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Dating early Australian pictograms

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Abstract

There is extensive, if little publicized, evidence of ancient cultural representations in rock shelters and open sites throughout Australia. While dating of this imagery remains problematic in many instances, there is growing evidence that a significant proportion survives from the Pleistocene period. Bednarik has reviewed the history of research and evaluated recent evidence of Australian rock art of the Pleistocene, especially petroglyphs. It is pertinent to consider this research with particular emphasis on painted representation.

This survey of pictograms[1] shown or argued to date to Pleistocene and pre-sea-level stabilization periods in Australia draws heavily, and necessarily selectively, upon others' original work and this is acknowledged. There are many more data, issues and debates than could be covered in a short conference presentation. It is an attempt to cover the main developments and concerns without being comprehensive in order to provide –as suggested– an introduction to the subject for a European audience, and to raise some matters of general importance. The subsequent papers in this section will provide more comprehensive and detailed presentation of many of the matters touched on here. Surveys of the dating evidence for Australian rock art have been written or incorporated within discussions of dating results by Rosenfeld (1993), Bednarik (1996, 2002, 2010), Rosenfeld and Smith (1997), Ward and Tuniz (2000), O'Connor and Fankhauser (2001), Watchman (2001), Gillespie (2002) and Franklin (2004).[2]

1. Pleistocene Australia and sea levels

Our focus here is the Pleistocene –a period differentiated from preceding and subsequent periods in terms of what are argued to have been major climatic

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1 Pictogram –"a rock art motif that involved an additive process in its production, such as the application of paint, dry pigment, beeswax." *Cf.* pictograph – "a writing character of figurative appearance, representing a word or syllable; a hierogyph." IFRAO Rock Art Glossary. AURA, Melbourne <mc2.vicnet.net.au/home/glossar/web/glossary.html>(accessed 2012/02/04).

2 Bibliographic notes: For those with limited access to published materials, much reference is made to a recent textbook by Peter Hisock (2008). As this paper was being finalized, a useful review by Langley and Taçon (2010) appeared in print; an appendix lists several hundred age determinations: "supplementary information" <www.australianarchaeologicalassociation.com.au/node/4078> (accessed 2012/02/04).

changes. Beginning students of Mankind learn that there is ample evidence of this in the northern hemisphere; and that the Pleistocene/Holocene change is accompanied by very significant changes in the ways of life of human societies.

The Pleistocene was a period of fluctuating glacial cycles, of severe Ice Age conditions, separated by short warmer periods. Oscillations in global sea levels tracked glacial cycles with greater amounts of water becoming trapped in polar ice caps and large glaciers in the Northern Hemisphere during colder phases. While the Southern Hemisphere appears to have been less glaciated, it is clear that reductions in sea level –over the last 140,000 years– exposed large regions of continental shelf that are presently below sea level.

These sea-level changes joined continental Australia to the islands of Tasmania and New Guinea (but not to all of island Southeast Asia). At about 70,000 years ago sea levels were sixty metres below their present levels. Very much lower sea levels resulted in a shorter sea distance to cross between Asia and Greater Australia. Illustrations of Pleistocene climatic conditions and geographic relationships can be seen in various publications; in his recent account of Australian archaeology, Hiscock (2008) has provided illustrations of the relationships between varying oxygen isotope ratios and the height of global sea-levels as indications of climatic change over the past 140,000 years (2008: 22), and a depiction at sea level of -130 metres of Greater Australia incorporating New Guinea and Tasmania (2008: 23). Extensive regions of coastal shelf were exposed –particularly in the north and west of Australia– and available for occupation during the period of 50,000 to 60,000 years ago when modern humans probably occupied Australia (2008: 44).

Last Glacial Maximum

Between 25,000 and 15,000 years ago a hyper-arid phase of the Last Glacial Maximum saw a large proportion of the Australian continent, particularly in the interior, become both cold and arid. The Centre was probably incapable of supporting human life. In the next 5,000 years climatic conditions ameliorated, and human groups resettled the interior. At the same time, the sea was flooding parts of the continental shelf. What we now know as the islands of New Guinea and Tasmania became separated from the mainland. Large areas of shallow sea were created, notably off the coasts of northern and north-western Australia. In the latter case, for example, the submerged continental shelf was in parts more than 200km wide, and various small islands were created. (Gillespie 2002: 456 has provided a useful depiction of Greater Australia from the time of LGM to the present.)

2. Pleistocene/Holocene change in Australia

The Pleistocene/Holocene boundary appears to be less well defined climatically in Australia than many other places in the world, and possibly was less significant in terms of human history. It is probable that the influence of the rise in sea levels and their stabilization by at least 6,500 years ago were more important.

"Palaeolithic"/"Neolithic"

The Pleistocene/Holocene change in the ways of life of human societies has often been summarized as the changes from the "Palaeolithic to the Neolithic". However, we know that this transition was not necessarily the same or as significant everywhere in the world. Some have argued that the "Palaeolithic" continued in

Australia until –and, indeed, after– European contact, and moreover, that there were "Neolithic" practices evident in the Australian "Palaeolithic". For example, ground stone tools were in use in northern Australia about 25,000 years ago (e.g. Hiscock 2008: 110). Savannah grasslands were systematically modified; grasses and other flora were to some degree cultivated and their characters modified; it is argued that the range of fauna was drastically reduced and altered by human intervention, including by anthropogenic fire regimes, during the Australian Palaeolithic.

One would not want to give the impression that Australia's early indigenous inhabitants were an "unchanging people in an unchanging land." (Pulleine 1929) We know that they were not, and research over the last half century strongly has put lie to this early contention. But we should question whether the climatic difference between the Pleistocene and Holocene were reflected in the way of life of the early inhabitants of Australia as much as has been found elsewhere in the world.

3. Conditions during period from 50,000 to about 10,000 years ago

If, in Australia, the Pleistocene/Holocene boundary is less dramatic than found in the northern hemisphere and the "Palaeolithic"/"Neolithic" differentiation is misleading, the effect of the climatic and environmental changes associated with gradual warming and sea-level rise, and stabilization by about 7,000 years ago, still had significant impacts upon regional human populations. To continue the Western Australian example, earlier accessible sources of an Eocene chert were submerged, and lack of access to this raw material is reflected in its absence from the later archaeological record in the southwest of Western Australia.

There were changes to the pattern of vegetation across the continent. Large areas of eucalyptus forest re-colonized the south, while tropical vegetation, reflecting a monsoonal rainfall pattern, was established across the north of the continent. This resulted in significant impacts upon human societies. Eucalyptus forests contain few edible food plants and, archaeologically, such regions appear to have become abandoned. However, northern regions became more habitable and were reoccupied, and the arid interior –re-vitalised with inland lakes and ephemeral rivers– was settled, with the use of new resources reflected in the archaeological record.

It may be that, about 7,000 years ago, with the migration of population groups from the now inundated continental shelf, and access to increasing environmental resources in the north and centre, it was not long before the carrying capacity of the continent was reached.

Several sets of archaeological data tend to support this view of increased population pressure:

– occupation of previously unsettled environmental niches

– maximizing of lithic resources

– marked reduction in the size and weight of individual stone artefacts

– development of regionally diagnostic artefact types, including bi-facially pressure-flaked projectile points.

Somewhat before and during this period there was a marked change in the range of fauna that human groups might have sought as prey.

Megafauna

It has been argued that the majority of Australian megafauna from all climatic zones started to become extinct about the same time that the original occupants spread across the continent. Debate continues as to whether these initial settlers were directly responsible for the demise of the megafauna or indirectly contributed to various extinctions over an extended period. (For non-Australianists the figure provided by Hiscock 2008: 64 may suffice to provide an understanding of the range and relative sizes of the megafauna, which appear to have ranged from less than 1 to about 2.5 metres in height at the shoulder; also Roberts 2010.) The debate about megafaunal extinctions generally has been conducted in conjunction with projects addressing problems of dating the time of earliest human settlement and the last manifestations of various megafauna.

Life in Pleistocene Australia

Earlier modelling of prehistoric lifeways almost inevitably were based in a view of “simplicity, uniformity and conservatism” (Hiscock 2002: 102) in the Pleistocene, followed by a Holocene period of greater complexity and “intensification”. This simplistic view prevailed despite a wide range of different environmental conditions and changes over time during the Pleistocene.

Pleistocene artistic life, for example, was seen to demonstrate cultural conservatism and homogeneity. Maynard (1978, 1979) divided Australian rock art into three stages. In the earliest, called “Panaramitee”, motifs were formed by breaking through the weathered surface of ancient boulders to expose fresher material of a different colour. Typical motifs appeared to be footprints of common animals, kangaroo and emu for example. Because most was weathered and widespread it was the earliest form of cultural expression, and typical of the hypothesized cultural conservatism of that period. Later rock art included painting as well as carving and displayed regional differences in style; it was thus more variable and “complex”. It confirmed a more diverse and rich Holocene archaeological record in contrast to the “unchanging” simplicity, pan-continental uniformity and conservatism of the Pleistocene.

But Pleistocene environments varied across Australia and through its tens of thousands of years, as, we are finding, did the diverse economic, technological and other cultural adaptations to them. The “Panaramitee style”, it has subsequently been argued, was a series of regionally distinct styles rather than a single tradition, differing spatially, and over time, in the frequency of different kinds of motif.

Dating aspects of pre-sea-level stabilization period

As elsewhere in the world, in attempting to date early settlement, the limits of the radiocarbon timescale at about 40,000 years BP were quickly reached. The ability to analyse small sample sizes of charcoal and bone using accelerator mass spectrometry (AMS) has extended the usefulness of the technique. Thermoluminescence (TL), optically stimulated thermoluminescence (OSL), electron spin resonance (ESR) and other methods have been applied.

Currently accepted ages obtained using multiple analytical techniques place human settlement by about 45,000 years ago at several sites: Devils Lair in the southwest, Carpenters Gap and Riwi in the northwest, Malakunanja in the north, and Mungo (Willandra Lakes) in the southeast (reference maps have been provided by

Gillespie 2002: 456; Flood 2004: 12; Hiscock 2008: 46; Bednarik 2010: 98). Application of a similar range of methods has shown that most components of the distinctive Australian megafauna from all climatic zones became extinct during the time that human populations spread across the continent –whether or not human predation or climatic change was directly responsible– with little reliable evidence for any megafauna surviving later than this time (Gillespie 2002; Roberts 2001, 2010).

While the minimum securely dated time for human occupation of Australia is about 45,000 years ago, we can suppose from the dating evidence available that modern humans probably occupied Australia during the period 50,000 to 60,000 years ago.

4. Evidence for ancient rock-painting

In these contexts –of climatic and environmental change over the last 60 or 50 millennia, the late Pleistocene and Holocene, that the Australian continent is thought to have been occupied by humans, the influence of the Pleistocene/Holocene border and the importance of the stabilization of sea-levels about 7,000 years ago– what is the evidence for any major differences revealed in the pictograms dated to this period?

Throughout much of Australia, rock carvings –exemplified above by the weathered Panaramitee motifs– are considered by many as typical of the mode of representation of the Pleistocene inhabitants of Australia. Earlier, rock-painting was thought to be absent from this period. Any study of the antiquity of rock-painting, of course, must take into consideration the prospects for its preservation over tens of thousands of years. Opportunities for preservation are poor at open sites and many shallow shelters. Preservation depends upon the type of rock, the characteristics of the paint used, and the micro-environment of the painted surface (Bednarik 1994). Under particular climatic conditions, the formation of stabilizing silica skins over a rock surface can preserve a painted image. These conditions are most likely to be found areas of in northern Australia subject to abundant rainfall.

Whatever the limitations of climate and depredations of the elements over time, there are significant numbers of rock-paintings in Australia that can be argued by various criteria to date to early periods.

Examples of indirectly dated early pictograms

If we share the perception of the likely significance to ancient societies of the opportunities provided by the stabilization of post-glaciation sea levels, then an earlier and influential study by George Chaloupka (1984) is of particular relevance.

Chaloupka defined a sequence of changes in the flora and fauna depicted in Arnhem Land rock-shelters, a significant proportion argued to belong to periods before the Holocene rise in sea-levels. The differentiation uses the geologically-defined Holocene rise in sea-level, after which occurrence, it was argued, painters depicted marine and swamp animals of the present-day environment including salt-water crocodiles and fresh-water fishes. These post-sea-level depictions contrast markedly with another suite of images that clearly represent a pre-sea-level rise environment with Ice Age flora and fauna. The earliest phases of the sequence show object imprints, including hand-prints; then images of grasses and large animals, naturalistically represented (Chaloupka 1984: 16), among which were identified extinct species, the Thylacine, the Tasmanian Devil and possible megafauna (Chaloupka 1984: 18, 23). In the next stage were depicted distinctive human figures

carrying weapons, some apparently clothed, and running or leaping – the “Dynamic figures” (Chaloupka 1984: 32). Chaloupka’s third phase is typified by anthropomorphic figures represented with the characteristics of bush food, yams in particular (1984: 39); these were followed by the well-known “x-ray figures”, then motifs that demonstrated contact with Western culture (Chaloupka 1984: 43). Chaloupka described the later styles as “Estuarine” –due to the partially inundated environment of the Arnhem Land lowlands– the Wetlands. The “Pre-estuarine” styles represented a period of lower sea levels. There was less available in the way of chronometric dating available then. Chaloupka’s estimates of chronological ages for the various stages were informed by geologist’s dating of the sea-level rise. The earlier stages he estimated to be of Pleistocene age (Chaloupka 1984: 16). While Chaloupka’s model has been reworked (e.g. Lewis 1988) the essential outline remains.

If Chaloupka’s sequence might be seen as representing “merely” pre- and post-sea-level change depictions, there are other ways in which evidence of ancient rock-painting can be inferred and there is increasing evidence of “Pleistocene” period rock-painting. A few examples will suffice to demonstrate this. But first –to consider instances other than from rock art of symbolic representation in the ancient past of Australia– perhaps one of the more striking examples is the burial of the WLH3 individual at Mungo in the southeast of the continent and dated to 40,000 years ago that was covered with ochre, as attested by the red stain in the sands surrounding the skeleton (Bowler *et al*. 2003; Hiscock 2008: 126).

In several sites, lumps of ochre –“crayons”– have been recovered from ancient excavation levels. Their faceted surfaces indicate that they have been used in the preparation of pigments for painting. While body-painting is a widespread indigenous Australian practice, so is rock-painting and many such finds have been at painted shelters. Faceted ochre was found in the lowest levels of the sandstone rock-shelters of Malakunanja II and Nauwalabila I in western Arnhem Land in most levels including those dated by OSL to between about 45,000 and 61,000 years ago (Roberts *et al*. 1994). Some questions have been raised about the associations and the dating results but both show some consistency (e.g. Hiscock 2008: 36, 43). At Puritjarra in the Western Desert evidence of occurrence of fragments of ochre throughout the deposit has been interpreted to indicate that rock-paintings were made at this site for a period of more than 40,000 years of occupation there despite the fact that none of the earlier paintings have been preserved (Hiscock 2008: 124). Such patterns and similar interpretations exist for other shelters of Pleistocene age.

Andrée Rosenfeld (Rosenfeld *et al.* 1981) argued that paintings at the Early Man shelter (near Laura, Cape York Peninsula, northern Queensland) could be indirectly (but minimally) dated from adjacent 13,000 to 15,000 year-old sediments wherein petroglyphs were buried (also Bednarik 2010: 102; Cole & Watchman 2005). At the Carpenters Gap 1 site, a painted rock-shelter in the Napier Range of the Kimberley region of Western Australia, an ochre-covered slab of roof-fall was excavated from strata dated by AMS radiocarbon analysis to between 33,000 and 43,000 years ago, thus suggesting a minimum age for the painting (O’Connor 1995; O’Connor & Fankhauser 2001). O’Connor saw (2001: 287) the find as adding to

> “…a growing body of data that indicates the widespread use of ochre –and by implication art– as an aspect of the earliest human occupation of widely separated and environmentally diverse regions in Australia.”

"Direct-dating" of pictograms

More direct evidence has been obtained from "excavation" of datable constituents within painted surfaces themselves. "Direct dating" techniques have been applied to the problem of securely dating petroglyphs in Australian limestone contexts since the 1980s (Bednarik 2002, 2010: 96, 102). Alan Watchman (1990, 2000) pioneered direct dating of silica, particularly oxalate, accretionary deposits, using carbon isotope methods. It is important to reflect that few pigments themselves can be dated directly; only the organic materials in oxalate-rich layers can be directly dated by AMS analysis of minute quantities of charcoal or other organic material able to be collected. It is this technique that has been seen as most successfully applying to pictograms, to the extent of demonstrating multiple layers of paint and identifying pigment residues in mineral skins hidden below the surface (Watchman 1992). Where these layers bracket a painting, they may provide a secure date for the presence of pigment and possibly of a painted motif.

The oldest directly dated paintings were reported by Campbell and Watchman from a painted wall at the Walkunder Arch shelter site in the Laura area (Cape York Peninsula, northern Queensland). They used direct and indirect dating methods to investigate the age of pictograms. Watchman subjected to AMS radiocarbon analysis the charcoal and oxalate minerals obtained from surficial accretions covering rock-paintings. Watchman's microscopic "excavation" of a sample of the painted wall revealed a sequence of laminae –mineral layers and remnant pigments– that provided organic material for ten AMS analyses. He obtained a conformable sequence of AMS results from a crust only 2.11 mm thick; the age estimates span approximately 26,000 radiocarbon years from about 30,000 to a little less than 3,000 years ago (29,700±500 to 3340±60 years BP), within which were three painting episodes (Watchman 1993; Watchman & Hatte 1996; Watchman & Campbell 1996; Watchman 2000; Campbell 2000: 81 Table 1). The details are shown by the micro-photograph used in the paper by Campbell (Fig. 1).

The radiocarbon analyses of the organic content are stratigraphically and internally consistent. They date specific painting episodes within this series from a little more than 28,000 to about 10,500 radiocarbon years ago.

The results provided a date for the earliest evidence of the application of a pigment to a rock-shelter wall. It was when published one of the oldest pictograms then identified. Watchman wrote (1993: 472):

> "…the Laura south pictograph is slightly younger than pictographs in the recently discover Cosquer Cave [near Marseille, France (Clottes *et al*. 1992)] it strongly suggests that human cognitive development in the use of pigment to leave marks on rocks was not only a pre-Glacial European phenomenon, but was simultaneously Australasian."

On the other side of the continent, in the Kimberley region, several researchers have attempted to date rock-paintings. Bert Roberts has applied optically stimulated luminescence (OSL) and AMS analysis techniques to determine the age of mud-wasp nests associated with rock-paintings and to understand their past environments (Roberts *et al.* 1997). Such nests contain materials suitable for dating using these techniques –quartz grains and organics respectively– whereas the pigments from which paintings are made usually do not. Robert's OSL results provided dates for fossilized nests overlying paintings.

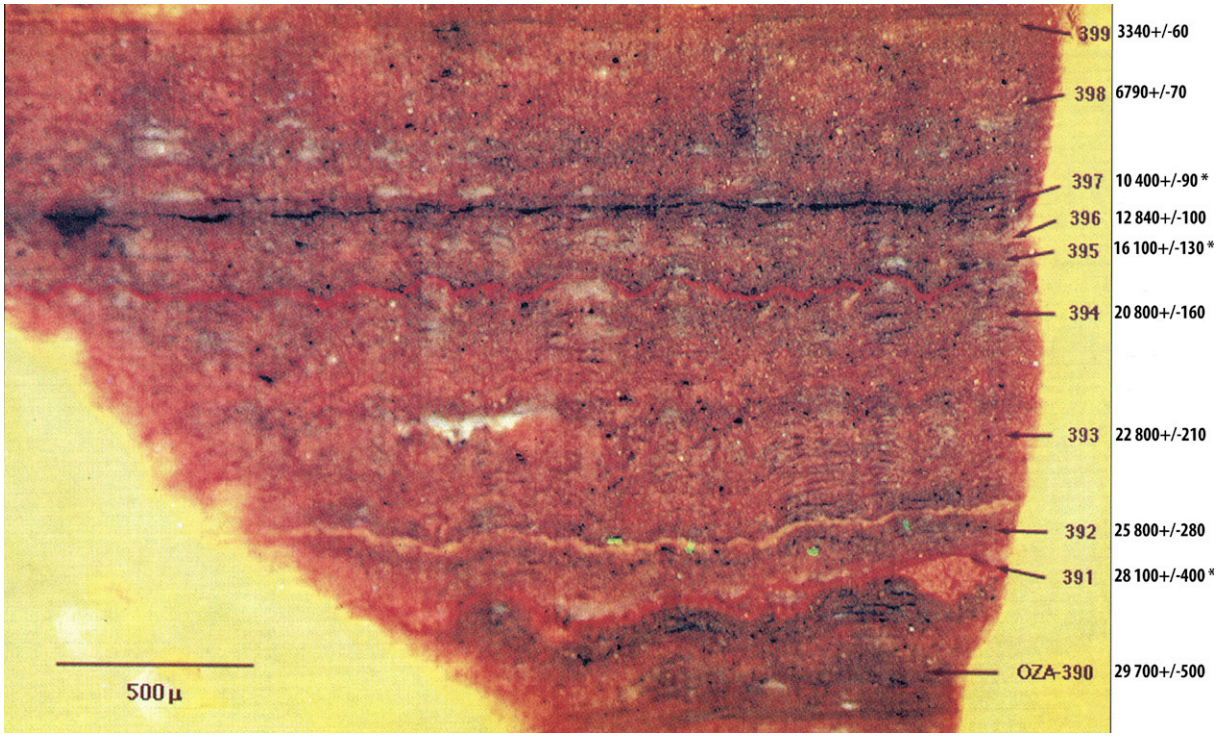

Fig. 1. Microphotograph of excavation by Watchman of stratified sample from painted area of Walkunder Arch shelter. Paintings are at levels marked by *; age estimates are uncalibrated (after Campbell 2000 Plate 1, cover).

Most paintings were minimally dated to within the last few thousand years; parts of two nests were dated to about 17,000 years ago.[3] Some nests also provided enough pollen for AMS determinations: all results were within the last millennium.[4] The older nests were claimed to be associated with a particular style "mulberry-coloured" anthropomorph (but there appears to be some doubt of this attribution –"the painting is so weathered and superimposed by later figures that [its attributes] can also be regarded as indiscernible and problematic." Watchman 2001: 318) Watchman's analyses, using AMS, of "mulberry-coloured" figures and a superimpositionally earlier image category at sites in the same area (Watchman *et al*. 1997: 25)[5] suggests that both types of image "are probably mid-Holocene or slightly younger in age" (Watchman 2001: 318).[6] Comparable results were obtained for similar figures in

3 KERC5 core 17.500±1800; KERC4 whole nest 23 800±2400 and 16 400±1800 (Roberts *et al.* 1997: 697, Table 1).

4 OSL ages for the same nests are <200 years, so that there is no significant discrepancy between the C-14 and OSL chronology. The same is also true for a much older (c. 30 ka) nest, as reported by Yoshida *et al.* 2003. The pollen grains were C-14 dated, and the quartz grains were OSL dated, to around 30 ka. This nest was not associated with any rock art. The purpose of the study was to see if nests could survive for tens of millennia, which would seem to be the case.
Roberts (personal communication 24 December 2010) maintains that the KERC5 results are defensible because they "…were based on OSL dating of quite large nests, so problems of partial bleaching of grains while embedded in the mud was much less of an issue than in the follow-up study. …nests that are too thin contain no useful information about their depositional age, at least not in terms of the OSL signal. […] I consider it as a rare example of what can be accomplished under favourable circumstances. If nests of decent dimensions can be located in association with rock art, then I think the prospects of obtaining reliable OSL ages would be good."

5 Between 3880±110 and 1430±180 BP (Watchman et al 1997: 25, Table 1).

6 In a recent paper, Pettigrew and others (2010), extrapolating wildly, appear to accept that this type of pictograph is between *"46,000* […] *and 70,000 years old"* and that, considering this antiquity, it is remarkable

adjacent regions including Keep River (Taçon *et al*. 2003) and the Fitzmaurice (Watchman *et al*. 2010). Roberts' 17,000 BP date has been much quoted as representing the period of the "Gwion" or "Bradshaw" paintings for which the region is notable; it appears to bolster the view wished by many of the very early dating of the Gwion suggested by superimposition studies (only one category of image appears to be older in the Kimberley) and the oft-claimed but countered view that these images were unknown to modern Indigenous peoples (senior Ngarinyin claim otherwise: Ngarjno *et al.* 2000).[7]

Bednarik (2002: 1221–1222, n.d.) discussed several problems with the application of luminescence dating to petroglyphs and pictograms, considering various difficulties and, for the Kimberley results in particular, the lack of a Pleistocene painting tradition elsewhere in the world where rock paintings have *"survived in such large numbers of motifs outside of caves."* While these first attempts to introduce luminescence dating into rock art science *"deserve every encouragement"*, the results needed

> "…to be considered carefully. […] as with any pioneering endeavour of this type it is important that archaeologists exercise the requisite restraint in interpreting such preliminary and experimental results. […] such results remain quite provisional, even in their order of magnitude, until they can be tested or the concerns can be dismissed."

The AMS methods in their application to rock art are not without a similar range of concerns – as Watchman has stressed in various accounts (e.g. 1997; *cf*. Bednarik 2002: 1223–1226, n.d. 2). What is most pertinent here is that the limited suite of results available for these sites require sceptical as well as restrained interpretation. To establish reliable ages for ancient rock art Watchman called for not only multiple sampling (1997: 31) but also (1997: 33)

> "…the systematic and scientific use of a combination of dating methods carried out by separate research teams working independently on finely laminated rock surface accretions […], on stratified floor deposits, and on paint components."

Richard Gillespie (2002), in reviewing evidence for dating of the earliest occupation of Australia, was firm in his requirement: he sought human occupation layers dated not only by multiple age estimates but also by some combination of overlapping methods for the interpretation to be acceptable; in 2002 he found only five places where results fulfilled his criteria. While Gillespie's criteria are extremely limiting, it may well be that, awaiting further and more secure evidence, we too should be cautious in our interpretation of all dating results for rock art.

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that these paintings, "…often exposed to sun and rain, can be vivid and with high contrast, even though they have never been repainted." They report instances where the original paint "…has been replaced by a biofilm of living, pigmented micro-organisms whose natural replenishment may account for the longevity and vividness of these ancient paintings." The lack of mineral pigment in Gwion images has been noted before and the biofilm explanation may well account for the distinctive appearance of these images, but the poorly considered claims of antiquity do their argument a disservice.

7 During his expedition to the western Kimberley in 1891, Joseph Bradshaw, who made recordings of the distinctive Gwion rock paintings also reporting encountering local persons wearing examples of the distinctive headdresses similar to those represented in the painted imagery (1892: 100, 99), a link that appears to have escaped his consideration and that of most others invoking his name. McNiven and Russell (1997, 2005) have provided a discussion of the "appropriation of indigenous pasts" and the continuing interpretation of the "strange paintings" and "mystery races" that they see as justifying European colonial activity and "refuelling a diffusionist debate, [and that] has resurrected a colonialist standpoint"; also Redmond (2002) for informed comment.

Discussion

In this review, apart from setting the climatic and geographical context of occupation of Pleistocene Australia and providing some examples of "indirect dating", the concentration is on the application of archaeometric –"direct"– dating and limitations of some methods, rather than stylistic approaches for which other types of limitations have been demonstrated in Australia as elsewhere. The archaeometric research results so far are involving, and the several applicable techniques show considerable potential for dating pictograms where the climatic and other conditions are favourable. Have they produced satisfying results? A problem with Watchman's approach (as he himself noted –1977: 32) is that, while we may be more confident with the dating results of the application of this technique, that we know within reasonable limits the likely date of the pigment applied to a rock-face which has been caught between two layers, we may not know anything about the character of the painting itself: its extent, its style, or clues to what is being depicted. The presence identified at the bottom of Watchman's "excavation" of an acceptably small sampling area of a painted surface is itself a minute sample of a painting –a posthole excavation taken to a "nano" level– where area excavation is required for the adequate identification of the subject matter and any insight into the intention of the painter. We might be excited by early results for pigments identified two millimetres below the painted surface but, if this indicates a purposeful application of pigment, what was being painted? Even with one hundred-fold sampling we may not have an answer to this most pertinent question.

Evidence from ?long-dead birds

Perhaps more satisfying evidence for many will be the identification of early pictograms from their subject matter, particularly that suggested by the recognition of extinct megafauna. Such an instance, just months before the conference at Tarascon-sur-Ariège, received coverage in Australian media.

The ABC headline read: "Scientists say an Aboriginal rock art depiction of an extinct giant bird could be Australia's oldest painting." (Masters 2010) The report described a red ochre painting depicting two large birds with their necks outstretched. A palaeontologist was said to have confirmed that the animals were the megafauna species *Genyornis*. This giant goose-like bird was said to have become extinct more than 40,000 years ago. Archaeologist RG Gunn, long researching with technical colleagues and Traditional Owners in central Arnhem Land, was reported to have said that

> "…the details on this painting indicate that it was done by someone who knew that animal very well. […] if it is a Genyornis […] it would be the oldest dated visual painting that we've got in Australia. Either the painting is 40,000 years old, which is when science thinks Genyornis disappeared, or alternatively the Genyornis lived a lot longer than science has been able to establish."

The bird in question is to hand (Fig. 2):

Fig. 2. Arnhem Land Plateau: depiction of *Genyornis*. Photograph: courtesy of R.-G. (Ben) Gunn, Traditional Owner Margaret Katherine, and the Jawoyn Association.

In a presentation to the Australian Archaeological Association in December 2010, Gunn argued cogently for the interpretation of the painting as an example of *Genyornis newtoni,* finding the portrayal in concordance with the palaeontological evidence, but modifying its likely time of extinction with the observation that it could have survived in some small areas until up to 25,000 years ago[8] (Gunn *et al*. 2011).

So back to "indirect dating" –if the item of Australian megafauna arguably depicted here was indeed not extinct until between forty and 25 millennia ago, if the circumstances were favourable for such longevity of representation, and if the depiction was not made later from "inter-generational memory"…, then the painting must be so old. And we can see it all.

Is the choice between being more sure of a chronometric date through the application of "direct dating" techniques but knowing very little of the subject, on the one hand, and, on the other, seeing much of the original image but being less sure of the age due to the limitations of "indirect dating"? The two are not necessarily mutually exclusive: where there is only a single layer of painting on a rock surface, a dated sample may be argued to date that painting. And it may be hoped that Gunn and his Arnhem Land research colleagues would pursue any opportunity for the application of direct dating methods as an independent test of their conclusions about the age of the painting. But where, as is frequently the case in Australia, there are

8 There have been numerous examples of "identification" of Australian megafauna from pictograms and petroglyphs, many problematic; Gunn *et al.* (2011) have provided a useful review. However, an extended critical review of the many claims for representation of ancient megafauna among Australian pictograms and petroglyphs is lacking; given some example of clear mis-identification, and claims for longevity of survival of pigment –and rock surfaces themselves!– far in excess of what might be expected in various environmental circumstances, a degree of scepticism is warranted in consideration of various claims.

many painting events represented on the same surface (e.g. Watchman 1992) underlying imagery may be difficult to discern in its entirety or at all. In this case, a secure age-estimate for lower layers may be considered to be of limited value beyond indicating that a painting event happened about that time. Then other approaches may be seen to be attractive despite their limitations. The dilemma is probably not restricted to the pictograms of ancient Australia.

Summary

Modern humans probably occupied Australia during the period 50,000 to 60,000 years ago. The minimum securely dated time for human occupation of Australia is about 45,000 years ago. Most components of the distinctive Australian megafauna became extinct between then and the later Pleistocene; whether from exclusively climatic factors or a combination of climate and human environmental modification is the subject of continuing debate.

Subsequently, the picture is somewhat blurred. There is a less clear Pleistocene/ Holocene boundary as might be argued exists elsewhere. Rising sea levels and lessening aridity prompted population movements and required –by about 7,000 years ago– abandonment of extensive continental plains and adaptation to new environments with new communities of plants and animals. These changes, however, were less dramatic and far-reaching than the adaptations required elsewhere where a pronounced Pleistocene/Holocene boundary is evident. Similarly, there is no dramatic transition from the Palaeolithic in Australia. It appears that the pressures that resulted in the development of the some of various aspects of human economy and society that we recognize elsewhere as comprising the Neolithic were less experienced on the island continent.

Opportunities for preservation of pictograms are poor at open sites and many shallow shelters. In northern Australia, subject to abundant rainfall, the formation of finely laminated oxalate crusts or lustrous siliceous skins over a rock surface can stabilize and preserve a painted image. There are significant numbers of rock-paintings in Australia that can be argued, by various criteria, to date to early periods.

In Australia, aspects of symbolic representation including rock-painting can be dated by indirect and direct methods to more than 40,000 years ago.

In the sequence of changes in the flora and fauna depicted in some Arnhem Land rock shelters, a significant proportion was argued to belong to periods before the Holocene rise in sea-levels, after which painters depicted marine and swamp animals of the present-day environment; the “Pre-estuarine” paintings clearly represent a pre-sea-level rise environment. In northern Queensland paintings were indirectly dated to about 18,000 years ago. Painted roof-fall in a Kimberley excavation has been dated to about 40,000 years ago. The oldest –circa 25,000 years BP– directly-dated evidence of rock-painting (charcoal and oxalate minerals in surficial accretions subjected to AMS radiocarbon analysis) has been reported from another Queensland site.

Watchman’s direct-dating approach is limited in that, while we may be more confident that we know within reasonable limits the likely date of the pigment applied to a rock-face that has been caught between two oxalate or silica layers, we might know little about the character of any painting itself. Perhaps more satisfying evidence for many will be the identification of early pictograms from their subject matter, particularly that suggested by the recognition of extinct megafauna reportedly

extinct by at least 25 millennia ago. Researchers are faced with a dating dilemma probably not unique to ancient Australia.

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