed with their sensational publication. Other archaeologists then sought to clarify the matter by excavating under the detached rock fragment and determined that the collapse occurred only 13 ka ago, so the purported *Genyornis* image had to be more recent than that (Barker et al. in press). In addition, there is what appears to be a barbed spear with the bird painting, and Gunn *et al.* had assumed that it was added later, and that an anthropomorph was also superimposed. Detailed analysis showed that the anthropomorph precedes the aviform zoomorph, and the "barbed spear" is of the same age and pigment as the bird (Chalmin *et al*. in press). The significance of this finding is that if the object does depict such a weapon, it demands a very recent antiquity for the purported *Genyornis*.

The remaining question is, why would experienced archaeologists attribute a relatively recent, rapidly fading rock painting to a species that has been extinct for 50 ka? Their visual perception of the paint traces was apparently strong enough to abandon caution and to propose an explanation that was extraordinary and challenging (*Figure 3*). There are many such claims by rock art interpreters, including a good number – mostly from the USA – of dinosaur and pterosaur depictions in rock art (Bednarik 2015). There is such a claim from China of the depiction of giraffes, which became extinct there in the Tertiary period. In such cases the rock art would predate the human species.

Of particular relevance is the proposal of a young Chinese archaeologist that an exfoliating patch of red paint residues on rock depicts a very large bird "biting" a deer. Its importance is that he explained in some detail his pareidolic and derivative reasoning (Qiao H. 2014). He presented pigment patches that in reality offer no prospects of identifying individual images. As he saw in this arrangement a bird pecking a cervid, he deduced that the bird must be very large, carnivorous and aggressive. He then considered three potential candidates of flightless birds, from Tertiary to Pleistocene times (*Phorusrhacos*, *Gastorni*, *Titanis*), but discounted them for various reasons and turned his attention to another, the cassowary (*Casuarius* sp.). The fact that this large bird of Australia and New Guinea is part of the Sahulian fauna and cannot have lived in China did not deter him; nor did another detail, namely that the cassowary is a strict vegetarian. Instead of bothering with such minor objections he proceeded

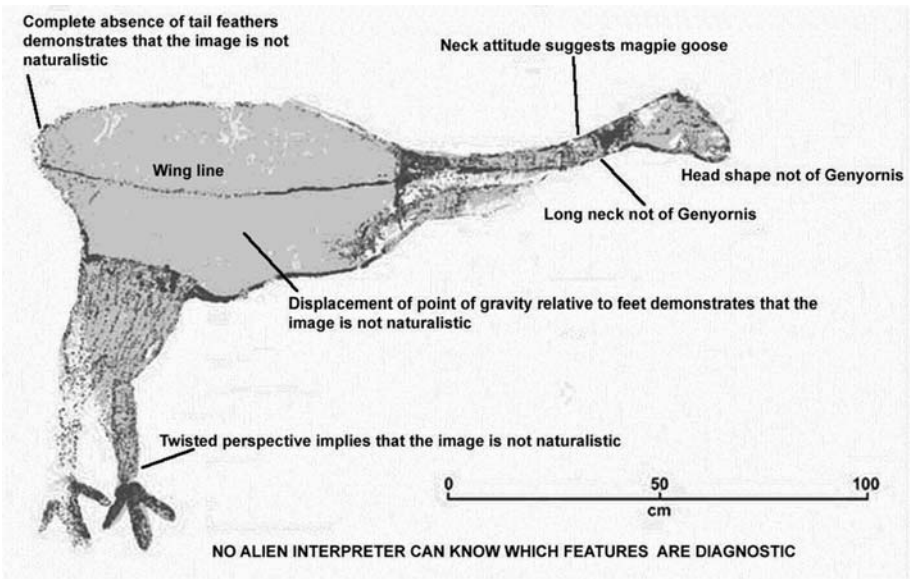

FIGURE 3. Aviform pictogram in western Arnhem Land, Australia. Several aspects imply that it is not a naturalistic rendering, and the iconographically diagnostic aspects cannot be known.

to explore how the Australian bird could have reached China. He reasoned that it might have crossed the sea during the Pleistocene by travelling over glaciers then covering the ocean, and he went as far as proposing that the bird's remains were still to be found in China. The last proposal is of course valid, because one day even the remains of a unicorn may turn up in China. However, Pleistocene glaciers did not exist in the tropics, any more than the land-bridges imagined by Australian archaeologists between the islands of Nusa Tenggara, bridging Wallace's line.

THE FACES OF XIAOJINGGOU

Honder College of the Inner Mongolian Normal University in Hohhot was founded in 2004 by its President, Professor Zhou Yushu. It hosts the North China Rock Art Research Institute (NCRARI). The college's President is a keen rock art researcher himself, and, having discovered a major rock art region near his summerhouse at Xiaojinggou, in the Daqing mountains north of Hohhot, has taken extraordinary steps to preserve this rock art. He found much of it among the rubble of road construction activity, or under threat in some other way, so he decided to collect all petroglyph blocks and deposit them in a large yard at his summerhouse. These blocks were up to 20 tonnes in weight, and he spent literally hundreds of thousands of dollars of his own funds to secure the preservation of the rock art. He can thus be defined as the most dedicated rock art protector in the world.

At present, there are approximately 350 large blocks of rock, almost entirely of granite, located in his protected salvage yard (*Figure 4*). Up to October 2015, some twenty students were engaged in deciphering and recording the petroglyphs. Honder College hosts an extensive exhibition of rubbings of the rock art, which shows that the dominant motifs are face or mask-like figures, often together with small motifs of unknown meaning, or possibly depicting small animals. Based on them, an elaborate interpretation of the Xiaojinggou rock art has been developed: it relates to a cult of the three emperors or three gods, which is in the order of 6,000 years old, i.e. of the Neolithic, and which is the oldest known religion in the world.

In October 2015 Honder College invited the foremost rock art scientists of China and India, respectively, together with the author, to inspect this discovery, to estimate the age of the petroglyphs, and to advise concerning submission of the extraordinary corpus to UNESCO's World Heritage List. First, the three rock art specialists were treated to a day of lectures on the interpretative hypotheses, and to

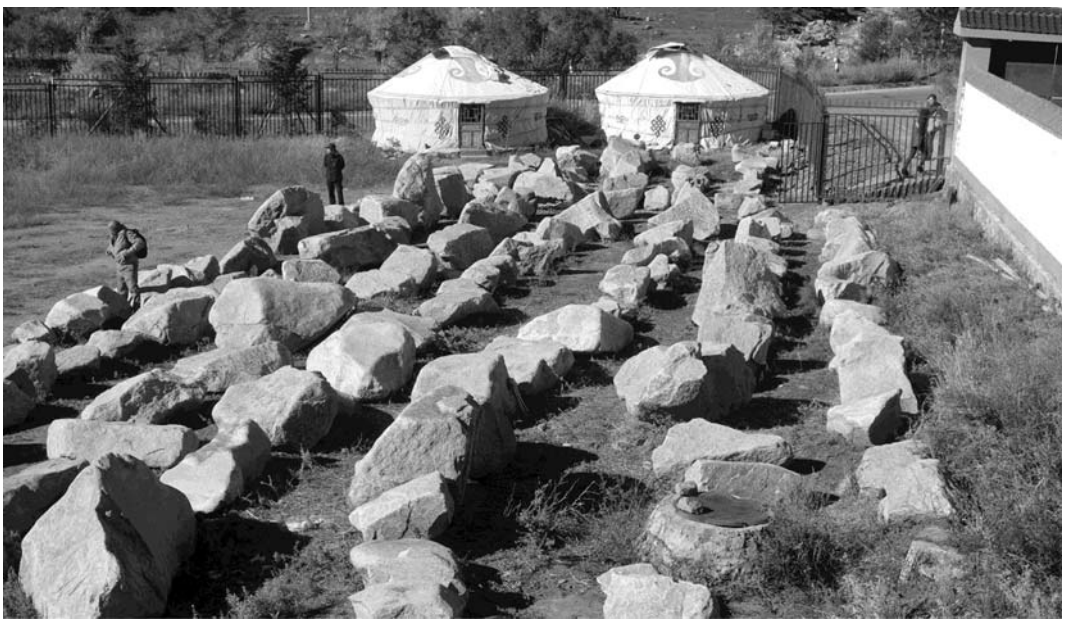

FIGURE 4. Some of the c. 350 granite blocks stored in the salvage yard of Xiaojinggou, north of Hohhot, Inner Mongolia.

detailed examination of hundreds of full-size rubbings of the "face" petroglyphs. Their striking vibrancy and stylistic integrity were astonishing, and it became evident that a major discovery had been made (*Figure 5*). Despite obvious similarities with "face/mask" petroglyphs across central Asia, including those of Helanshan and eastern Inner Mongolia (Chifeng region), this was a very distinctive regional corpus: while each design differed in the details, the stylistic integrity of the collection was overwhelming.

On the second day the three international rock art specialists were taken to Yémá Gōu (Wild Horse valley), a steep side valley to the east of Xiaojinggou in which many similar petroglyphs had survived *in situ*. Here, the first problems became apparent: the specialists could not detect any of the petroglyphs pointed out to them. This left the specialists with a quandary: why was it that what everyone else in the large accompanying group saw remained invisible to them? In the late afternoon they began examining the

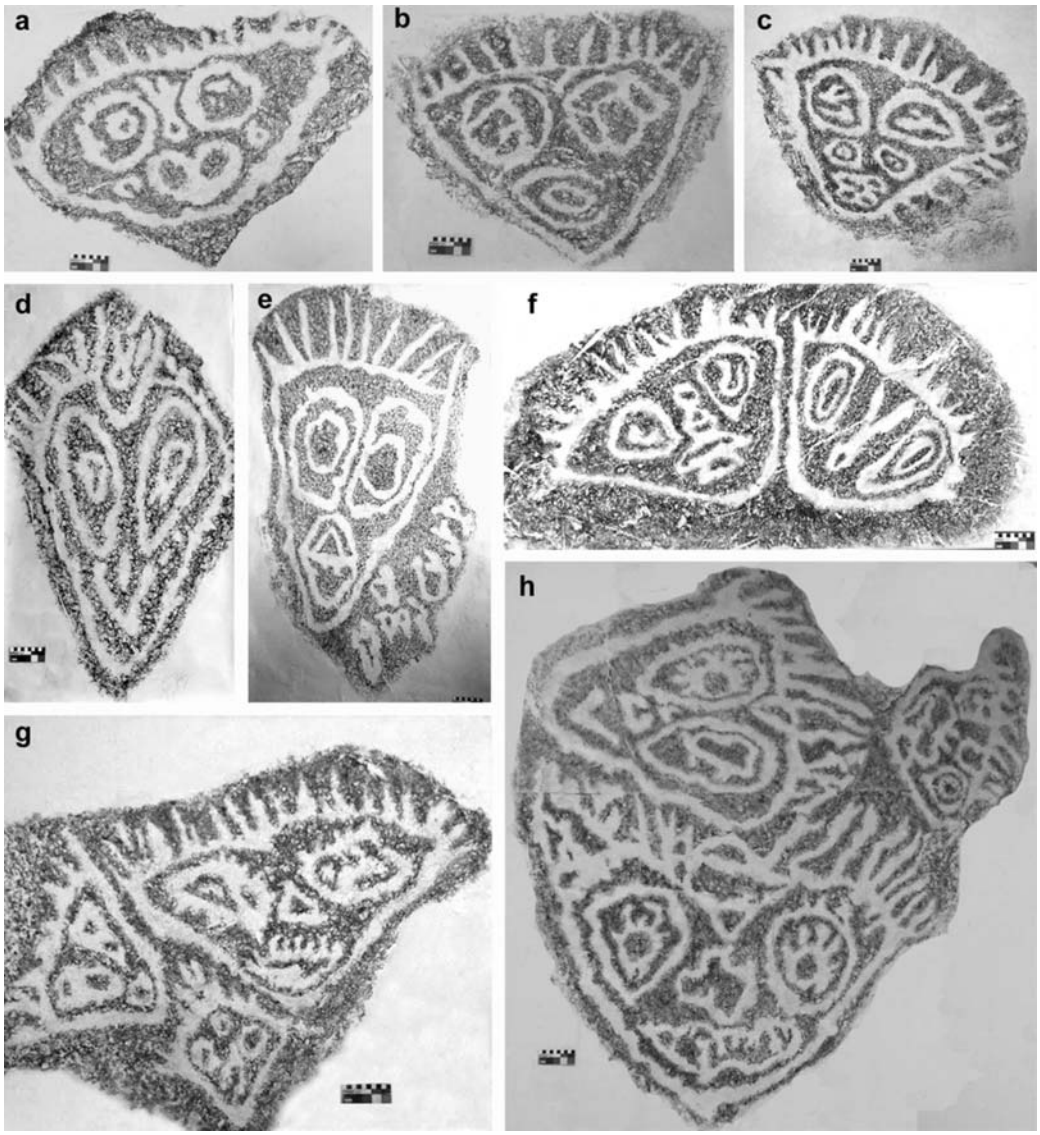

FIGURE 5. Some of the hundreds of stampings of "face" or "mask" petroglyphs recorded at Xiaojinggou, suggestive of a distinctive regional style of rock art.

salvage yard. On most of the boulders, the petroglyphs had been marked out in black colour (*Figure 6*), but the further these were examined, the more it became evident that there were no depressions and no fractured grains present, except that all blocks had been subjected to extensive taphonomic damage, especially impact from other boulders. This is not surprising because all the granite blocks in the main valley and side valleys have been transported from elsewhere and most of these blocks have travelled many kilometres by fluvial or glacial transport.

Next, the author placed the recording of a large "face" petroglyph immediately next to the boulder on which is was said to occur, demonstrating that none of the details of the rubbing were visible on the rock surface. For instance there was a double-turn spiral recorded, in a place where there were absolutely no impact marks, and the surround of the large "face" or its "eyes" or "hair" simply did not exist (*Figure 7*).

This left the specialists with the dilemma of having to explain how rubbings, supposedly an objective way of recording petroglyphs (but a method now eschewed almost worldwide because it is damaging), could possibly detect rock art where there was none. Tang Huisheng then suggested that he wanted to see how the rubbings were made. Two of the students who had been conducting recording work obliged immediately, and it soon became evident that they were not making rubbings in the traditional sense of the term, but *stampings*. They placed a papery membrane over the entire panel, sprayed it lightly with water and covered it with a thick cloth, before stamping the paper maché into position with stiff brushes (*Figure 8*). Once the paper was snugly pressed into the crevices of the rock, the cloth was removed and the paper allowed to dry for one or two hours. Clearly it had taken on the shape of the rock and was a faithful cast of its details.

The next stage was crucial. Stiff smaller brushes were sparsely coated with black paint, and stamped over the paper maché. In this the operators began by searching for depressions in the rock, and then working from them to determine where a perceived groove was leading. In doing so they stamped where they expected rises in the rock surface, and avoided depressions where they expected them. The three specialists examined the result and agreed that it was not a faithful recording of raised or depressed surface aspects. It appeared that the operators had imposed their expectations and subconsciously stamped areas according to their expectations. Giriraj Kumar then asked the recorders to show him how they coloured in the perceived petroglyphs in black colour and discovered that they were not tracing any petroglyphs, but were projecting mental templates onto the rock

FIGURE 6. Granite block with five perceived "face/mask" petroglyphs marked in black colour; there are in fact no petroglyphs on the boulder. Xiaojinggou salvage yard.

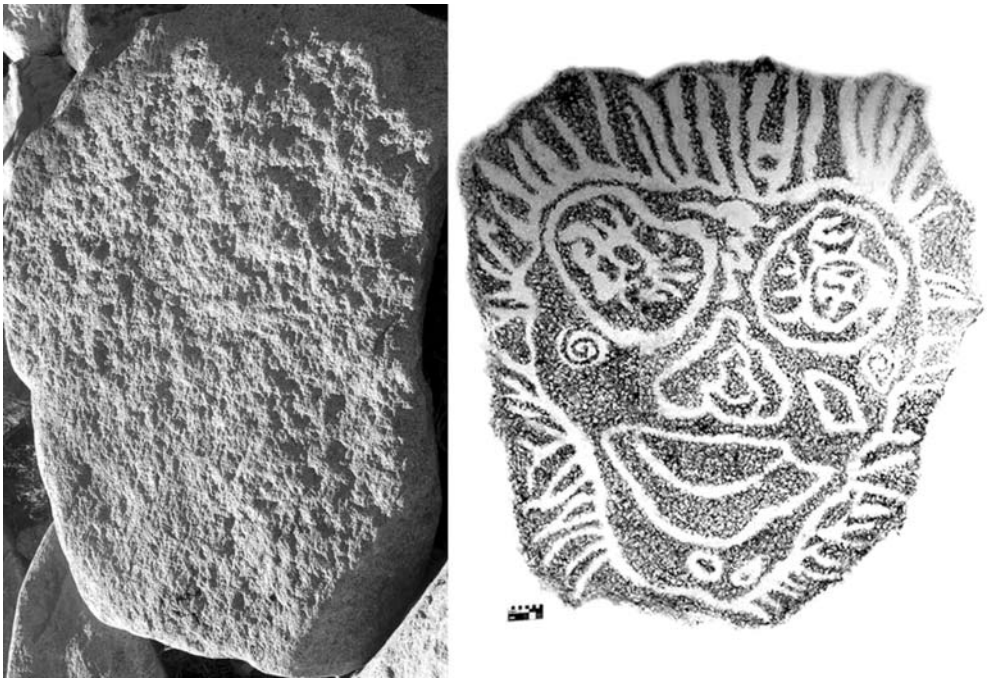

FIGURE 7. Undecorated granite block in Xiaojinggou salvage yard (on left), and the petroglyph "recorded" on this surface by stamping.

FIGURE 8. First stage of the stamping method as demonstrated by the students who have created hundreds of these "faces" by "strategic" stamping.

instead and traced these. The author then experienced a strange phenomenon: when he looked at traced "motifs" of "faces" from about 2 m distance, he seemed to see grooves where the black marks occurred (cf. *Figure 6*), but when he examined them closely the grooves disappeared. This suggests that after two days of being subjected to the strenuous need of detecting "faces" on the rocks, a fixation had developed to try and see petroglyphs where there were none.

On the third day, the Director, whose principal defence of the "rock art motifs" was that their number and stylistic consistency was simply too great to be ignored, had begun to concede that many of his examples were perhaps not what he had thought, but he kept on introducing more and more examples. He was then asked to take the group to the best three or four specimens he had encountered, and two slopes of schist exposures were then examined near his base. Each and every example turned out to be an entirely unmodified boulder, with the exception of a modern inscription on top of a large granite block. Ignoring the finding that there was not a single petroglyph on his collection of 350 salvaged granite blocks, Zhou then requested that some of his "petroglyphs" be dated. Three microerosion age estimates were extracted from natural or transport-caused impact damage on three boulders, and although they were clearly random numbers, he rejoiced that one of them indicated to him that the imaginary petroglyph was in the order of 21,000 years old. In short, although he admitted that many of his petroglyphs did not exist, he continued to insist that others were authentic.

It is emphasised that this account is in no way intended to disparage him or his certainly most dedicated work; rather, it is meant to provide the basis of a much needed explanation of what happened here. After all, this is not about one person's vision: many others had shared this belief, and what needs to be explained is how the autosuggestion could have been shared by so many, to the extent of inventing well over one thousand "face" and thousands of other petroglyphs. It needs to be elucidated how numerous rock art recorders shared Zhou's conviction, and also discovered the petroglyphs he saw on blank rocks. It is our impression that they had tried hard to see the imagery that others purported to see, and subconsciously traced what they thought was on the blocks, genuinely believing their own creations. In a form of mass hysteria they managed to convince themselves that the rock art must be present, and when requested to trace it they discovered elaborate patterns on rocks that bore nothing other than random impact occasioned by transport (*Figure 9*).

This is one of the most dramatic examples of pareidolia in rock art interpretation, resulting in a proposal for World Heritage listing of a large corpus of fictitious rock markings. The problem with it is that it could all too easily be explained away as an extreme example; but there is no reason to assume that it is unique, and the real obstruction to understanding is that many will explain it away as an idiosyncrasy attributable to a charismatic individual, as an exceptional occurrence without parallel. This would be a grave mistake: the involvement of pareidolia is an important subject in rock art interpretation that deserves better than such convenient explaining away of its consequences.

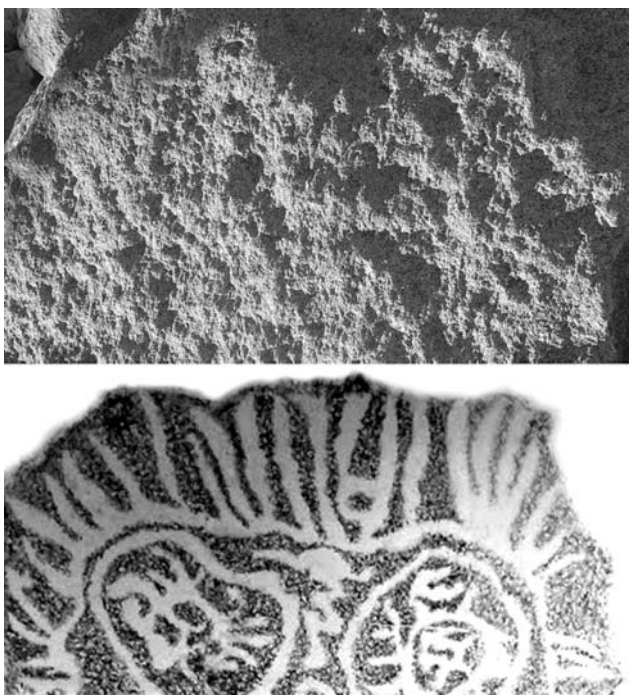

FIGURE 9. Among the most readily detectable aspects of a complex petroglyph are subparallel grooves, such as those forming the "hair" of this "face" petroglyph at Xiaojinggou salvage yard. The upper image shows an undecorated surface lacking any indication of subparallel grooving or circular "eyes" shown in the corresponding imagined petroglyph in the lower image, created by stamping this panel.

DISCUSSION

The susceptibility of humans to visual pareidolia is of course not limited to markings on rock; it can be detected in respect of numerous types of objects, including large granite tors, whole cliff faces or mountain shapes, even including aspects of heavenly bodies such as Moon or Mars, down to much smaller examples, ranging from burnt toast bearing the face of Jesus, to odd shapes on tree bark, vegetables of various types, buildings representing faces, and a great variety of other perfectly random shapes in the visible world. It has been commented upon by William Shakespeare in the dialogue between Hamlet and Polonius in *Hamlet* (Act 3, Scene 2).

Pareidolia, as noted, is a form of apophenia, which occurs when meaningful patterns are seen in what are in reality random or meaningless data, such as in clustering illusion or confirmation bias. In visual pareidolia, familiar objects are recognised in stimuli that are generally vague and sometimes random. This occurs because the visual system is conditioned for rapid disambiguation of the incoming information, to form a "first impression" in case swift response should be required. The misapprehension prompted by pareidolia tends to be clarified quite rapidly, but as it wears off the brain may dwell on its image, prolonging the apophenic illusion and consciously registering that there is indeed a meaningful pattern in what should be a random arrangement of visual clues. This is the phenomenon that needs to be examined here.

The perhaps most common forms detected by pareidolia are faces, especially human faces. Facial recognition is of obvious importance in social animals and well developed in humans, unless they suffer from the cognitive impairment prosopagnosia (*https://en.wikipedia.org/wiki/Prosopagnosia*). Associated with the fusiform gyrus (in the lowest part of the brain), this condition may affect a much larger segment of the population than once thought, perhaps as much as 2%. Individual susceptibility to pareidolia varies considerably among people, and tends to be notably greater in subjects with religious convictions (cf. acheiropoieta). Interestingly, in Christian subjects the pareidolic illusions are often of Jesus or the Virgin Mary, while Muslims tend to detect the Arabic word of Allah or Koranic verses in random arrangements. In other words, the cultural conditioning determines pareidolia's course. A magnetoencephalographic study found that objects resembling faces evoke a 165 ms activation in the ventral fusiform gyrus, which actual faces do slightly earlier (i.e. after 130 ms), whereas other common objects fail to evoke such an activation altogether (Hadjikhani *et al*. 2009). This suggests that face perception of face-like objects is not a later cognitive reinterpretation phenomenon of ambiguous stimuli. The processing speed of face-like data suggests that both subconscious and conscious processes are involved (Dehaene *et al.* 2006, van Gaal, Lamme 2012) and the threshold of subconsciousness and consciousness may be modulated by the amygdala (deep within the temporal lobes of the brain in complex vertebrates) (Mitchell, Greening 2012). This interplay is suggested by the rapid rate of face detection and scene perception (Peelen *et al*. 2009, Rieth *et al*. 2011).

Of particular interest is the reaction of those subjects who do detect the illusion of their pareidolic vision, but then are so fascinated by the apparent meaningfulness of the random pattern that they manage to convince themselves that it is not random after all. This phenomenon is well known in the study of rock art and therefore requires examination here. The conviction is often developed into passionate belief that defies all opposition to it. An example is provided by the humanoid face some see on Mars, in mountains and their shadows in the Cydonia region (Brandenburg *et al*. 1991) of that planet (which, conversely, is not the only face some see on Mars; there is also a face of Gandhi, a smiley face and even a Kermit the Frog). First photographed in 1976 by the Viking 1 spacecraft, it was shown by the better-resolution images of 1998 to be a purely geological feature, yet some of the "believers" insisted that this was a cover-up by a conspiracy, and still in recent years defend their belief steadfastly (Van Flandern 2015). The hundreds of collectors who have found thousands upon thousands of stone figurines of the Lower Palaeolithic experience the same conviction: once they see a face or animal shape in the stone, they are convinced that the effect of their pareidolic vision is not accidental, and that therefore the object must have been shaped by human hand.

An important factor in the effects of pareidolia in rock art interpretation is how, once the brain has been conditioned to anticipate specific patterns, such as a mammoth figure or a stylised face, it will find it increasingly easy to detect such a pattern, even to the point of discovering it where no justification at all exists. It is easy to "see" faces when expecting to see them, and it is exceedingly difficult to see non-faces when expecting faces. This phenomenon has

a straightforward explanation: only about 10% of the information processed by the human visual centre is derived from the retina, i.e. is attributable to sensory input; the rest originates within the brain itself (notably the thalamus). This is again attributable to the shortcut the system takes so as not to delay identification. It means in effect that the brain sees what it expects to see, until it is corrected by more information (cf. the "error-detection governor"; Shermer 2008). But in some subjects the false identification overrules any correction, as for example in the believers of the face on Mars who reject any clarification.

Face detection can occur with the most minimal retinal sensory information, as shown by using a holistic face detector and a facial expression classifier, applying progressive reduction of detail from greyscale to histogram equalised greyscale, and to Sobel and Canny edge abstractions (Hong *et al*. 2013). In their systematic work, Hong and colleagues discovered that some candidate face detectors saw faces even in blank black or white images, and decided that such subjects "should be discarded from further processing". This level of pareidolia that requires virtually no visual input explains in part the Xiaojinggou observations, although the group effect there needs to be elucidated further. Another notable factor in this phenomenon is that none of the Xiaojinggou "faces" are inverted, which is attributable to the face-inversion effect (Rakover 2013): effective face recognition requires upright orientation, whereas in random positioning on boulders the sample would be expected to include many inverted examples.

This case also illustrates that the anticipation of seeing a specific design can be transferred to others. In the case of rock art this is particularly easy because many motifs are ambiguous or hard to detect in the first place. For instance petroglyphs may be severely weathered or patinated, to the point of being barely detectable. Therefore if a researcher who is regarded as more experienced in the field asks a less experienced colleague, can he or she see the iconic arrangement, the latter, not seeing it, is likely to oblige by making a concerted effort to detect the details. The second person's visual system will summon the images seen of such petroglyphs from within the brain, in an attempt to spot similar details on the rock. This endeavour is likely to result in imagining faint details, a prelude to acceptance of the whole design. The Xiaojinggou example shows that after being exposed to days of anxiety about glimpsing what others "see", many will readily succumb and begin to spot the faces they are prompted to perceive.

In the case of the young Chinese archaeologist who thought he observed a giant bird pecking a deer it was noted that he fortunately explained the reasoning that determined his beliefs. His chain of deductions contained several crucial errors of fact or interpretation, but it also shows how such erroneous beliefs, initially derived from pareidolia, can easily be rationalised by a structure of flawed arguments. A similar pattern is evident in the Xiaojinggou case, which led to elaborate hypotheses about the deeper meanings of imagined rock art imagery.

While elevated pareidolia can be involved in a number of psychiatric conditions (e.g. dementia with Lewy bodies, Alzheimer's disease) and is reduced by cholinergic enhancement (Yokoi *et al*. 2014, Sarter 2015), it needs to be emphasised that pareidolia is an integral phenomenon of the visual systems of both humans and non-human animals. It is not a neurological aberration as such, but forms part of the strategy by which the "normal" visual centre disambiguates information it receives. Susceptibility, as noted, varies widely among individuals, and is clearly a function of various psychological predispositions. Among the latter is the belief of beholders of rock art that they can divine the meaning of such arrangements on rock surfaces in the absence of emic (original cultural) interpretation. Another such predisposition is the belief of some archaeologists to somehow possess an elevated level of such an ability, which leads them to assume the authority of interpretation (Bednarik 2014). This academic appropriation of elements of traditional indigenous belief systems, metaphysical or social constructs through arbitrary construal is a form of cognitive colonialism, i.e. a political act, as it has no scientific justification. It does not only result in untestable propositions, it is posed precisely because it cannot be falsified, and hence it is deliberately unscientific. Similarly, the opinions of zoologists and palaeontologists about the nature of rock art zoomorphs are offered by specialists who have been trained to recognise species or genera of animal specimens, but *who possess no cultural knowledge of the iconographic conventions of the producer of the rock art*.

CONCLUSION

In summary, pareidolia in rock art interpretation is far more pervasive than has been appreciated. It is so fundamental to the process of "identification" that all

such propositions not supported by ethnography need to be questioned. Bearing in mind that all etic motif interpretations are untestable (unfalsifiable) propositions and are made outside of science, the entire artifice needs to be reviewed. The only blind test ever conducted of etic rock art interpretation (Macintosh 1952, 1977) has shown that a distinguished professor of anatomy failed in correctly identifying most of the painted biomorphs of Beswick and Tandandjal Caves, two sites in the Northern Territory of Australia. His 10% success rate in identifying the images correctly is no better than a random result, suggesting that even the most "highly trained" cultural outsider has little chance of interpreting the formal attributes of rock art motifs correctly. This is no great surprise to the neuroscientist, who knows that the brains of a literate and a non-literate person differ fundamentally (Helvenston 2013). How readily parts of a brain can be "rewired" is illustrated by how rapidly the inferior posterior parietal lobule "rewires" itself in the rubber hand illusion (Botvinick, Cohen 1998, Peled *et al*. 2003, Tsakiris, Haggard 2005, Costantini, Haggard 2007, Marjolein *et al*. 2009). It is a tangible demonstration of localised human neuroplasticity, and it is now well known that ontogenic conditioning modifies both the chemistry and the structure of the brain significantly (Maguire *et al*. 2000, Draganski *et al*. 2004, Smail 2007, Malafouris 2008). Thus the way the brain of a producer of rock art processed visual information can safely be assumed to have differed very greatly from the way a modern literate Westerner perceives (Helvenston 2013).

The tendency to seek patterns in random information is fundamental to the ability of any species in processing sensory input. High levels of dopamine affect the propensity to find meaning, patterns and significance, even when there is none, and this proclivity is related to a tendency of receptivity for the paranormal (Leonard, Brugger 1998). Alcock emphasises how evidence that should be rejected on a rational basis is instead accepted by default, and how rationality is changed to fit the perceived evidence (Alcock 1981, Alcock *et al*. 2005, Foster, Kokko 2009). He also notes how this is reinforced when believers listen to each other's reflections (consider the Inner Mongolian case described above). Therefore the creative pattern detection that constitutes rock art "interpretation" is effectively a projection of newly created meaning onto marks on rock that, in reality, consist of pigment patches or anthropogenic surface depressions. The point is well illustrated by di Maida's (2016) dilemma in interpreting a zoomorph in Grotta di Cala dei Genovesi, Sicily. This predisposition to "abnormal meaningfulness" (Brugger 2001, Brugger, Mohr 2008) offers some comparisons with the Rorschach inkblot test (Exner 2002). In both cases, the subject views graphic arrangements of marks, the meaning of which is not available but must be divined by examination. As implied by the Rorschach test, this process is subjective in that it is influenced by numerous factors, such as personality traits of the subject and his/her life experiences. The comparison should, however, not be stretched too far because the marks rock art consists of are not random blots but have been made deliberately by human hand.

Where the pareidolic reading of rock art fails is in the belief that one can "communicate" with the rock artist via the marks (Mithen 1998), particularly concerning intent: which visual clues are deliberate iconographic referents? The modern beholder's perception searches the rock art motif for details resonating with his/her visual system, in the same way as pareidolia operates. When it detects such elements, it locks onto them *as if it knew* that these are the clues the rock artist wanted to convey as being representational. For instance in the cited example of the misinterpretation of an aviform rock painting as *Genyornis*, Gunn *et al*. (2011: 6) locked onto "the head shape (including blunt beak), long neck, stubby legs, tail-less rump and large heavy feet", as if they knew that these were the diagnostic aspects. This poses two issues: first, the head shape of *Genyornis* is unknown (no undamaged specimens are available, so what were available were artists' impressions of what the species might have looked like), and the remaining features are far from diagnostic or are only assumptions. Second, the number of visual characteristics in the figure that *contradict* their "identification" is much greater and more decisive, and include the long neck, the wing line or alimentary canal, and the absence of tail feathers. But the most pivotal factor is that aspects such as the attitude of the creature (the horizontal displacement of the point of gravity relative to the feet) or the "twisted perspective" treatment of the feet show clearly that this is not a naturalistic image. Therefore the basis on which an emically uninformed beholder would decide which aspects are naturalistic and which are not is entirely arbitrary. So are his/her decisions of which of an image's aspects are diagnostic; or even whether they were intended to be so. At this point it becomes obvious that all such "determinations" are scientifically misleading and counter-productive. They discredit the discipline.

As every experienced rock art researcher knows, practically all rock art motifs in the world are non-naturalistic. All rock art pictures are abstractions of physical reality, and the two-dimensional abstractions one finds in rock art are not "naturalistic" in the sense that images in a zoological textbook are. Most comprise a majority of elements that contradict a favoured interpretation, and most are so coarse or stylised or abstracted that it is imprudent to enunciate identification at species level. Often a feature like a "hump" on a bovid is deduced from a single impact mark or paint smudge that may be fortuitous or have no diagnostic strength. Rock art interpreters are oblivious of the processes by which their own visual system manages visual information, and how that system "identifies" objects, in the same way as synaesthesia patients cannot explain their unique perception of reality. They are similarly ignorant about the barriers preventing them from experiencing the rock artists' visual reality, enabling them to invent meanings, which when published burden the discipline with a cacophony of unwarranted information. The number of such unfounded claims is in the millions and grows with every year. To call this hobby a legitimate field of research is a caricature of the academic endeavour. In this format of free-standing interpretation of rock art, using nothing but the visual system of the interpreter, the instant an opinion of the meaning is formed, all disconfirming aspects are subconsciously or subliminally suppressed. It is this tendency that most disallows such "identifications" from scientific consideration, because in science the disconfirming evidence should be of particular weight. Therefore from the perspective of neuroscience, the notion that rock art connoisseurs can somehow conjure up the real (emic) meanings of rock art motifs from their own brains' past experiences is simply preposterous (Bednarik 2011, 2013a, 2013b, 2014, 2015). The modern human brain has no relevant past experiences to draw on and no such ability should be presumed to exist. No *scientific* access to the meaning is possible in the absence of credible ethnography. All other modern interpretation of rock art is via pareidolia.

REFERENCES

ALCOCK J. E., 1981: *Parapsychology: science or magic? A psychological perspective.* Pergamon, Oxford/New York.

ALCOCK J., CARMENT D. W., SADAVA S. W. 2005: *A textbook of social psychology* (6th edn). Pearson Education Canada, Ontario.

BARKER B., LAMB L., DELANNOY J. J., DAVID B., GUNN R. G., CHALMIN E., CASTETS G., et al., in press: Archaeology of the "Genyornis" site, western Arnhem Land: determining the age of the 'Genyornis' painting. In B. David, P. S. C Taçon, J. J. Delannoy, J. M. Geneste (Eds.): in press. *The archaeology of rock art in western Arnhem Land, Northern Australia.* Terra Australis, ANU Press, Canberra.

BARNOSKY A. D., KOCH P. L., FERANEC R. S., WING S. L., SHABEL A. B. 2004: Assessing the causes of late Pleistocene extinctions on the continents. *Science* 306: 70–75.

BEDNARIK R. G., 1986: Comment on W. Davis, "The origins of image making". *Current Anthropology* 27: 202–203.

BEDNARIK R. G., 1998: The australopithecine cobble from Makapansgat, South Africa. *South African Archaeological Bulletin* 53: 3–8.

BEDNARIK R. G., 2002: An Acheulian palaeoart manuport from Morocco. *Rock Art Research* 19, 2: 137–139.

BEDNARIK R. G., 2003: A figurine from the African Acheulian. *Current Anthropology* 44, 3: 405–413.

BEDNARIK R. G., 2006: The Middle Palaeolithic engravings from Oldisleben, Germany. *Anthropologie* (Brno) 44, 2: 113–121.

BEDNARIK R. G., 2011: *The human condition*. Springer, New York.

BEDNARIK R. G., 2013a: On the neuroscience of rock art interpretation. *Time and Mind: The Journal of Archaeology, Consciousness and Culture* 6, 1: 37–40.

BEDNARIK R. G., 2013b: Proboscidean petroglyphs in the USA. *International Newsletter on Rock Art* 67: 1–7.

BEDNARIK R. G., 2014: The archaeological interpretation of rock art. *Purakala* 24: 63–75.

BEDNARIK R. G., 2015: Pleistocene fauna depictions in American palaeoart. *Rock Art Research* 32, 1: 3–30.

BENEKENDORFF U., 2012: Lower Paleolithic "figure stones" from the Ohle gravel pit, Gross Pampau, Germany. *Pleistocene Coalition News* 4, 1: 17–19.

BOSTWICK T. W., 2001: North American Indian agriculturalists. In D. S. Whitley (Ed.): *Handbook of rock art research.* Pp. 414–458. Altamira Press, Walnut Creek, CA.

BOTVINICK M., COHEN J., 1998: Rubber hands "feel" touch that eyes see. *Nature* 391: 756.

BRANDENBURG J. E., DIPIETRO V., MOLENAAR G., 1991: The Cydonian Hypothesis. *Journal of Scientific Exploration* 5, 1: 1–25

BRUGGER P., 2001: From haunted brain to haunted science: a cognitive neuroscience view of paranormal and pseudoscientific thought. In J. Houran, R. Lange (Eds.): *Hauntings and poltergeists: multidisciplinary perspectives.* Pp. 195–213. McFarland & Company, Jefferson, NC.

BRUGGER P., MOHR C., 2008: The paranormal mind: how the study of anomalous experiences and beliefs may inform cognitive neuroscience. *Cortex* 44: 1291–1298.

CHALMIN É., CASTETS G., DELANNOY J.-J., BARKER B., DAVID B., LAMB L., SOUFI F., PAIRIS S., CERSOY S., MARTINETTO P., GENESTE J.-M., HOERLÉ S., RICHARDS T., GUNN R., in press: Geochemical analysis of the painted panels at the "*Genyornis*" rock art site, Arnhem Land, Australia.

COLE S. J., 2009: *Legacy on stone: rock art of the Colorado Plateau and Four Corners Region*. Johnson Press, Boulder, CO.

COSTANTINI M., HAGGARD P., 2007: The rubber hand illusion: sensitivity and reference frame for body ownership. *Consciousness and Cognition* 16, 2: 229–240.

DEHAENE S., CHANGEUX J.-P., NACCACHE L., SACKUR J., SERGENT C., 2006: Conscious, preconscious, and subliminal processing: a testable taxonomy. *Trends in Cognitive Sciences* 10, 5: 204–211.

DI MAIDA, G., 2016: 3D in the cave: hey young deer, why the long face (and no tail)? *Rock Art Research* 33, 2: 209–218.

DRAGANSKI B., GASER C., BUSH V., SCHUIERER G., BOGDAHN U., MAY A., 2004: Changes in grey matter induced by training. *Nature* 427, 6972: 311–312.

EXNER J. E., 2002: *The Rorschach: basic foundations and principles of interpretation*. Vol. 1. John Wiley & Sons, Hoboken, NJ.

FAITH J. T., SUROVELL T. A., 2009: Synchronous extinction of North America's Pleistocene mammals. *Proceedings of the National Academy of Sciences U.S.A.* 106, 49: 20641–20645.

FIEDEL S. J., 1999: Older than we thought: implications of corrected dates for Paleoindians. *American Antiquity* 64, 1: 95–115.

FIEDEL S., 2009: Sudden deaths: the chronology of terminal Pleistocene megafaunal extinction. In: G. Haynes (Ed.): *American megafaunal extinctions at the end of the Pleistocene*. Pp. 21–37. Springer, New York.

FISHER D. C., 1996: Testing late Pleistocene extinction mechanisms with data on mastodon and mammoth life history. *Journal of Vertebrate Paleontology* 16 (Suppl. 3): 34A.

FOSTER K. R., KOKKO H., 2009: The evolution of superstitious and superstition-like behaviour. *Proceedings of the Royal Society*, Series B 276: 31–37.

GILLAM M. L., WAKELEY L. D., 2013: Are Utah's Sand Island "mammoths" late Pleistocene? A geologic view. *IFRAO 2013 Proceedings, American Indian Rock Art* 40(DVD), 147–172.

GILLESPIE R., 2004: First and last: dating people and extinct animals in Australia. *Australian Aboriginal Studies* 2004, 1: 97–101.

GOREN-INBAR N., 1986: A figurine from the Acheulian site of Berekhat Ram. *Mi'tekufat Ha'even* 19: 7–12.

GUNN R. G., DOUGLAS L. C., WHEAR R. L., 2011: What bird is that? Identifying a probable painting of *Genyornis newtoni* in western Arnhem Land. *Australian Archaeology* 73: 1–12.

HADJIKHANI N., KVERAGA K., NAIK P., AHLFORS S. P., 2009: Early (M170) activation of face-specific cortex by face-like objects. *Neuroreport* 20, 4: 403–407.

HAYNES G., 1987: Proboscidean die-offs and die-outs: age profiles in fossil collections. *Journal of Archaeological Sciences* 14, 6: 659–668.

HAYNES G., 1991: *Mammoths, mastodonts, and elephants. Biology, behaviour and the fossil record*. Cambridge University Press, New York.

HAYNES C. V., 2008: Younger Dryas "black mats" and the Rancholabrean termination in North America. *Proceedings of the National Academy of Sciences U.S.A.* 105, 18: 6520–6525.

HELVENSTON P. A., 2013. Differences between oral and literate cultures: what we know about Upper Paleolithic minds. In: R. G. Bednarik (Ed.): *The psychology of human behaviour*. Pp. 59–110. Nova Press, New York.

HILL B., HILL R., 1974: *Indian petroglyphs of the Pacific Northwest.* Hancock House, Saanichton, B.C.

HONG K., CHALUP S. K., KING R. A., OSTWALD M. J., 2013: Scene perception using pareidolia of faces and expressions of emotion. *Proceedings of 2013 IEEE Symposium on Computational Intelligence for Creativity and Affective Computing (CICAC)* (Singapore 16–19 April, 2013). Pp. 79–86.

LEONARD D. M. A., BRUGGER P., 1998: Creative, paranormal, and delusional thought: a consequence of right hemisphere semantic activation? *Neuropsychiatry, Neuropsychology, and Behavioral Neurology* 11, 4: 177–183.

LOUGUET-LEFEBVRE S., 2013: Les mammouths de Colomb du Pléistocène supérieur de Hot Springs (Dakota du Sud, Etats-Unis). *Paleo* 24: 149–172.

MACINTOSH N. W. G., 1952: Paintings in Beswick Cave, Northern Territory. *Oceania* 22, 4: 256–274.

MACINTOSH N. W. G., 1977: Beswick Creek Cave two decades later: a reappraisal. In: P. J. Ucko (Ed.): *Form in indigenous art: schematisation in the art of Aboriginal Australia and prehistoric Europe*. Pp. 191–197. Prehistory and Material Culture Series 13, Australian Institute of Aboriginal Studies, Canberra.

MAGUIRE E.A., GADIAN D. G., JOHNSRUDE I. S., GOOD C. D., ASHBURNER J., FRACKOWIAK R. S. J., FRITH C. D., 2000: Navigation-related structural change in the hippocampi of taxi drivers. *Proceedings of the National Academy of Sciences, USA* 97, 8: 4398–4403.

MALAFOURIS L., 2008: Beads for a plastic mind: the "blind man stick" (BMS) hypothesis and the active nature of material culture. *Cambridge Archaeological Journal* 18, 3: 401–414.

MALOTKI E., WALLACE H. D., 2011: Columbian mammoth petroglyphs from the San Juan River near Bluff, Utah, United States. *Rock Art Research* 28, 2: 143–152.

MALOTKI E., WEAVER D. E., 2002: *Stone chisel and yucca brush: Colorado Plateau rock art*. Kiva Publishing, Walnut, CA.

MARJOLEIN P., KAMMERS M., VERHAGEN L., DIJKERMAN H. C., HOGENDOORN H., DE VIGNEMONT F., SCHUTTER D. J. L. G., 2009: Is this hand for real? Attenuation of the rubber hand illusion by transcranial magnetic stimulation over the inferior parietal lobule. *Journal of Cognitive Neuroscience* 21, 7: 1311–1320.

MARSHACK A., 1996: A Middle Palaeolithic symbolic composition from the Golan Heights: the earliest known depictive image. *Current Anthropology* 37: 357–365.

MARSHACK A., 1997: The Berekhat Ram figurine: a late Acheulian carving from the Middle East. *Antiquity* 71: 327–337.

MARTIN P. S. 2005: *Twilight of the mammoths: Ice Age extinctions and the rewilding of America*. University of California Press, Berkeley, CA.

MATTHES, W. 1969: *Eiszeitkunst im Nordseeraum*. Niederlbe-Verlag Otterndorfer Verlagsdruckerei H. Huster KG. Otterndorf, Germany.

MELTZER D. J., MEAD J. I., 1983: The timing of the late Pleistocene mammalian extinctions in North America. *Quaternary Research* 19: 130–135.

MILLER G. H., MAGEE J. W., JOHNSON B. J., FOGEL M. L., SPOONER N. A., MCCULLOCH M. T., AYLIFFE L. K., 1999: Pleistocene extinction of *Genyornis newtoni*: human impact on Australian megafauna. *Science* 283, 5399: 205–208.

MITCHELL D. G. V., GREENING S. G., 2012: Conscious perception of emotional stimuli. *The Neuroscientist* 18(4): 386–398.

MITHEN S., (Ed.) 1998: *Creativity in human evolution and prehistory*. Routledge, New York.

PEELEN M. V., LI F.-F., KASTNER S., 2009: Neural mechanisms of rapid natural scene categorization in human visual cortex. *Nature* 460, 7251: 94–97.

PELED A., PRESSMAN A., GEVA A. B., MODAI I., 2003: Somatosensory evoked potentials during a rubber-hand illusion in schizophrenia. *Schizophrenia Research* 64, 2–3: 157–63.

QIAO HONG 2014: Pleistocene fauna in southern China's rock art. Paper presented at IFRAO Congress of the Rock Art Research Association of China, Guiyang City, 18 July 2014.

RAKOVER S. S., 2013: Explaining the face-inversion effect: the face–scheme incompatibility (FSI) model. *Psychonomic Bulletin & Review Journal* 20: 665–692.

RIETH C. A., LEE K., LUI J., TIAN J., HUBER D. E., 2011: Faces in the mist: illusory face and letter detection. *i-Perception* 2: 458–476.

SARTER M., 2015: Behavioral-cognitive targets for cholinergic enhancement. *Current Opinion in Behavioral Sciences* 4: 22–26.

SHERMER M., 2008: Patternicity: finding meaningful patterns in meaningless noise. *Scientific American*, http://www.scientificamerican.com/article/patternicity-finding-meaningful-patterns/; accessed 25 Oct. 2015.

SMAIL L. M., 2007: *On deep history and the brain*. University of California Press, Berkeley.

SUROVELL T. A., GRUND B. S., 2012: The associational critique of Quaternary overkill and why it is largely irrelevant to the extinction debate. *American Antiquity* 77, 4: 672–687.

TSAKIRIS M., HAGGARD P., 2005: The rubber hand illusion revisited: visuotactile integration and self-attribution. *Journal of Experimental Psychology: Human Perception and Performance* 31, 1: 80–91.

TURNER C. G. II, 1963: Petrographs of the Glen Canyon region. *Museum of Northern Arizona Bulletin* 38: 1–74.

TURNER C. G. II, 1971: Revised dating for early rock art of the Glen Canyon area. *American Antiquity* 36: 469–471.

VAN FLANDERN T., 2015: *Proof that the Cydonia face on Mars is artificial*. http://www.metaresearch.org/solar%20system/cydonia/proof_files/proof.asp.

VAN GAAL S., LAMME V. A. F., 2012: Unconscious high-level information processing. *The Neuroscientist* 18, 3: 287–301.

VOKEY J. R., READ J. D., 1985: Subliminal messages: between the devil and the media. *American Psychologist* 40, 11: 1231–1239.

WATERS M. R., STAFFORD T. W., Jr. 2007: Redefining the age of Clovis: implications for peopling of the Americas. *Science* 315: 122–126.

YOKOI K., NISHIO Y., UCHIYAMA M., SHIMOMURA T., IIZUKA O., MORI E., 2014: Hallucinators find meaning in noises: pareidolic illusions in dementia with Lewy bodies. *Neuropsychologia* 56: 245–254.

ZUSNE L., JONES W. H 1989: *Anomalistic psychology: a study of magical thinking*. Lawrence Erlbaum Associates, Hillsdale, NJ.

Robert G. Bednarik
International Federation of Rock Art Organisations
P.O. Box 216
Caulfield South, Melbourne, VIC 3162
Australia
E-mail: robertbednarik@hotmail.com