Studies in Speleology, Volume 9, pp. 51-70, 1994.

WALL MARKINGS OF THE CAVE BEAR

ROBERT G. BEDNARIK
International Federation of Rock Art Organizations

SUMMARY

Scratch markings of the cave bear occur frequently in the caves of much of Europe. They are examined and discussed, together with the distribution and habits of this Pleistocene animal, and within the overall context of the natural markings generally found in caves. The question of the interaction between the species and its human contemporaries is discussed, and particular attention is given to the co-occurrence of cave bear scratches and human wall markings in caves, and to the misidentification of both by archaeologists. A few of the many sites examined are considered as case studies, and a survey of morphological aspects, spatial distribution and statistical features of the cave bear marks leads to the definition of seven possible classes of such wall markings.

INTRODUCTION

Practically all caves in the world contain some form of wall markings. On a number of islands, such as those of New Zealand, obvious faunal limitations until the most recent past mean that animal scratch marks, notably those of mammals, are lacking. It should be noted from the outset that, among the many types of wall markings found in caves, animal scratches of mammalian species are by far the most common (Bednarik, 1991). Cave markings would seem to be of considerable significance to the archaeologist, the zoologist, the geomorphologist, the palaeontologist and a variety of other specialists. For instance, if the markings can be demonstrated to have been made by humans, they would be of interest to the semiotician, the rock art researcher, the epistemologist, the psychologist and so forth. Incredibly, no comprehensive studies of this subject have been undertaken, and the only reasonably detailed examination of parietal animal scratches dates from 1931, is in German (and not widely known) and deals largely with one species only (Bachofen-Echt, 1931). Despite this massive hiatus of knowledge, decisions about the meaning of doubtful cave markings have been made by archaeologists on many occasions. Not surprisingly, there have been countless misidentifications of cave markings, in all parts of the world (cf. Bednarik, 1991). Natural marks, such as animal scratch marks, 'geological' marks or taphonomic marks, on rock surfaces as well as on various portable objects, have been interpreted as intentional engravings made by humans, while other archaeologists have described intentional engravings as incidental products of utilitarian activities or as natural markings of some type. There are even instances of markings that were clearly produced with modern steel tools which have been published as 'prehistoric', for instance in Australia. I derive no satisfaction from exposing the details of this disturbing state of affairs, and therefore refrain categorically from citing specific instances, but there are hundreds known to me in the literature and from personal experience, some of which I have listed in earlier publications. The entire subject is one requiring considerably greater knowledge than has hitherto been applied to the task, and archaeologists, specifically, need to acquire such knowledge if they wish to attempt the identification of doubtful rock marks.

One of the difficulties to contend with is that such cave marks tend to be subjected to a great variety of alteration phenomena over time, of both biospheric and atmospheric nature. Speleologists tend to be more familiar with these alteration processes than archaeologists, but the latter rarely consult the former on these issues. A cave is rather like an organism, experiencing a birth, life and death in its history, and one might compare the cave wall to the skin of an organism: it bears the traces of many life experiences, while other traces have disappeared, or their scars have been so distorted over time that they become almost unrecognizable. For instance, finger flutings on soft speleothem (called moonmilk in English, and in Europe *Monmilch* [by Gesner in 1555], *Montmilch, Mondmilch, Bergmilch, Nix* and *Galmei*) are often so altered that they are almost unrecognisable, and would be rejected by

many archaeologists. This is because the speleothem can be subjected to one or more of a number of processes subsequent to being marked by humans (Bednarik, 1986a), and the finger flutings, which have so far been found in France, Spain, Australia and Papua-New Guinea, may be beyond recognition. The same may apply to other types of cave markings.

All secondary cave markings (i.e. those not related to some inherent characteristic of the rock support) are a type of response of lithospheric materials to conditions determined by speleo-atmosphere, hydrosphere or biosphere. In order to determine whether a doubtful marking can be of human 'cultural' origin, one needs effectively to negate any possible 'natural' origin. As I have observed before, this is not a task for which archaeologists are qualified (Bednarik, 1991). There is a wide range of natural wall markings to be found in caves, the most common being animal scratch marks, and among them those of bats are by far the most numerous. They occur in almost all caves, and while they are usually very faint, they are of such ubiquity that they sometimes allow the student of Palaeolithic petroglyphs in caves to distinguish different art traditions from the amount of wear by airborne bats. Generally speaking, scratch marks of larger animals are most common in Australian caves, but they can be found in most other parts of the world. Claw marks are the most common, but parietal markings of tusks (elephants in Kenya), antlers, horns, wings (particularly of primaries of birds near their nesting sites) are also widely distributed, and numerous species have polished cave walls with their bodies. Many mammals entered caves involuntarily and produced wall markings in their attempts to escape confinement, and I have considered the behaviour of various mammals in such predicaments (Bednarik, 1991: 31-33), as deduced from my palaeontological studies in various continents. Finally, markings of many non-vertebrate origins occur in most caves of the world, and their effective identification is again a specialist task. One of the problems facing the archaeologist interpreter is that, in a sense, agents causing non-cultural cave marks are far from random in their effects. The production of such marks follows certain rules, even if they are merely cryoturbation marks, or grooves on limestone that are the result of mycorrhizal associations of bacteria and fungi in the root systems of plants. Therefore one must expect certain classes of regularities which may lead to repetition of certain visual characteristics. Archaeologists, who are only conducting simple eye-ball inspection of the evidence and in most cases have no understanding of the complex processes involved, may perceive such repetitive patterns as evidence of human intent, thus identifying even markings caused by plants or by speleomorphological processes (e.g. clastic adjustment) as having been made intentionally by humans.

THE CAVE BEAR IN SPACE AND TIME

Out of the great variety of natural and human cave markings I have studied in the caves of most continents (355 caves in Australia alone), I select here just one type for detailed assessment: the parietal markings of the cave bear (*Ursus spelaeus* Rosenmüller and Heinroth). This is probably the palaeontologically best known species of central Europe. Its remains have been found in vast numbers in numerous caves, and details deducible from skeletal remains (physiological, pathological) had been so thoroughly studied by the early part of this century that it was better known than its human contemporaries. Among the animal claw marks of European caves, those of the cave bear are by far the most prominent, and they are the principal subject of this paper. In order to assist archaeologists in distinguishing them from human engravings in caves I shall describe them, and the circumstances surrounding their production and survival. After all, the question of distinguishing animal markings from cave petroglyphs, which has been studied most extensively in Australia, is of renewed interest in Europe, in view of the (genuine) Palaeolithic engravings recently found in southern Germany which resemble animal scratches (at Hohler Fels; Hahn, 1990; Bednarik, 1992a) and which were located on *Bärenschliffe* (the panels of polished wall surfaces produced by cave bears). It is also of concern that there are many engravings in western European caves which should be considered to be bear scratches rather than petroglyphs.

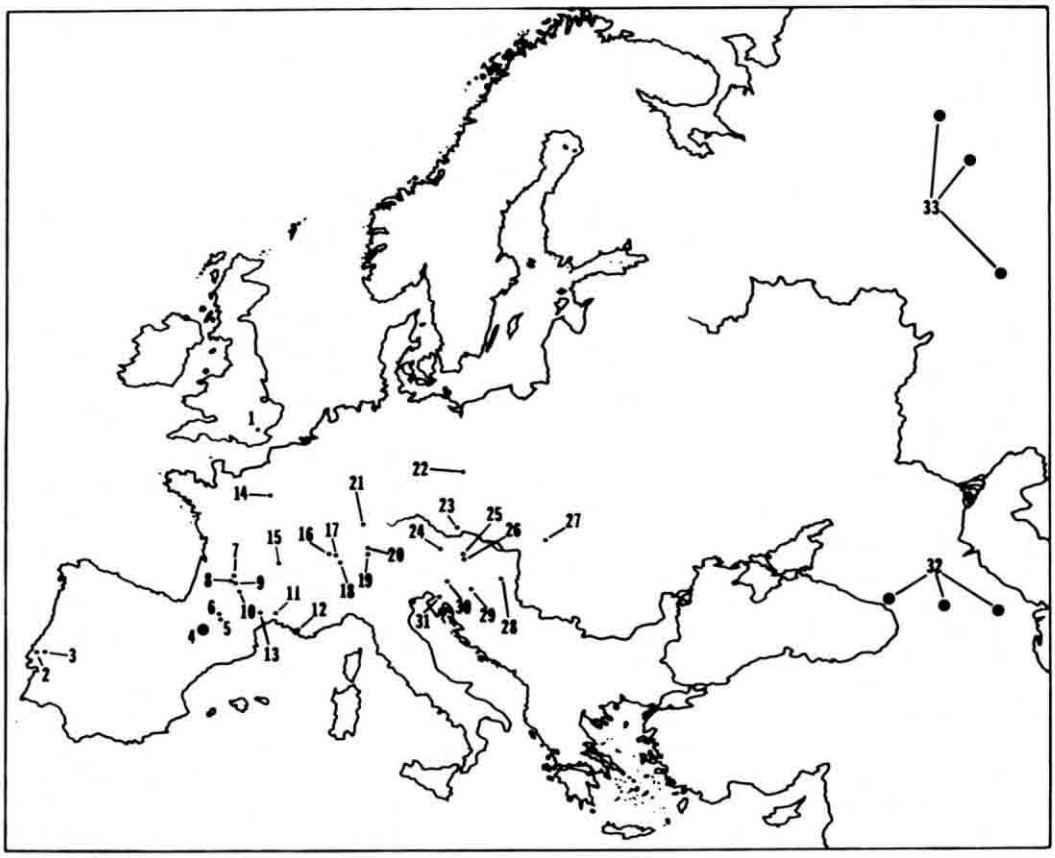
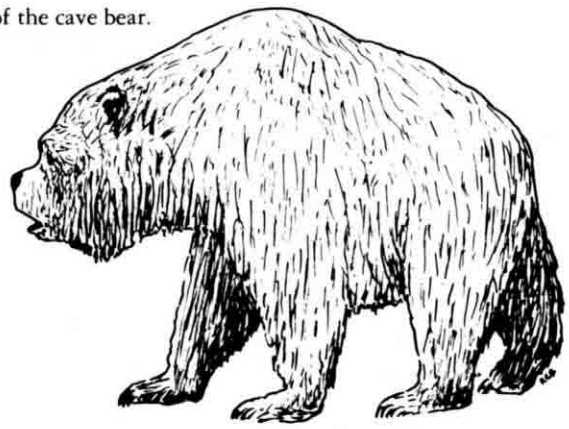


Fig. 1. European sites and regions mentioned in the text:
1—Swanscombe; 2—Furninha; 3—Salemas; 4—Pyrenees; 5—Montespan; 6—Le Trois Frères; 7—Rouffignac; 8—Bara Bahau; 9—Grotte des Endrevies; 10—Pech Merle; 11—Baume Latrone; 12—Cosquer Cave; 13—Aldéne; 14—Paris; 15—Furtins; 16—Cotencher; 17—Saint Brais I-II; 18—Chilchli Cave, Ranggiloch, Schnurenloch; 19—Drachenloch; 20—Wildkirchli, Wildenmannlisloch; 21—Hohler Fels; 22—Reyersdorfer Cave; 23—Gudenus Cave; 24—Salzofen Cave; 25—Drachenhöhle; 26—Repolust Cave, Kugelstein Cave II, Grosse Badl Cave; 27—Kölyuk Cave, Istállóskö Cave, Hillebrand Jenö Cave; 28—Homoródalmáser Cave; 29—Veternica Cave; 30—Potocka zijalka, Mornova Cave; 31—Rotes Feld Cave, Crni kal Cave; 32—Caucasus; 33—Urals

The cave bear's range included, at some stage between the Mindel-Günz interstadial and the early Holocene, much of Europe from Portugal to Russia (Fig. 1). However, the distribution map of Koby and Schaefer (1960) is not accurate. For instance, it ignores the widespread occurrence of the species in Russia, with over sixty sites in the Urals and Caucasus alone. The map ignores the Russian finds in the Cantabrian Mousterian, the Portuguese finds (at Furninha and Salemas), those in central Spain, the numerous sites in southern Italy, while on the other hand the map shows all of France to have been occupied by the species when in fact there are no reliable finds from the entire northern half of the country, with one doubtful find in the Paris alluvium from 1925. Also, in claiming the presence of the animal in Britain it should be remembered that there appear to be no confirmed finds from the Würm, and that most of the bear remains described in Britain as *U. spelaeus* are in fact *U. arctos, U. taubachensis, U. deningeri* or *U. savini*. The two finds from Swanscombe, which Kurtén (1959) insists are of *U. spelaeus*, are of the penultimate interglacial.

Fig. 2. Reconstruction of the cave bear.



In contrast to other carnivores, the feeding habits of the cave bear (Fig. 2) were almost exclusively vegetarian. Its dental wear patterns suggest that grass was the staple component of its diet (Ehrenberg, 1962), an overspecialization which apparently contributed to the animal's extinction (Vértes, 1959: 153) soon after the end of the Pleistocene. It seems to have been common for this species to die during hibernation, and the caves once frequented by it now contain the remains of many individuals, numbering tens of thousands at some localities. These often very large caves also contain massive quantities of chiropterit, a phosphate-rich sediment formed largely by bear faeces, decomposing carcases and bat guano. In some regions, virtually every cave of suitable dimensions appears to have been occupied by the cave bear, from elevations of up to 2500 m above sea level. In some of them, skeletal remains of specimens between the ages of three to nine months are conspicuously absent, a circumstance suggesting that the caves were only used during the winter half of the year (Ehrenberg, 1951: 99). Furthermore, the sites located at high altitudes could only have been occupied during a mesocratic climate oscillation, which is why many researchers have equated such occupants with the last interglacial. This also applies to occupations of the sites by the mysterious 'cave bear hunters', Palaeolithic people who are said to have stalked this formidable beast in its hibernation haunts, but whose cultural and racial affiliations remain unclear. Together with the geochronological position of their 'Alpine Palaeolithic' tradition these issues are among the most enigmatic in European Palaeolithic research.

Bächler (1940) first identified the Alpine Palaeolithic in Switzerland, describing deposits of bear remains (particularly skulls) in vaults constructed of rock slabs. Numerous European caves have yielded deposits of human occupation that have a number of characteristics in common: they are embedded in large deposits of cave bear remains which are, practically without exception, fractured. Lithic implements are very scarce, and are fashioned from poor quartz and quartzites in most cases; bones and teeth have been claimed to have been used extensively for tool manufacture; sites occur commonly at high elevations and in very mountainous terrain; and many sites are believed to provide evidence of some form of bear cult.

Since Bächler's industry had been assigned to the Mousterian of the last interglacial, there was a tendency to attribute every similar discovery also to the Neanderthals. The objections of various writers (Hilber, 1922; Bayer, 1929a; Adametz, 1933; Zotz, 1944) went unheeded for many decades, and the correct antiquity of many of these sites has been accepted either with great reluctance, or remains controversial. Austrian prehistorians, in particular, have been characteristically obstinate in their refusal to accept that the Göttweig, or Würm I/II interstadial, approached optimum climatic conditions comparable to those of the Holocene. For instance, Pittioni (1957) conceded this only in the face of overwhelming evidence, thus

abandoning by implication most of his chronology of the Austrian Palaeolithic three years after its publication (Pittioni, 1954). A site's high altitude in the European Alps does not necessarily indicate an interglacial antiquity for its occupation evidence (see Schmid, 1963 concerning the snow and forest limits during the Würm stadials). Most of these sites had been dated purely on the basis of faunal evidence, sometimes supplemented by the identification of tree species from charcoal, a situation that persists widely in Austria to the present time (Bednarik, 1990). Yet a perusal of the faunas of all eastern Alpine Palaeolithic stations reveals no typical pre-Würmian elements, with the possible exception of a few sites, such as Repolust Cave, Kugelstein Cave II and Badl Cave, all in Styria and only a short walk apart. These reservations are widely accepted today, and such prominent sites as Potocka zijalka, Drachenhöhle and Salzofen (Bayer, 1929b) are almost universally acknowledged as belonging to the Upper Palaeolithic. Nevertheless, this does not prevent the continued propagation of earlier misrepresentations (and the frequent *faux pas* of confusing Drachenloch and Drachenhöhle) in popular publications, even in those written by supposedly competent archaeologists (e.g. Neugebauer and Simperl, 1979).

Both the hypothetical 'osteal culture' and the bear cult have been the subject of much contention, perhaps the most prominent objections being raised by Bayer (1930), Koby (1953), Cramer (1941) and Jéquier (1975). While there is no objective support for the '*Protolithikum*', the hypothetical industry based on bone tools (this excludes of course such bona fide artefacts as the Lautsch point), some of the evidence for 'ceremonial' deposition of bear remains is so pervasive that it should be re-examined. At least in some instances it is difficult to brush aside all aspects of the reports as being merely the result of wishful thinking. Among these might be Drachenloch (Bächler, 1940), Reyersdorfer Cave (Zotz, 1939), and especially Veternica Cave (Malez, 1956, 1958). The 'cave bear hunters' have also been credited with the earliest musical instruments (at Istállóskö and Potocka; see Horusitzky, 1955; Bayer, 1929b: 84; Zotz, 1944: 25), an early form of needle, and technological innovations such as the drilling of bone and teeth (which is doubtful now in view of G. Rabeder's recent claims regarding the chronology of Repolust Cave, cf. Bednarik, 1992b: 34). However, many aspects of the 'Alpine Palaeolithic' remain contentious, and this 'industry' may in fact indicate local or seasonal adaptations of various peoples which are of quite diverse chronological, technological and ethnic affiliations (a possibility originally propounded by L. Zotz). While in the western Alps these were claimed to be with the Mousterian (Bächler, 1940; confirmed by Schmid, 1958; but questioned by Bayer, 1924; 1928: 5; and Zotz, 1951: 121), they appear to be with Aurignacoid cultures (the Olschewian) or the Szeletian at most of the sites in the eastern Alps (Bayer, 1929a, 1929b; Zotz, 1944: 35; Brodar, 1957: 151; Ehrenberg, 1959: 23; Movius, 1960: 361; Mottl, 1950a, 1950b, 1950c, 1951; Murban and Mottl, 1955; Bednarik, 1989).

Bächler's (1940) dating of his Swiss sites to the Riss/Würm interglacial has only been rendered possible for the Drachenloch, where layer 3 has provided a radiocarbon date of older than 49,000 years b.p. (Andrist et al., 1964), and it may still be valid for Wildkirchli (Tschumi, 1949). However, in the Schnurenloch, Wildenmannlisloch and Chilchli Cave, the occupation strata have been re-assigned to the Würm by pollen and radiocarbon dating, while layer 3 in Ranggiloch, attributed by Schmid (1958) to the interglacial, yielded a radiocarbon date of only 9,500 b.p. Similarly the supposedly interglacial occupation layer of the Austrian Salzofen Cave provided a radiocarbon date of only about 34,000 years b.p. (Movius, 1960: 361), which in this part of Europe is of the Upper Palaeolithic. Of the many cave bear sites in the eastern Alps that contain evidence of human occupation, only three seem to warrant consideration as pre-Würmian occupation sites: Repolust, Grosse Badl Cave and Kugelstein Cave II. Only one Austrian site, the Gudenus Cave, yielded conclusive Lower Palaeolithic evidence, from its lowest of four major human occupation phases, a handaxe-dominated Acheulian (Bednarik, 1992b), but it contained no typical 'Alpine Palaeolithic' horizon and is located in lowland, north of the Danube. Interestingly, it is also one of very few central European Palaeolithic cave sites that is not located in a karst region. In considering the distribution of the 'Alpine

Palaeolithic' and of the large cave bear sites with their enormous quantities of skeletal remains, it is self-evident that it coincides significantly with the extent of limestone karsts across Europe. This phenomenon has been widely neglected by palaeontologists as well as archaeologists. Taphonomic reasoning would lead to two arguments of relevance:

(1) If a class of remains is found in environmental conditions that are conducive to their survival, but not in environmental conditions that are not, then it is highly probable that the extant record is a result of environmental conditions (high sedimentary pH, sheltered location, focal archaeological locality are all taphonomic selection criteria; Bednarik, 1993) and not of former distribution of the class of remains. In other words, both cave bears and the type of human behaviour that has been linked with them were probably distributed beyond limestone karsts, but only the karsts provided suitable conditions of preservation, combined with a likelihood of discovery.

(2) Such selective survival and reporting of evidence is also likely to lead to the creation of biased ethological models: it may create the illusion that cave bears generally hibernated in caves, even that they frequently died in caves.

While the first proposition, which questions distributional data, can only be tested by theoretical argument (but is logically convincing), the second can be tested by examining specific aspects of the data. If cave bears died mostly in the caves, there should be distinct statistical patterns in the sexual and age characteristics of the remains, otherwise we must assume that there were selective processes at work. Similarly, there would be representation of warm and cold climate oscillations commensurate with their durations. Neither indicator is what it should then be in most caves, which suggests that there has been very considerable variability in the behaviour of the animal, and that taphonomy has selected heavily in favour of cave-related behavioural evidence.

ABOUT THE CAVE BEAR AND THE CAVE BEAR HUNTERS

Koby (1951), a principal opponent of both the concepts of cave bear hunt and cult, propounded the argument that the paucity of bear representations in Pleistocene art relative to other species refutes a systematic hunt of the bear by Palaeolithic people, for which '*on n'a pas des preuves certaines*' (Koby, 1951). This view invites several comments:

(a) Charred and smashed cave bear bones have been recorded at numerous cave hearths, and worked bones and teeth of this species have been found in ample quantities. Although the adult animal would have been a formidable quarry, it may have been easy prey during its hibernation, in a season when other game may have been hard to hunt and when the cave bear would have been fattened. It seems very likely that humans would have taken advantage of this comparatively reliable protein source, harvesting it annually.

(b) Whilst bears are, admittedly, not among the most common subjects of the Palaeolithic artists, they are not quite as neglected as Koby proposed. Of the identifiable mammals in Europe's parietal art listed by Leroi-Gourhan (1971: 463), 1.75% are in fact bears — a proportion exceeding, amongst others, that of the woolly rhinoceros, lion and megaloceros, and exceeded only by the mammoth, *Bovidae*, horse, ibex and *Cervidae*, the principal quarries of these hunters. However, on portable art objects of the western European Upper Palaeolithic, the bear accounts for 7.4% of all identifiable mammal representations.

(c) During some twenty millennia of European Palaeolithic art there were several distinctive traditions, cultures or peoples that practised forms of artistic expression of which some have survived as Upper Palaeolithic art. The total number or proportion of illustrations of a particular subject are of little scientific importance, as they may have been determined by any number of taphonomic (in the widest possible sense) factors. Moreover, cultural association of most rock art depictions of bears is only tentative, most specimens are

undated now that stylistic and simplistic archaeological dating of this art corpus is no longer accepted (Bednarik, 1992b).

(d) There is no evidence that the cave bear hunters practised iconographic art (cf. Ehrenberg, 1954: 58), and since some of them were of the late Middle Palaeolithic rather than the earliest Upper Palaeolithic (which began considerably earlier in central Europe than in parts of western Europe) it is most unlikely that they produced such art. Hence Koby's argument on the basis of frequency of depiction is hardly relevant. It is more relevant that not even the most representative sites of the Olschewian have yielded any single hint of an iconographic tradition, nor have any of the Szeletian sites of central Europe, or any other 'Aurignacoid' traditions prior to 32,000 b.p., the age of the sophisticated tradition of sculptures in southern Germany and Austria (Hahn, 1971; Marshack, 1985; Bednarik, 1989).

(e) Complete lack of bear depictions during a particular phase of parietal art would not necessarily constitute conclusive evidence that the animal was not hunted by the people concerned; for example, a taboo may have prohibited its representation. Historical accounts of bear cult rituals and ethnographic evidence of such a cult are available from many parts of Eurasia (Vértes, 1959: 165; Hallowell, 1926; Wüst, 1956), and a salient aspect of these cults is usually an inhibitive element, such as a prohibition on the bear's name. Other common features of these recent bear cults include ritual killing and eating, deposition of the head and other parts of the body, and assumption of a blood relationship of the bear to people, or to a particular moiety. While such ethnological evidence must not be applied to Pleistocene evidence, it does illustrate that simple explanations may not do justice to complex cultural phenomena. Moreover, as Bahn (1991) has argued, the role of Palaeolithic art in depicting subjects connected to the hunt may have been over-emphasized, and I would argue that it is not rational to assume that this art was a Palaeolithic 'shopping list' for food, and to see proportional species representation as indicating hunting preferences. Otherwise we would have to expect a far greater number of depictions of fish, fowl and vegetable foods, and an absence of species that are unlikely to have been food sources.

(f) The find of a hornfels flake embedded in the *os frontale* of a cave bear skull in the Rotes Feld Cave near Triest (Zotz, 1951: 120) seems to provide conclusive evidence that the animal had a traumatic experience with humans.

Neither the Palaeolithic art of Europe nor the archaeological record provide support for Koby's view. On the other hand, objective support for cave bear hunting is also modest. Two adjacent petroglyphs at Les Trois Frères (Bégouën and Breuil, 1958) appear to depict bears lying on their sides, with marks at their muzzles that may (or may not) depict an issuance, and their bodies pierced with numerous holes and covered with arrow-like marks. H. Bégouën (pers. comm. to L. Zotz, see Ehrenberg, 1954: 48) reported cave bear skulls from the site which appeared to be intentionally deposited. The near-life size clay model of a bear in the Galerie Casteret, 300 m deep in Montespan Cave (Trombe and Dubuc, 1946: 45-6), is punctured with forty-one holes. At Pech Merle (Lemozi, 1929), 15 m from the entry to the main gallery, is a petroglyph of a well-detailed bear head with two lines crossing the neck in a manner suggesting severance of the head. However, none of these and other examples provide conclusive evidence, at best they are suggestive.

Evidence offered in support for a bear cult includes the striking positioning of ten bear skulls in the Caverne des Furtins, France (Leroi-Gourhan, 1950), and similar finds in the Hungarian caves Homoródalmáser, Istállóskö, (Vértes, 1951, 1955) and Kölyuk Caves (Vértes, 1959: 160-2); in the Salzofen Cave, Austria (Ehrenberg, 1951, 1953a, 1953b, 1954, 1956, 1957, 1958, 1959; Trimmel, 1950; Schmid, 1957) and in Mornova Cave, Slovenia (Brodar, 1957: 154-5; Zotz, 1944: 29), in addition to suspected depositions at other localities already mentioned above.

CAVE BEAR CLAW MARKS

Of more interest than the inconclusive arguments about the bear cult are, at least in the present context, the instances of a potential relationship between bear claw marks and non-iconic, parallel humanly made markings. Les Trois Frères is part of a major cave system that also includes Tuc d'Audoubert and Enlène Cave (Bégouën, 1936). A former bear lair, it contains both claw marks and humanly-made 'meanders' (near the end of the Galerie aurignacienne, over 200 m from the entrance). In the huge cavern of Aldéne, in a minor passage 300 m from the entrance, are a few incisions of animal profiles adjacent to cave bear claw marks. One clearly represents a bear (although *Ursus arctos*, it seems to me), most of the others could be either bears or lions. Some are virtually superimposed over the deep claw marks.

Cave bear markings extend literally for kilometres along the walls of the long galleries in Rouffignac (Nougier and Robert, 1959). Occasionally, engraved designs can be identified among them, such as the head of a cave bear at the left-hand Galerie Breuil, over 600 m from the entrance. Elaborate finger meanders of the macaroni style (Bednarik, 1986a) are occasionally associated with evolved animal drawings. In all, finger line compositions occur at nine localities in Rouffignac, particularly in the Galerie latérale, on the Plafond rouge and in the extensive panel of Plafond peint. The claw marks of cave bears occur again adjacent to finger flutings.

In Bara Bahau (Glory, 1956), claw marks and finger flutings are interwoven to such a degree that close examination is required to distinguish between them. The finger lines belong to the earliest 'style' I have identified (Bednarik, 1986a) and are probably not contemporary with the eighteen animal engravings, or even with the mining evidence discovered among them (Bednarik, 1986b). At Baume Latrone (Bégouën, 1941; Drouot, 1953; Bednarik, 1986a), a particularly prominent panel of cave bear markings is located on the western wall just before the Salle Bégouën is entered, and others are found at various locations in this large cave system (Plate I). Immediate superimposition of finger lines over bear scratches occurs within the

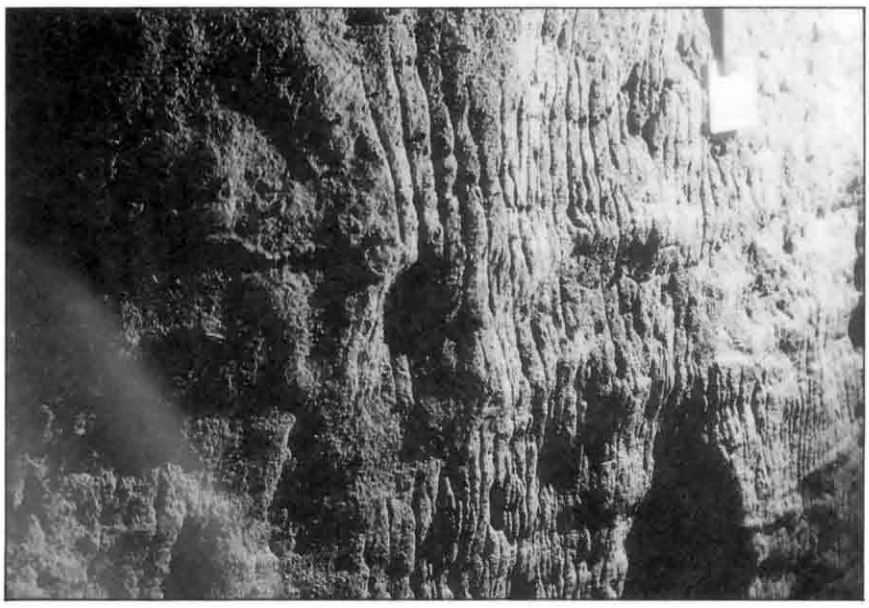


Plate I. Long vertical cave bear scratches, Baume Latrone, France.

Salle itself, and the animal figures engraved over the finger flutings are significantly younger. A very similar chronological and stylistic sequence is found in the recently discovered Cosquer Cave, where the finger flutings have been shown to be around 27-28,000 years old (Clottes et al., 1992). Bear scratches are common in Montespan, for example at the northern end of the Galerie Trombe-Dubuc, and at several localities in the first half of the Galerie Casteret, supposedly the scene of some form of bear ritual. In the latter passage, finger marks also occur in close vicinity to bear claw scratches. There are many more instances of rock art having been superimposed over claw marks, contrary to a recent claim by Smith (1922: 74) that 'Out of millions of scratch marks that cave bears put on the walls, not one of the signs or icons cuts through these marks'. Smith, in his 'unfortunate attempt at theory construction' (these are his own words in misjudging others' work), cites his fallacy to support his vacuous claim that 'The artists might have been acknowledging or seeking powers of the bears by avoiding any interference with their scratches'.

Although there has been some speculation in European literature on the significance or purpose of the ursine cave markings, agreement seems lacking. Most theorizing in this area has remained somewhat cursory, a frequent explanation being that they were caused by the bears' rambling about in the dark, or by their attempts to surmount obstacles. It should be emphasized that there are in fact two basic types of parietal cave bear markings. The *Bärenschliffe* are panels of polished rock surface, on cave walls and on the sides of large boulders, typically between 0.4 and 1.4 m from the floor. They are found at narrow passages, indicating the route of paths once used by generations upon generations of cave bears. As their bodies rubbed against the rock, the sand and silt embedded in their shaggy fur acted as an abrasive, gradually smoothing the rock face (Bachofen-Echt, 1931: 712-4).

The second type of marks left by the bears, the claw marks, cannot be interpreted so readily. Ehrenberg (1954) has demonstrated that the claw marks in the caves of the eastern Alps are of an average spacing exceeding by about one third that which *Ursus arctos*, the brown bear, would produce. Since *Ursus spelaeus* was by about one third larger than its surviving cousin, and since its remains account for up to 99% of osteal remains in some of the caves concerned (e.g. Wildkirchli, Wildenmannlisloch, Saint Brais I-II, Drachenloch, Drachenhöhle, Potocka zijalka; see Bächler, 1940; Kyrle, 1931; 854; Tschumi, 1949; Cramer, 1941; Ehrenberg, 1951; Rakovec, 1967), at Chilchli Cave the proportion is 98% (Andrist et al., 1964), and at Cotencher, Schnurenloch and Crni kal Cave it is 95% (Stehlin and Dubois, 1916; Malez, 1965), we can reasonably infer that the claw marks were executed by the cave bear.

THE DRACHENHÖHLE RE-VISITED

However, the animal's motivation remains a subject of conjecture. The most plausible and comprehensive arguments advanced that I know of are those of Bachofen-Echt (1931), who discusses the animal markings in the Drachenhöhle. Some 250,000 kilograms of cave bear bones have been excavated in this huge cave. The numerous claw marks, their locations and their arrangements are quite instructive. Bachofen contrasts the quiet and cautious manner of movement typical for bears, the rather stealthy fashion of their bearing if they are not aroused, with the considerable force used to produce the deep incisions in the limestone walls. He observes that some of the concentrations of marks occur at points along the pathways which would be ideally suited for traps, that curved marks in such localities are suggestive of restricted movement (Fig. 3) and, perhaps most significantly that, typically, bear skulls show damage of the zygomatic bone (the animals' most vulnerable point of the facial architecture) of a nature that appears to indicate that the mortal blow was always received from the left and from a position behind its head (Tasnádi-Kubacska, 1936: 104-7). This recurrent type of injury would imply that the animals were restrained in a noose, as it would not seem plausible

otherwise that the victims could have been struck with such precision, and with the required considerable force — unless, of course, they were killed while hibernating. Bachofen considers the paw marks to be evidence of violent struggles as the snared, powerful beasts tried to free themselves.

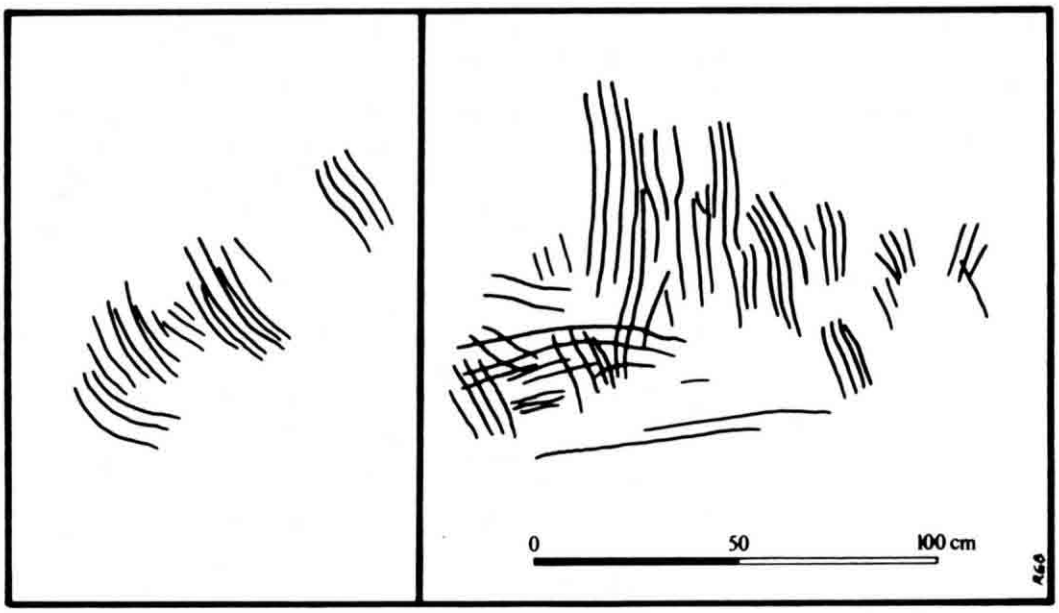


Fig. 3. Two examples of cave bear scratches from the Drachenhöhle, near Mixnitz, Styria, Austria. Both are from the east wall, third rockfall. The curved and horizontal sets are thought to be by animals that were restricted in their movement.

Such a hunting strategy would have been by far the most attractive to the hunters concerned (although illustrators of popular books and film makers might find other versions of such encounters more agreeable, in which Palaeolithic heroes, brandishing spears and stone daggers, wrestled with the massive beasts): narrow points along the well-worn bear paths offered excellent oportunities for anchoring the ropes to boulders and rock formations, the noose could be positioned with great precision, and it was invisible to the victim. The physical risks would have been minimal to the hunters concerned who can safely be assumed to have possessed the necessary technological skills. We know from ethnography that all recent hunting and foraging peoples were extremely well attuned to the food resources available at different times and places, and planned their seasonal movements largely around this knowledge. We have no reason to assume that Palaeolithic peoples did not have such strategies, and did not exploit such a secure seasonal food resource as the fattened and drowsy cave bears.

Bachofen (1931: 715) considers also two other potential interpretations of the claw marks. Mating excitement in contemporary bear species, which may result in heavy paw blows to nearby trees, is one of them, the other is fighting between males. In reference to the second point it is relevant that it has been suggested (Kurtén, 1968: 125) that instances of healed fractures of the *os penis* of cave bears are the result of combat between rival males.

My own several investigations of the Drachenhöhle (over twenty years, from 1962 to 1981) have led me to view Bachofen's hypothesis as rather convincing with respect to some, but not all of the marks. Very broadly speaking, I have found several distinctive types at this site, and at the almost fifty other caves with bear scratches which I have studied. The first is

characterized by concentrations of irregular sets which may include horizontal or oblique marks, and curved sets. They may well indicate some sort of a struggle. Other sets occur more or less in isolation, or in only small groups, and are frequently rather short. In a few cases it could reasonably be suggested that marks are incidental to the activities of a bear preparing its lair. Straight, usually long (often over 50 cm in length), vertical sets that seem to be executed with an even pressure are found in some locations. Where the floor level appears to have remained unchanged, these marks reach to well over 2 m height, and their upper limit would coincide with the maximum vertical reach of the largest specimens. This mode commonly occurs in conspicuous concentrations in which different individuals are clearly represented. In heavily frequented caves, such as Rouffignac, these parallel vertical markings may be of such lateral extent that they form a virtual horizon along the wall, reliably indicating the contour of the floor at the time of the cave bear occupation, sometimes over great distances; wherever a rockfall has since occurred, this band approaches the floor, or may even disappear beneath it, only to re-appear after some further distance.

Bachofen ignores the possibility that the bear markings could be the result of attempts to overcome obstacles, by individuals unfamiliar with the terrain. The polished paths do indeed convey the subjective impression that the ursine inhabitants moved about confidently in the dark, presumably possessing a sense orientation acquired by memorization or by inheritance. This would not appear to preclude, however, the possibility that individuals, perhaps under the stress of being pursued, lost their bearings and attempted to clamber up any obstructing barrier. Arrangement and location of some marks does intimate this, but I agree with Bachofen insofar as I consider this interpretation unconvincing for most of the markings. My view is based primarily on the distribution of the scratch marks relative to topographical features of a cave, such as the configuration of passages, projections and recesses. Had the marks been produced by bears trying to negotiate obstacles in cave systems with which they were unfamiliar, these marks would occur in large numbers at appropriate localities: near the terminal portions of passages, in recesses promising further advance, at wall formations offering prospects of an ascent. How well do observed distribution patterns of the markings actually correspond with these suggestions?

A CASE STUDY IN THE DORDOGNE

Grotte des Endrevies is selected as a case study here for two reasons. Firstly, this cave has remained unpublished, despite its location in the very heart of the 'world's prehistoric centre', as the Dordogne is called. Secondly, it seems plausible that Upper Palaeolithic humans had not entered the cave, that its entrance had collapsed before their time. Where sediment fill has been removed by speleologists to facilitate exploration, no indications of prehistoric human habitation were observed in the disturbed floor deposits. The cave appears well suited for rock art and is located in a region abounding with it, yet there are no traces of it present.

The collapse of the original entrance portion has sealed up the former portal at some time in the distant past. The cave's interior is also characterized by the debris of tectonic adjustments, which have all but closed some of the passages. The cave bear markings in fact clearly indicate that the floor was in many areas one or two metres lower at the time of the bear occupation. The remaining convacuation space (the volume of a cave's cavities, minus the volume occupied by solid and liquid cave contents) is quite small in most parts and three squeezes have to be negotiated nowadays. Certainly, in its present state the cave would be inaccessible to a bear. Its new-made entrance is a small aperture that was exposed only during the construction of a road. It now opens in the cutting above the road from Sarlat to Les Eyzies, on the outside of the northern-most bend near the castle Puymartin, some eight kilometres from Sarlat.

I have recorded the distribution and density of all bear claw marks in Grotte des Endrevies. Even a cursory examination of Fig. 4 shows that the marks are distributed quite randomly, and they seem to be lacking in locations where one would expect to find them according to cave configuration. In particular, the only large chamber (where my climatic recording station No. 1 was located) would appear to be a prime target for marks by an animal searching for a continuation in the dark, because the exits are quite small and cannot be readily found. A little further on, in the western-most part, a cul-de-sac to the left would seem to have invited attempts to find a continuation, yet there are hardly any traces of scratching. They are also lacking at the following blind passage on the right, which is in fact the logical means of proceeding from that junction. Again, at the northern-most inflexion there are no marks at all, and they are equally lacking in the cave's terminal passage.

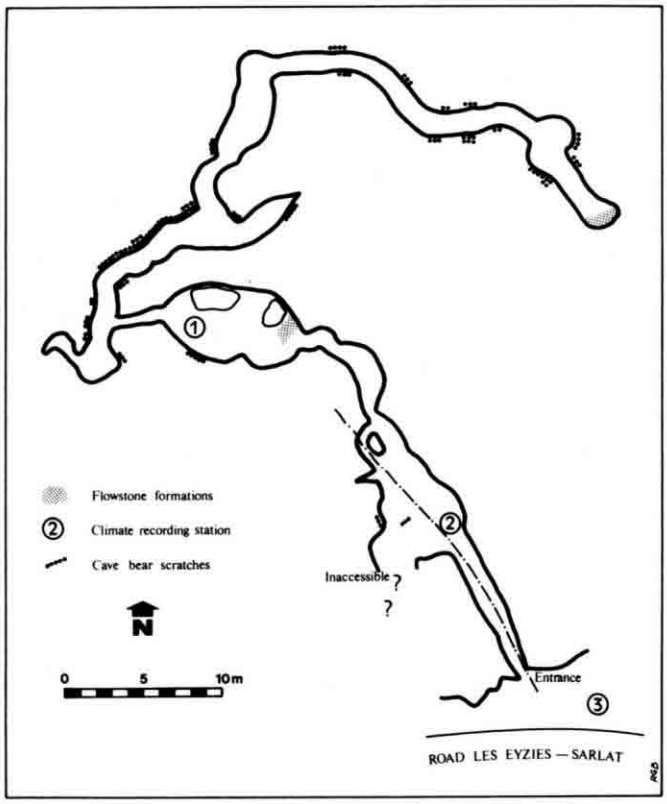


Fig. 4. Plan of Grotte des Endrevies, near Sarlat, Dordogne, France. Distribution of cave bear claw markings.

At large accumulations the marks are almost exclusively vertical and include a high proportion of long sets, measuring up to one metre (Plate II). Characteristically, the more dispersed scratches tend to be shorter and are frequently oblique. Horizontal sets occur, although rarely, and there is a single instance of marks on a ceiling. Claw spacings range generally from 20-40 mm, and it is obvious here, as well as at many other sites, that the highest markings usually possess the greatest spacing and were therefore probably executed by the largest individuals (Plate III). The depth of incisions is obviously a function of rock hardness and consequently varies greatly; it frequently exceeds 10 mm. The great majority of sets consist of four parallel or sub-parallel grooves. Several marked surfaces are covered with a cutaneous deposit of secondary carbonate.

Plate II. Vertical sets of cave bear claw marks, Grotte des Endrevies, France.

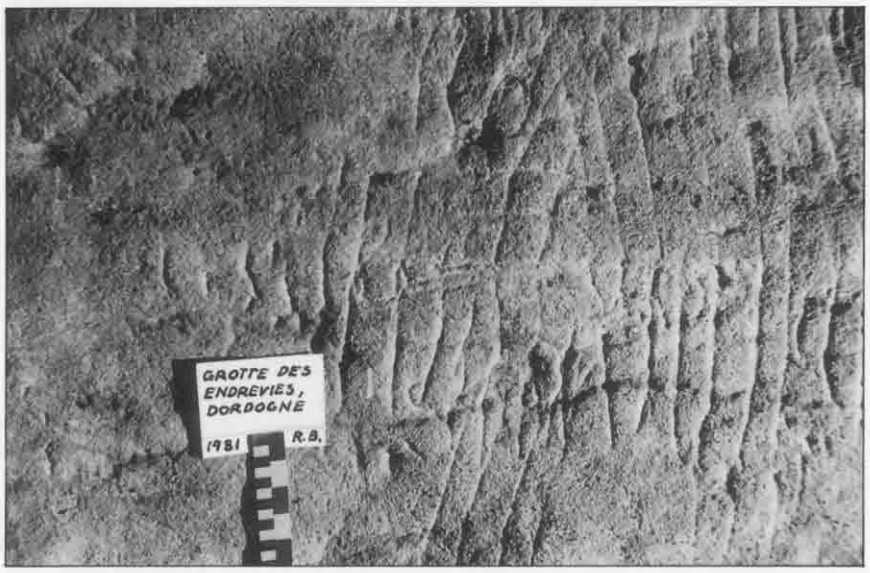


Plate III. Detail of cave bear claw marks, Grotte des Endrevies. Differences in weathering indicate that they are of greatly differing ages.

Whilst the sporadically occurring, generally short markings can be plausibly interpreted as 'incidental', this explanation is not entirely satisfactory for the long vertical marks. Neither does Bachofen's hypothesis offer a convincing alternative. As he observes, snares would have been placed only at certain advantageous points, and they could not possibly have been the cause of the seemingly endless galleries of bear scratches at sites such as Rouffignac. The densest concentrations of the long vertical incisions are at many sites located in the most improbable localities: on high and smooth walls that are devoid of any features promising progress and that often project into a chamber (Plate IV), or are convex overall. Individual sets among the long markings appear to be done almost meticulously: they are often perfectly perpendicular, straight, and produced by the application of even pressure over their entire length of usually about one metre, occasionally more. Clearly they are not the result of violent of frenzied strokes or blows, but were done by the bears slowly drawing a paw down the surface of a rock, in a seemingly purposeful manner.

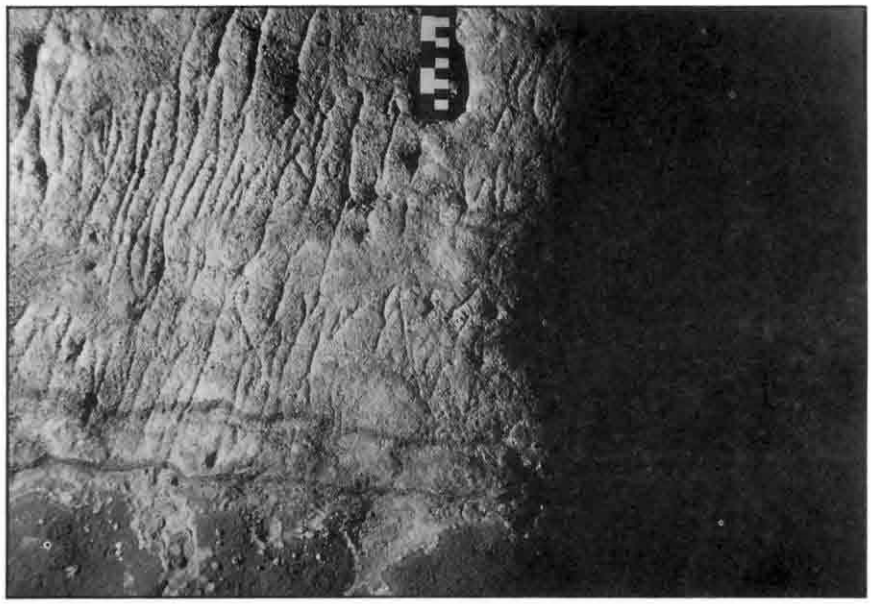


Plate IV. Cave bear claw marks at projecting corner, Grotte des Endrevies, France. Observe the large spacing of the uppermost set, of up to 40 mm.

The closest living relative of the cave bear, the North American grizzly bear (sub-species *Ursus arctos horribilis*, but not descended from *U. spelaeus*) habitually marks its territory by reaching up the trunk of a conspicuous tree, and scoring the bark with downward strokes. This behaviour (which reflects that of several other large carnivores) appears to be part of a mechanism designed to avoid conflict, warning off potential challengers by indicating the defender's size and power. Various behaviour patterns of forestalling serious and fatal conflicts exist in numerous animal species, and this often involves a comparison of body sizes. The obvious problem in using this explanation for the cave markings is that the introduction of such behavioural traits into the totally dark cave environment would have served no useful purpose. Yet this argument is specious: firstly, any redundant behavioural aspect in a species may survive for quite some time before it is discarded. Secondly, it would be wrong to postulate that cave bears exclusively occupied, or even always hibernated in, large limestone caves. The abundance of skeletal remains may suggest this, but the often very disproportionate representation of sexes implies that perhaps only a small part of the former cave bear

population actually died inside caves. Generally, males are far more common in the cave deposits examined. Despite being quite at home in deep caves, this beast was hardly a true trogloxene (which live largely in caves but derive their nutrients from outside). Considering the cold and damp conditions (relative air humidity ranges up to 98% in bear caves; Bednarik in prep.), it is likely that the caves became popular haunts only during the telocratic phases of the stadials (periods of climatic deterioration), when the stable temperatures they offered became preferable to those at alternative places for hibernation. Pathological deformations caused by rheumatism have been commonly diagnosed in cave bear remains (Abel, 1931; Kyrle and Ehrenberg, 1936), indicating perhaps that the species was not adequately adapted to the life to which it was forced to adjust during periods of cooling climate. The speleo-climatic studies conducted by Ehrenberg (1970: 247), Mottl (1951: 8-10) and myself (Bednarik, in prep.) certainly suggest that the cave bears were well acquainted with speleo-meteorological effects, such as warm air syphons.

CONCLUSIONS

I have come to the conclusion that the long vertical claw marks of the cave bear are always most conspicuous in that part of a cave which is most likely to have been used for hibernation, or where hibernation pits can in fact still be found. I therefore suggest that they are territorial markings, originally designed to warn potential intruders that they are approaching a large bear's den, which may have been located in a rockshelter, earth hollow or small cave. Such markings would probably have been made in the open where they did not survive for any great length of time. However, as the bears were forced into deeper caves, this aspect of territorial behaviour was not shed, and a small sample of its results has survived to the present day.

On occasion, claw marks of the cave bear have been interpreted as petroglyphs. For instance, an arrangement that has been called the oldest work of art (Glory, 1955: Pl. 2) and suggested to be almost 40,000 years old (Paturi, 1976: 58) is in reality almost certainly a cave bear mark. It is located on the upper left hand end of the petroglyph panel in the cave Bara Bahau, Dordogne, on which there are numerous other cave bear scratches. It resembles a human hand, but several of its features suggest that it is of ursine origin. Vértes (1965: 181-3) reports a small panel of deep scratch marks from the Hillerbrand Jenö Cave (north-eastern Bükk Mountains, Hungary) that resemble cave bear claw marks. He identifies them as humanly made on the basis of their oblique inclination, since the bear scratches he has seen on photographs are of a different orientation (they were presumably perpendicular, as the majority of these marks are). The cave contains cave bear remains (Vértes, 1959), and I have mentioned above that the cave bear marks can be orientated at any angle; they may even be horizontal or occur on a cave ceiling.

Hallam (1971: 101), an Australian archaeologist, observed that many individual and grouped scratches occur among Upper Palaeolithic art, and can be seen in many of the published illustrations, 'where their occurrence passes without comment'. Not realising that they are animal scratches, she speculates what the apparent 1+3+1 spacing in these sets could possibly mean. Other writers have mistaken bear scratches for human engravings, or have included them in sets of humanly-made marks. I have provided some general guide lines for distinguishing intentional human engravings from animal scratches (Bednarik, 1991) and they are applicable here too. However, it must be cautioned that a totally reliable discrimination may not be possible in every single instance, not even for the most experienced observer. Nevertheless, it is certainly possible in nearly every case, but it is a specialist task.

Conversely, megafaunal wall markings are not restricted to Europe, they occur also in the caves of other continents, where on occasion they were also identified as petroglyphs. For instance, megafaunal marks are very common in Australian caves, where much of the

Pleistocene megafauna became extinct around 18,000 years ago. There, too, they have been described as human markings, and they can be found superimposed over genuine cave petroglyphs.

In summary, my morphological, distributional and statistical observations of cave bear scratches have led to definition of seven possible classes of them, determined by the reasons why they were made:

1. *Territorial marking behaviour:* these are the long, vertical sets, usually found at prominent locations, projecting walls, or near hibernation pits. They can be easily recognised from location and arrangement.
2. *Escape attempts:* animals may have become imprisoned by roof falls, snow drifts at the entrance, or avalanches, in which case they may have tried to seek an alternative passage. Similarly, they may have been pursued or disturbed by humans and may have acted under stress, seeking a way in the dark.
3. *Fighting or mating behaviour:* this could conceivably result in damage to walls in a confined space such as a cave. Perhaps short and 'erratic' marks fall into this category.
4. *Snares:* it is thought highly possible that the bears were snared in their hibernation haunts, and that prominent concentrations of certain types of marks indicate the attempts of the animals to free themselves. The marks are most distinctive and occur in specific types of locations.
5. *Injury:* it seems possible that an ill or injured animal, which may have sought refuge in a cave or have fallen into a shaft might, while in great pain, claw nearby walls.
6. *Exploratory behaviour:* while most cave bears probably followed established routes within large cave systems, individuals may have penetrated into less fequented passages and, as they explored in the dark, marked the walls with their claws. Exploratory marks by other mammalian species are among the most common in continents other than Europe.
7. *Play:* some trogloxenes may scratch cave walls in a more or less playful manner. In particular, adolescent and ludic behaviour is relevant here. Again, such marks have been suggested as attributable to the play of other species.

Perhaps the most interesting of all these marks are those listed first, the territorial markings. They present us with a unique problem. Archaeologists sometimes write about intentionality, symbolism and communication in an anthropocentric fashion, considering such capacities as touchstones of human-ness. If the marks discussed here are territorial, which seems likely to be the case, they contain a clear message: 'I am bigger than you, and I am around, so watch out!' In the naive vocabulary of humanistic archaeologists, such a message would provide a clear case of communication. Moreover, the communication is by means of an engraving, i.e. a permanent sign or symbol. A symbol is something that represents something else, particularly a material object that represents something invisible or immaterial. Consequently, using naive empiricist language, these cave bear markings are then clearly symbolic: they have no intrinsic meaning, but they stand for a concept, a concept that is being communicated to other bears. If it were not, it would be pointless to produce the marks. This leads to the subject of intentionality, which archaeologists have not satisfactorily defined in their humanist discussions of symbolism (Bednarik, 1992b: 28). There have been many discussions of such faculties in primates. Were cave bears capable of symbolism and communication via symbols? While ethologists emphasise that cognition is not a uniquely human faculty, some archaeologists would no doubt respond to the questions posed by seeking ways of re-defining symbolism to exclude non-human animals. The point may seem trivial, but it does emphasise the anthropocentricity of so much of what we carelessly call 'science'.

REFERENCES

ABEL, O., 1931. Das Lebensbild der eiszeitlichen Tierwelt der Drachenhöhle bei Mixnitz, in O. Abel and G. Kyrle (eds), *Die Drachenhöhle bei Mixnitz*, 885-920, Speläologische Monographien, Band 7-9, Vienna.

ADAMETZ, L., 1935. Ergänzungen zu dem vorstehenden Bericht von Kyrle und eine Zusammenfassung der alt- und jungpaläolithischen Funde Österreichs auf Grund der Ausgrabungen und Untersuchungen von Josef Bayer, *Report of the XVIth International Geological Congress, Washington 1933*, 1165-1169.

ANDRIST, D., FLÜHIGER, W. and ANDRIST, A., 1964. Das Simmental zur Steinzeit, *Acta Bernensia* 3, 1-46.

BÄCHLER, E., 1940. *Das alpine Paläolithikum der Schweiz*, Monographien zur Ur- und Frühgeschichte der Schweiz, Volume 2, Basle.

BACHOFEN-ECHT, A., 1931. Fährten und andere Lebensspuren, in O. Abel and G. Kyrle (eds), *Die Drachenhöhle bei Mixnitz*, 711-718, Speläologische Monographien, Band 7-9, Vienna.

BAHN, P.G., 1991. Where's the beef? The myth of hunting magic in Palaeolithic art, in P. Bahn and A. Rosenfeld (eds), *Rock art and prehistory*, 1-13, Oxbow Monograph 10, Oxbow Books, Oxford.

BAYER, J., 1924. Die geologische und archäologische Stellung des Hochgebirgspaläolithikums der Schweiz, *Die Eiszeit* 1, 59-65.

BAYER, J., 1928. Das zeitliche und kulturelle Verhältnis zwischen den Kulturen des Schmalklingen-kulturkreises während des Diluviums in Europa, *Die Eiszeit* 5, 9-23.

BAYER, J., 1929a. Die Olschewakultur, *Eiszeit und Urgeschichte* 6, 83-100.

BAYER, J., 1929b. Wildkirchlikultur, *Eiszeit und Urgeschichte* 6, 142.

BAYER, J., 1930. Hat das Hochgebirgspaläolithikum der Schweiz Knochenwerkzeuge geliefert? *Eiszeit und Urgeschichte* 7, 139-140.

BEDNARIK, R.G., 1986a. Parietal finger markings in Europe and Australia, *Rock Art Research* 3, 30-61, 159-170.

BEDNARIK, R.G., 1986b. Cave use by Australian Pleistocene man, *Proceedings, University of Bristol Spelaeological Society* 17, 227-245.

BEDNARIK, R.G., 1989. The Galgenberg figurine from Krems, Austria, *Rock Art Research* 6, 118-125.

BEDNARIK, R.G., 1990. Review of G. Fuchs (ed.), 'Höhlenfundplätze im Raum Peggau-Deutschfeistritz, Steiermark', *Archaeologia Austriaca* 74, 237-238.

BEDNARIK, R.G., 1991. On natural cave markings, *Helictite* 29(2), 27-41.

BEDNARIK, R.G., 1992a. Premières découvertes d'art Paléolithique en Allemagne, *International Newsletter on Rock Art* 2, 3-4.

BEDNARIK, R.G., 1992b. Palaeoart and archaeological myths, *Cambridge Archaeological Journal* 2(1), 27-43.

BEDNARIK, R.G., 1993. A taphonomy of palaeoart (in press).

BEDNARIK, R.G., in prep. On the climatic habitability of caves.

BÉGOUEN, H., 1936. Les grottes de Montesquieu-Avantès (Ariège). Tuc d'Audoubert, Enlène, Les Trois-Frères, le Musée de Pujol. *Toulouse, les éditions du travail*, Toulouse.

BÉGOUEN, H., 1941. La Grotte de Baume-Latrone à Russan (Sainte-Anastasie), *Mémoires de la Société Archéologie du Midi de la France* 20, 101-130.

BÉGOUEN, H. and BREUIL, H., 1958. Les Cavernes du Volp, Trois-Frères, Tuc d'Audoubert, *Arts et métiers graphiques*. Paris.

BRODAR, S., 1957. Zur Frage der Höhlenbärenjagd und des Höhlenbärenkults in den paläolithischen Fundstellen Jugoslawiens, *Quartär* 9, 147-159.

CLOTTES, J., COURTIN, J. and VALLADAS, H., 1992. A well-dated Palaeolithic cave: the Cosquer Cave at Marseille, *Rock Art Research* 9, 122-129.

CRAMER, H., 1941. Der Lebensraum des eiszeitlichen Höhlenbären und die 'Höhlenbärenjagdkultur', *Zeitschrift der Deutschen Geologischen Gesellschaft* 93, 181-196.

DROUOT, E., 1953. L'art paléolithique à La Baume-Latrone, *Cahiers ligures de préhistoire et d'archéologie*, Pt 1, 13-46.

EHRENBERG, K., 1951. 30 Jahre paläobiologischer Forschung in österreichischen Höhlen, *Quartär* 5, 93-108.

EHRENBERG, K., 1953a. Die paläontologische, prähistorische und paläoethnologische Bedeutung der Salzofenhöhle im Lichte der letzten Forschungen, *Quartär* 5, 35-40.

EHRENBERG, K., 1953b. Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge. VII. Beobachtungen und Funde der Salzofen-Expedition 1953, *Sitzungsberichte der österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 162, 51-56.

EHRENBERG, K., 1954. Die paläontologische, prähistorische and paläo-ethnologische Bedeutung der Salzofenhöhle im Lichte der letzten Forschungen, *Quartär* 6, 19-58.

EHRENBERG, K., 1956. Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge. IX. Die Grabungen 1956 und ihre einstweiligen Ergebnisse, *Sitzungsberichte der österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 165, 15-19.

EHRENBERG, K., 1957. Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge. VIII. Bemerkungen zu den Untersuchungen der Sedimente durch Elisabeth Schmid, *Sitzungsberichte der österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 166, 57-63.

EHRENBERG, K., 1958. Vom dermaligen Forschungsstand in der Höhle am Salzofen, *Quartär* 10, 237-251.

EHRENBERG, K., 1959. Die urzeitlichen Fundstellen und Funde in der Salzofenhöhle, Steiermark, *Archaeologia Austriaca* 25, 8-24.

EHRENBERG, K., 1962. Über Lebensweise und Lebensraum des Höhlenbären. *Verhandlungen der Zoologisch-Botanischen Gesellschaft in Wien* 101, 18-31.

EHRENBERG, K., 1970. Vigaun, Salzburg. *Fundberichte aus Österreich* 9, 247.

GLORY, A., 1955. *Bara-Bahau, Le Bugue-sur-Vézère (Dordogne)*, Le Bugue.

GLORY, A., 1956. La Caverne ornée de Bara-Bahau (Le Bugue-sur-Vézère, Dordogne), *Congrès Préhistorique de France*, 15^{e} Session, 529-535. Poitiers-Angoulême.

HAHN, J., 1971. Eine jungpaläolithische Elfenbeinplastik aus dem Hohlenstein-Stadel, *Fundberichte aus Schwaben*, Neue Folge 19, 11-23.

HAHN, J., 1990. Höhlenkunst aus dem Hohlen Fels bei Schelklingen, Alb-Donau-Kreis, *Archäologische Ausgrabungen in Baden-Württemberg* 10, 19-22.

HALLAM, S.J., 1971. Roof markings in the 'Orchestra Shell' Cave, Wanneroo, near Perth, Western Australia, *Mankind* 8, 90-103.

HALLOWELL, A.I., 1926. Bear ceremonialism in the Northern Hemisphere, *American Anthropologist* 28, 1-175.

HORUSITZKY, Z., 1955. Eine Knochenflöte aus der Höhle von Istállóskö, *Acta Archaeologica* 5, 133-139.

HILBER, V., 1922. *Urgeschichte Steiermarks*, Graz.

JÉQUIER, J.-P., 1975. *Le Moustérien alpin, révision critique*, Eburodunum II, Yverdon.

KOBY, F., 1951. L'Ours des cavernes et les Paléolithiques, *L'Anthropologie* 55, 119-131.

KOBY, F., 1953. Les Paléolithiques ont-ils chassé l'ours des cavernes? *Actes de la Société jurassienne d'emulation*, 14-17, Porrentruy.

KOBY F. and SCHAEFER, H., 1960. Der Höhlenbär, *Veröffentlichungen des Naturhistorischen Museums Basel* 2, 1-24.

KURTÉN, B., 1959. On the bears of the Holsteinian interglacial. *Stockholm Contributions in Geology* 2, 73-102.

KURTÉN, B., 1968. *Pleistocene mammals of Europe*, Weidenfeld and Nicolson, London.

KYRLE, G., 1931. Die Höhlenbärenjägerstation, in O. Abel and G. Kyrle (eds), *Die Drachenhöhle bei Mixnitz*, 804-962, Speläologische Monographien, Band 7-9, Vienna.

KYRLE, G. and EHRENBERG, K., 1936. Die Drachenhöhle bei Mixnitz in Steiermark, in G. Götzinger (ed.), *Führer für die Quartär Exkursionen. III. Internationaler Quartär Kongress, Wien 1936*, 92-97, Vienna.

LEMOZI, A., 1929. *La Grotte temple de Pech-Merle. Un nouveau sanctuaire Paléolithique*, Paris.

LEROI-GOURHAN, A., 1971. *Préhistoire de l'art occidental*, Éditions d'art Lucien Mazenod, Paris.

MALEZ, M., 1956. Geoloska i paleontolska istrazivanja u pecini Veternici, *Acta Geologica Zagreb* 1, 83-88.

MALEZ, M., 1958. Das Paläolithikum der Veternicahöhle und der Bärenkult, *Quartär* 11, 171-188.

MALEZ, M., 1965. Novi opci varijacioni raspon vrste Ursus spelaeus Rosnm. et Heinroth, *Geoloski Vjesnik* 18, 133-139.

MARSHACK, A., 1985. Theoretical concepts that lead to new analytic methods, modes of inquiry and classes of data, *Rock Art Research* 2, 95-111.

MOTTL, M., 1950a. Das Protoaurignacien der Repolusthöhle bei Peggau, Steiermark, *Archaeologia Austriaca* 5, 6-17.

MOTTL, M., 1950b. Das Lieglloch im Ennstal, eine Jagdstation des Eiszeitmenschen, *Archaeologia Austriaca* 5, 18-23.

MOTTL, M., 1950c. Die paläolithischen Funde aus der Salzofenhöhle im Toten Gebirge, *Archaeologia Austriaca* 5, 24-34.

MOTTL, M., 1951. Die Repolust-Höhle bei Peggau (Steiermark) und ihre eiszeitlichen Bewohner, *Archaeologia Austriaca* 8, 1-78.

MOVIUS, H.L., 1960. Radiocarbon dates and Upper Palaeolithic archaeology in central and western Europe, *Current Anthropology* 1, 355-391.

MURBAN, K. and MOTTL, M., 1955. Neue Grabungen in der Repolusthöhle bei Peggau in der Steiermark, *Mitteilungen des Museums für Bergbau, Geologie und Technik am Landesmuseum 'Joanneum' Graz* 15, 77-87.

NEUGEBAUER, J.-W. and SIMPERL, K., 1979. *Als Europa erwachte. Österreich in der Urzeit.* Verlag das Bergland-Buch, Salzburg.

NOUGIER, L.R. and ROBERT, R., 1959. *Rouffignac. I. Galerie Henri Breuil et grand plafond*, Florence.

PATURI, F.R., 1976. *Zeugen der Vorzeit*, Econ Verlag, Düsseldorf-Wien.

PITTIONI, R., 1954. *Urgeschichte des österreichischen Raumes*, Wien.

PITTIONI, R., 1957. Nachschrift. Appendix to K. Ehrenberg, 'Berichte über Ausgrabungen in der Salzofenhöhle im Toten Gebirge', *Sitzungsberichte der Österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse* 166, 62-63.

RAKOVEC, I., 1967. Jamski medved iz Mokriske Jame v Savinjskih Alpah, *Razprave* 10, 123-203.

SCHMID, E., 1957. Von den Sedimenten der Salzofenhöhle, *Sitzungsberichte der Österreichischen Akademie der Wissenschaften, mathematisch-naturwissenschaftlicher Klasse*, Abteilung I, 166, 43-55.

SCHMID, E., 1958. *Höhlenforschung und Sedimentanalyse*, Schriften des Institutes für Ur- und Frühgeschichte der Schweiz, Volume 13, Basle.

SCHMID, E., 1963. Zur alpinen Schneegrenze und Waldgrenze während des Würmglazials, *Eiszeitalter und Gegenwart* 14, 107-110.

SMITH, N.W., 1992. *An Analysis of Ice Age art. Its psychology and belief system*, Peter Lang, New York.

STEHLIN, H.G. and DUBOIS, A., 1916. *Note préliminaire sur les fouilles entreprises dans la Grotte de Cotencher (canton Neuchâtel)*, Eclogae Geologica Helvetia 14, Lausanne.

TASNADI-KUBACSKA, A., 1936. Pathologische Untersuchungen an ungarischen Versteinerungen VI. Verletzungen an Schädeln pleistozäner Raubtiere, *Paläontologische Zeitschrift* 18, 95-108.

TRIMMEL, H., 1950. Die Salzofenhöhle im Toten Gebirge, Ph.D. thesis, Philosophical Faculty, University of Vienna.

TROMBE, F. and DUBUC, G., 1946. *Le centre préhistorique de Ganties-Montespan (Haute-Garonne)*, Archives de l'Institut de Paléontologie Humaine No. 22, Paris.

TSCHUMI, O., 1949. Die steinzeitlichen Epochen, in *Urgeschichte der Schweiz*, Vol. 1, 407-727, Frauenfeld.

VÉRTES, L., 1951. Novi'e raskopki v peschtschere na Istállóskö, *Acta Archaeologica* 1, 15-34.

VÉRTES, L., 1955. Neuere Ausgrabungen und paläolithische Funde in der Höhle von Istállóskö, *Acta Archaeologica* 5, 111-131.

VÉRTES, L., 1959. Die Rolle des Höhlenbären im ungarischen Paläolithikum, *Quartär* 11, 151-170.

VÉRTES, L., 1965. *Az Öskökor és az átmeneti kökor emlékei Magyarországon*, Akadémiai Kiadó, Budapest.

WÜST, W., 1956. Die paläolithisch-ethnographischen Bärenriten und das Alt-Indogermanische, *Quartär* 7/8, 154-165.

ZOTZ, L.F., 1939. *Die Altsteinzeit in Niederschlesien*, Leipzig.

ZOTZ, L.F., 1944. *Altsteinzeitkunde der Südostalpenländer*, Archiv für vaterländische Geschichte und Topographie 29, Wiemar.

ZOTZ, L.F., 1951. *Altsteinzeitkunde Mitteleuropas*, F. Enke, Stuttgart.