

A taphonomy of palaeoart

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As one digs back through the archaeological record, art and other evidence of symbolic behaviour becomes scarcer, so it is much disputed just when human marking behaviour and human language began. Is the fading away a real fact of prehistory, or a distorting effect of selective survival?

The term taphonomy is a recent introduction to archaeology, referring to the transformations experienced by those materials which archaeologists consider to form the archaeological record (Bahn 1992: 489). As well as 'primary taphonomy', such as that related to preservation and deposition, selective recovery and even selective reporting also determine the way in which the 'archaeological record' has become distorted over time.

The complexity of the issue is perhaps best illustrated by example. We could consider the many factors that contribute to the relative over-representation of, say, gold objects in the archaeological record. Apart from the obvious advantage in preservation of a noble metal, gold objects are far more likely to be collected, noticed, salvaged, recorded or sought with detectors than other remains. Moreover, they are more likely to occur in select places — tumuli, shipwrecks, pyramids or hoards — especially likely to attract the interest of archaeologists, who prefer not to dig in places without promise. Even the preoccupations of archaeologists become taphonomic factors, and are decisive in determining what we innocently call the 'archaeological record'. Once found, a gold object is more likely to be mentioned in a publication than, say, a bone object. The observation that there are x times more bone objects than gold objects in the 'archaeological record', without further qualification, is meaningless.

Studying evidence of symbolic behaviour

The symbolic productions of human beings are almost without exception extremely ephemeral: language, gesture, mimetic behaviour, ritual, or

indeed any symbolic creation has only the tiniest chance of surviving even for a short period — a few days, years or decades — such as symbolic productions on paper, textiles, bark or dwelling walls, to name just a few. Nevertheless, a few of these manage to survive for centuries, even millennia. But for a symbolic product to have any real prospect of surviving for millennia, it needs to be of a durable material such as stone, ivory, bone, antler, egg shell, metal or ceramic.

The study of early symbolic behaviour should be based on a taphonomy of symbolic production. Yet most studies of palaeoart have been exercises in naive empiricism. Pre-historic corpora of art are described quantitatively and assessed statistically (Bednarik 1990/91), when all they can do is to define a taphonomic remnant. The 'archaeological record' is no accurate reflection of an early tradition: many extant cultural traditions produce no graphic art at all, while others make no use of media that would survive into an archaeological record. The distorting effect of taphonomic processes is more potent in respect of symbolic production of the Pleistocene, than in any other 'cultural' evidence of such antiquity. Nearly all symbolic production is eliminated; the minute remainder is so distorted by numerous factors that it is ludicrous to interpret its quantifiable characteristics without extensive recourse to taphonomic logic. However, most interpretations of palaeoart have been conducted with an implicit assumption that the surviving remnants are a representative sample of the culture or period they are believed to belong to. Although this is almost certainly untrue in all

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cases of pre-historic art, entire artistic 'styles' have been created, and geographical or chronological distributions interpreted as of cultural significance. Palaeoart has been generally interpreted in terms of distributional, compositional and statistical indices, which are largely taphonomic characteristics of the evidence.

The 'archaeological record' of palaeoart is inherently distorted by further sources of subjectivity, among them personal bias, jingoism, and limitations of observer's relevant knowledge or perception. Models of Pleistocene art that are attributable to the partial views of influential practitioners have often proved to be more effective in guiding the discipline than those based on more rigorous assessment, and these trends continue to disadvantage the discipline severely (Bednarik 1990/91). In this paper I examine some of the many ways in which taphonomy has resulted in erroneous interpretation of palaeoart, and present some suggestions on how to interpret Pleistocene art data more effectively, through the application of a 'taphonomic filter'.

How taphonomic effects on petroglyphs create 'art traditions'

The survival of petroglyphs over long periods, hardly a function of cultural intent, is closely related to geomorphological factors. All petroglyphs outside deep caves are subject to patination and weathering processes, whose effectiveness varies with rock type, site morphology and various environmental conditions. Inherent characteristics of the petroglyphs themselves also contribute. In particular, the depth of engraved grooves, and the complexity and type of design contribute to survival, and to the likelihood of detection by researchers. A clearly figurative outline motif is easiest to detect, while a cupule or a line may go unnoticed, or be interpreted as a natural mark. Deeply engraved petroglyphs survive longer than shallow ones, and petroglyphs on granite survive far longer than equally deep figures on sandstone, other factors being equal. Petroglyphs survive longer in an arid than in a humid climate. As well as these biases, there are those of the recorders — probably the single most effective factor in shaping what is presented as the 'archaeological record'.

Technically, most of the world's petroglyphs

are *sgraffiti*, a form of graphic art in which the design is rendered visible by scratching or engraving through a surface layer of different colour. In rock art, the surface lamina is provided by a patina such as rock varnish, a dark-brown veneer (Engel & Sharp 1958) which conceals a lighter-coloured rock, usually a weathering rind. For instance, the grey, greenish or bluish gabbro and granophyre of the arid Pilbara region in Australia bears a whitish weathering zone which in turn is concealed under a ferromanganese skin (of rock varnish or a similar deposit; Bednarik 1977; 1979). If the outermost varnish is removed, the subcutaneous weathering zone is exposed in a dramatic colour contrast. The *sgraffiti* so produced are typically shallow and usually infilled (termed *intaglios* by McCarthy 1967); they become virtually invisible if the dark varnish re-forms on them. By contrast, a deeply engraved petroglyph, especially a line figure, remains visible even if the patina in the grooves comes to match that of the adjacent surface completely.

The chronological sequence of Australian petroglyph traditions pioneered by McCarthy in the 1960s begins with abraded grooves and outline figures, and ends with the filled-in 'intaglios'. While subsequent writers differ in many details with McCarthy, it is true that the surviving earlier petroglyphs are consistently deeply carved, usually linear and fully patinated, whilst the more recent petroglyphs are often shallow and not fully repatinated. Here a chronological sequence of techniques has been invented on the basis of empirical evidence which is largely the result of taphonomic processes. Shallow *sgraffiti* become repatinated and thus undetectable if they are of sufficient antiquity. Shallow figures on unvarnished rock have an often much shorter life than deeply engraved motifs, because they are far more likely to be obliterated by erosion processes (e.g. aeolian erosion, granular mass-exfoliation). Deeply carved figures may even survive extensive fluvial wear in a creek bed. All these taphonomic processes select deep petroglyphs (FIGURE 1).

It is either the depth of the relief or the colour difference which renders a petroglyph visible, or both properties. *Sgraffiti* may be so shallow that specialists have mistaken them for rock paintings on occasion (Michelsen 1983). Relief petroglyphs, those that are deeply carved, in-

volve a significantly greater work effort which varies according to the hardness of the rock. Rock hardness has a dual effect: it is reflected in the rate of physical weathering, and petroglyphs on hard rock tend to be relatively shallow and thus much harder to detect, particularly if re-patinated. The subject of rock hardness raises another issue, of relevance to dating. There is no great technical or economical incentive in producing a deep relief petroglyph on patinated rock, where visibility relies mostly on colour contrast. One can therefore argue that fully varnished deep petroglyphs are likely to have been made before the rock panel itself became varnished — particularly where the rock is hard.

If relative groove depth affects the rate of repatination or the visual appearance of a petroglyph (Crawford 1964; Vinnicombe 1987: 29) it would follow that patination is not so much a function of age, but of groove depth and thickness of crust. But rock varnish, in particular, is extremely thin, and its rate of re-formation does not seem related to groove depth.

The sequence perceived in Australia — deeply carved linear designs followed by filled-in motifs — is widespread globally at open air sites. Chronological models that explain this trend in cultural terms follow a naive empiricism without taphonomic logic. The latter demands that any physical characteristic of a petroglyph that may conceivably assist its longevity (e.g. groove depth) must not be seen as 'culturally significant': it must not be seen as defining any preference of technique, style, location or medium.

Some taphonomic effects on rock paintings

The same principles apply to rock paintings, which also undergo an assortment of selection processes to which a certain portion of an art corpus falls victim. None of these processes are random; they favour certain techniques, pigment or paint types, locations, media (type of rock support), climates etc. Many pigments or paints change colour with age (or with different moisture regimes, solar exposure, rock support etc.). The longevity of rock paints varies significantly. The observation that the oldest open-air paintings in a region are always a specific hue of dark-red (especially in regions of warm and dry climate, such as northeast Brazil, Mexico, southwest USA, Australia, the Sa-

hara and central India) is almost certainly a product of taphonomic processes. It is no coincidence that the most stable of the iron minerals, such as haematite, are of that colour (Bednarik 1992a; *in press*).

A favoured pigment of most traditional societies, the iron oxides and hydrous iron oxides commonly known as ochres are metastable minerals whose reflective properties vary with redox state, content of adsorbed, absorbed, capillary or crystalline water, even of grain size (Bednarik 1979; 1980; 1987). Since the reflective properties determine the colour, and since these may result from post-depositional alterations or selective survival, archaeological colour definitions are of very limited use in interpreting the art, in defining traditions or styles, or in any form of statistical treatment for purposes of interpretation. A rock painting that is now dark-red may well have been applied in orange, brown, even yellow. Present colours do not show in which colour iron minerals were originally applied as pigments, and are no sound base for ethnohistorical reconstructions (e.g. Stumfohl 1990).

Colours other than ochres also change with age. In many decorated shelters at Jaora, Madhya Pradesh, India, white paint changes directly to black colour (Bednarik 1992b), where the conversion seems attributable to bacteria or fungi. McNickle (1991: 42) reports black rock paint being converted into light-green in Australia.

Even more effective as a taphonomic selector is the greatly varying longevity of different pigment types, and their respective abilities to penetrate into interstitial spaces or to become bonded into a surface zone of the rock support. No other mineral pigment seems to match the ability of ochre pigments to penetrate sandstone pores, or to become chemically or physically bonded into a stabilizing agent such as a silica skin, where a haematite motif may become almost indestructible. By comparison, all substances used as white pigments bond poorly with the support surface; they are among the most fugitive of all rock art paints. In many red-and-white bichrome traditions (Sahara, southern Africa, India, Kimberley in Australia), most or all of the white pigment has disappeared, leaving the ochre elements alone. Often the bichrome character is only apparent because of the consistent gaps in painted figures (Welch

1990). Where all traces of one pigment have disappeared, the former extent of the white (or other non-ochre) paintwork cannot be known. If the remnant of red figures is only a tiny fraction of the original art, or if red was reserved for certain types of figures, a 'style' defined by the remnant sample is misleading; it may well differ from that of another assemblage of the same tradition that had been subjected to different preservation conditions.

Many pertinent questions are raised by these considerations. Why are rock paintings most commonly reported in sandstone shelters, the world over? Is it because sandstone is particularly susceptible to processes of shelter formation, and because art in shelters has better chances of survival? Or is it because sandstone has better ochre retention abilities than other rocks? If so, does the statistical survival bias for ochre favour sandstone shelters as art sites, or do sandstone shelters favour ochre dominance in the surviving sample? The more one thinks of these possible sources of misinterpretation, the clearer it becomes that contradictions between individual interpreters of rock art may be attributable to selective emphases on taphonomically skewed samples.

Taphonomic effects of site location and environment

One of the most potent factors in distorting the 'archaeological record' of rock art is site location. Rock art in deep limestone caves, as it occurs, for example, in Franco-Cantabria, the Caribbean, Yucatán and southern Australia, is subject to environmental regimes and deterioration processes quite different from the open air. In general these are perhaps less selective, so there is a better chance of finding substantially complete assemblages, subject to less alteration. Yet the amount of rock art found in speleo-environments is minuscule. Taphonomy provides an answer to the old question why the distribution of Upper Palaeolithic rock art and portable art are different, by prompting us to rephrase it: why is the geographical distribution of a phenomenon that survived a certain set of selective processes different from that of another phenomenon subjected to a different set of such processes? The two sets of spatial information cannot be fully related to one another because they have been differently distorted by taphonomic factors.

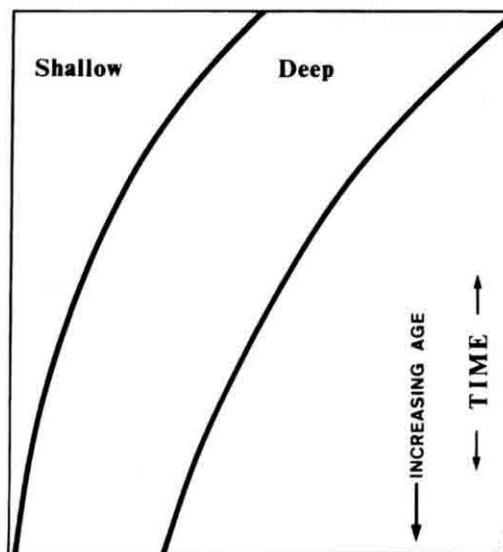


FIGURE 1. Schematic of relative taphonomic effects on deep and shallow petroglyphs as a function of time, in a population of initially equal proportions.

Upper Palaeolithic rock art is often described as a cave art: an entire mythology has been built around the idea that this art occurs in caves because it was produced only there, and location is intrinsic to it. Yet this art could not possibly have been endemic to caves. Its survival is clearly a function of location; not one of the motifs from the caves of Europe would have survived on limestone outside caves. It can only be a surviving small remnant of major art traditions: the number of anthropomorphic and zoomorphic figures from caves in France, Spain and Italy totals little more than 2188 (Leroi-Gourhan 1971), yet they were made over some 600 human generations. The number of works actually fashioned, reflecting the number of artists required per generation to maintain symbolic traditions, as well as the number produced by each artist, can be assumed to have been immensely greater (Bednarik 1986: 41).

'Cave arts' occur only in the caves of certain climatic, and possibly geological, regions — those lacking cryoclastic deposits post-dating the art. The caves of central Europe contain vast quantities of late Würmian *Frostbruchschutt* (Bednarik 1970). These periglacial deposits of angular detritus, derived from the cave walls by freezing and thawing, are lacking at the French and Spanish art sites. The same applies to other regions with 'cave art', notably in Aus-

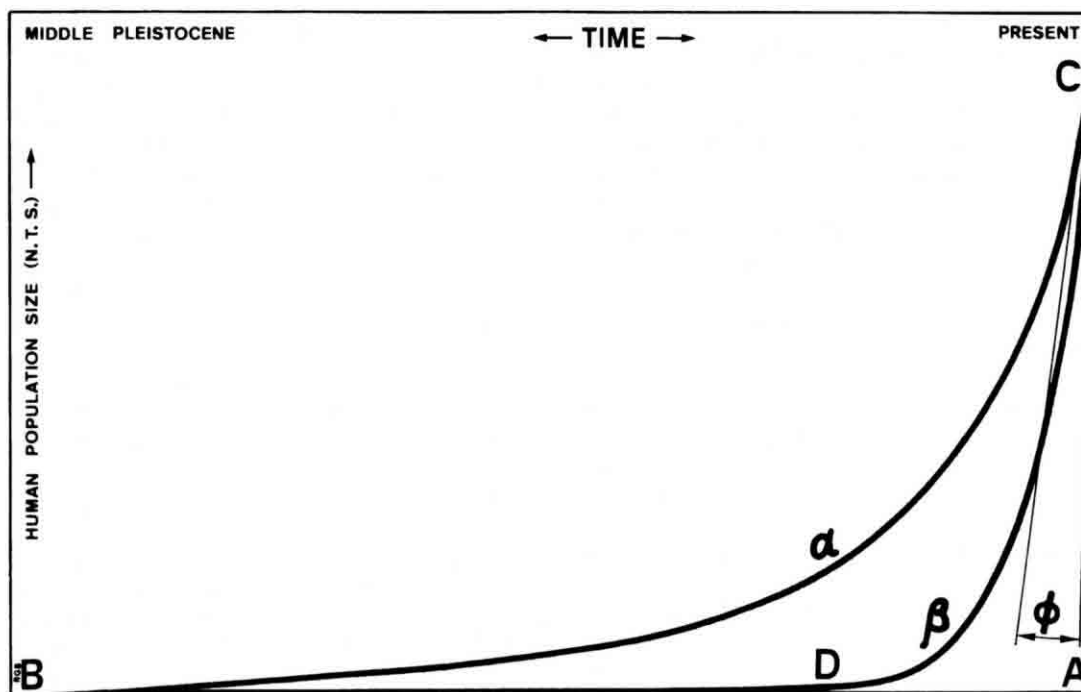


FIGURE 2. Principles of the relationship of produced art s_α (the area below α) to surviving art s_β (the area below β), being a function of angle ϕ .

tralia and the Caribbean. Some limestone facies are probably more susceptible to regelation than others (Schmid 1958: 16). The only Palaeolithic rock art discovered in central Europe (Hahn 1990) occurs on exfoliated clastics and was found by only the most observant of excavators.

Reasoning about the portable art finds of the Upper Palaeolithic has often been as futile. As distribution is again the outcome of complex preservation biases, all the spatial and compositional data have merely descriptive value. For instance, all but twelve of the 'female figurines' (Bednarik 1990a) consist of mineralized organic remains, notably calcium carbonate. All these figurines were found in high-pH sediments (either in loess, where the pH is determined by calcite and dolomite; or in limestone cave sediments), the only ones offering good conditions of survival (Bednarik 1992c). The figurines are found in pedological conditions conducive to their survival, and they are not found in conditions not favouring their survival! This correlation, hardly an unexpected finding, renders any contrived interpretations of what the distribution of this material implies

(in terms of culture, meaning, social role, ethnicity etc.) meaningless.

Taphonomy of the symbolic production of the Pleistocene

The most obvious characteristic of Pleistocene art is its profound incompleteness, its patchy occurrence. All extant regional corpora of early art are poorly connected, spatially as well as chronologically (Bednarik 1992d). A case in point is the earliest presently dated rock art in the world, the archaic linear petroglyphs of Australia (Bednarik 1992e). This tradition is thought to extend to the time of first colonization (Bednarik & You 1991; cf. Noble & Davidson 1991), and yet no trace has been found of a potential parent tradition in Southeast Asia. Indeed, our knowledge of Palaeolithic art in Asia consists almost entirely of isolated specimens and finds that are widely separated in both time and space (Bednarik 1992f; 1993). Much the same applies elsewhere; even in the more continuous record of Pleistocene Europe there are significant hiatuses. The model most compatible with the objective evidence at hand would emphasize discontinuity rather than coherence.

If it were not for the fact that some Palaeolithic people placed a minute fraction of their rock art production in limestone caves, we would have no idea that any Pleistocene rock art had ever been produced in Europe; the authenticity of the few known open air sites (Bahn 1985) would certainly not have been accepted (Bednarik 1992g). Evidence for symbolic behaviour in the Pleistocene is extremely patchy, available only where miraculous combinations of preservation conditions applied.

It would not be fair to disparage past empirical interpretation attempts of Pleistocene art without offering an alternative. Many of the problems are perhaps easiest to perceive if the concepts of total symbolic production versus surviving symbolic production are shown in a simplified graphic form (FIGURE 2).

In my graph, the ratio $r = \alpha : \beta$ on all ordinates must inevitably increase from right to left, beginning with $r = 1$ at A. It cannot decrease at any stage, even though the increase will progressively diminish from right to left, until β approaches the x-axis and the trend is reversed.

If we posit that an average of n number of symbolic artefacts were produced by every human since the advent of such artefacts, and if the total number of humans since then were p , the total production of symbolic artefacts produced (s_α) would be

$$s_\alpha = np \quad (1)$$

We know that only a small proportion of these artefacts (s_β) survived:

$$R\% = \frac{100 s_\beta}{s_\alpha} \text{ in } \% \quad (2)$$

Several points are immediately apparent from FIGURE 2. The ratio of produced art (s_α) to surviving art (s_β) expresses the effects of 'primary taphonomy'. This ratio R can be expressed as an integral function:

$$R = \frac{\lim_{\Delta x_\alpha \rightarrow 0} \sum_B^A f(x_\alpha) \Delta x_\alpha}{\lim_{\Delta x_\beta \rightarrow 0} \sum_B^A f(x_\beta) \Delta x_\beta} \quad (3)$$

The crucial factor determining this ratio is the

angle ϕ formed by the parabolic tangents \tan_α and \tan_β , immediately adjacent to C: so greater the angle, so greater the ratio R . The actual course of β is determined by a second factor, besides angle ϕ : as B is approached, the curve must run almost parallel to the abscissa, because the population remaining at that age would be approaching equilibrium status within its environment, i.e. very little further loss is conceivable (Bednarik 1990b), and the probability of survival can never be nil.

Two quantitative approaches are now possible. Firstly, we can estimate the initial loss rate from the observation of recent trends or from qualified assumptions and thus tentatively determine ϕ . (It is obvious that \tan_β is likely to be almost parallel to the ordinate.) Secondly, if we make the reasonable assumption that the extant record is an accurate reflection of the symbolic production that has actually survived (an assumption that is not beyond taphonomic criticism, but is nevertheless much more sound than conventional archaeological deduction), we see that the point D, at which β approaches the x-axis without reaching it, perhaps represents the final Pleistocene. This would suffice to determine the approximate time at which the production of symbolic artefacts must have commenced in order to have resulted in the extant record (ignoring here the paucity of empirical data required for actual quantification).

Bednarik (1992h) constructs a speculative curve β for a different purpose, using current information and 'educated guesswork' tentatively to apportion rock art to age groups. Even the most imprecise attempt at quantifying taphonomic logic as presented here underlines the *validity* of the postulate that 'art' production began long before the period that provides the first well-represented traditions, the Upper Palaeolithic. The model demands that we should be looking for such evidence in Middle and even Lower Palaeolithic contexts, where it should exist, albeit in exceedingly small numbers (Bednarik 1992i). This does not suggest that every claim made of such finds is valid, but it should remind us to examine such claims more objectively than has often been the case in the past. The notion that art began at the time from which the first frequent and consistent evidence of it is available is illogical: it is equivalent to ignoring the cumulative taphonomic effects on palaeoart.

Finally, the model presented here shows that the intractable problem of the taphonomy of

palaeoart is not beyond quantitative approach, and that it can be addressed logically.

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