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# COLONIZATION OF NEW LAND BY HUNTER-GATHERERS

## Expectations and implications based on ethnographic data

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Nearly all of the world was initially colonized by people equipped with a foraging adaptation. How hunter-gatherers adapt to "empty" land masses, therefore, is a question that is essential to understanding an important segment of human history. It is a frustrating question, however, for there are no easy analogies. We have no cases of ethnographically known hunter-gatherers moving into terra incognita.[1] Yet too often it is assumed that the first prehistoric foragers to occupy a region fit an ethnographic model, one based on only one or two ethnographic cases that serve as simple ethnographic analogies. In recent decades, it has been the Ju/'hoansi (the !Kung, San, Basarwa, or Bushmen), or some amalgam of Arctic groups (Kelly 1996). But it is clear that such analogies are not always useful even when examining later Holocene foragers (Kelly 1995). How much less so for colonizing populations that faced environmental and social circumstances that would have been foreign to ethnographically known foragers?

The purpose of this volume is to move toward a better understanding of how humans initially occupy large land masses about which nothing was known, about which nothing could have been encoded into oral history or folklore, about which the accumulated wisdom of grandparents and great-grandparents was silent. This chapter's contribution is to ask what ethnographically known hunter-gatherers have to contribute to this venture. Since there are no analogies to call upon, our effort is aimed at looking at how ethnographically known hunter-gatherers "know" their landscape and what this might suggest about foragers entering unoccupied continents. It is most likely that different land masses were occupied differently, depending on a number of variables such as population density, the particular environment (e.g. the Australian desert versus the Siberian taiga), and the adaptation that the colonizers brought with them to the new land. But in writing this paper I must admit that in the back of my mind is the colonization of the western hemisphere.

## Landscape knowledge: the ethnographic record

Some years ago, Lawrence Todd and I argued that some facets of North American Paleoindian archaeology might be accounted for by the fact that Paleoindians may not have known their landscapes very well (Kelly and Todd 1988). We took some flak for this claim from several individuals who pointed out that "all hunter-gatherers know their landscape well." This is, of course, true enough for ethnographically known hunter-gatherers, people who have lived someplace for a long time. I would be surprised if they did not know their landscape very well.

But there is some variability in how well hunter-gatherers *have* to know their landscape as well as in how well they *can* know it. Ethnographically known Arctic foragers, for example, can draw fairly accurate, detailed maps of large parcels of land. The Central Eskimo drew maps for Boas that covered some 650,000 km$^2$ (Boas 1888: 234–40). The Aivilingmiut (Iglulik) could map Southampton Island – some 52,000 km$^2$ (Carpenter 1955), and the Bering Strait Eskimo could also make accurate maps of long stretches of coast (E. Nelson 1899: 197). Inuit in Greenland could carve long, accurate maps of the coastline from wood (Petersen 1984). Groups in the tropics live in much smaller territories (Kelly 1983, 1995), although they also know large tracts of land. Silberbauer (1981: 95) notes that "few G/wi [of the Kalahari Desert] have any knowledge of geography beyond a radius of 250 km [about 196,000 km$^2$] and the personal experience of most is limited to a range of about 80 km [about 20,000 km$^2$]." The latter is still, nonetheless, a large area. Silberbauer relates several accounts which show that the G/wi do know this area extremely well and can orient their current location to known places. Likewise, Holmberg (1950: 120) noted that although the lowland Bolivian Siriono have only two cardinal directions (east, where the sun rises, and west, where it sets), "most adults have an excellent knowledge of the geography of the area in which they wander. No matter how meandering his course, the Indian never gets lost in the jungle and is able to return directly to the spot from which he started."

How do foragers know and communicate these large landscapes? First, hunter-gatherers know their landscape as cognitive maps, an internalized representation of spatial information (Golledge 1999: 15). These maps may occasionally be physically constructed through images scratched in the sand, or carvings, but these are temporary. Instead, landscapes are memorized and based on experience, rather than learned through an iconic projection; geographers refer to these two modes of acquiring a cognitive map as route-based and survey knowledge (Golledge 1999). Second, hunter-gatherers, like members of most small-scale societies, know their landscape in terms of specific named localities rather than in general terms (Fowler 1999). These place names often refer to specific characteristics of a place, as when the Toedökadö Paiute (cattail-eater Paiute) refer to a spring as *padici yibiwinni*, "place-where-water-bubbles-up" (Fowler 1992: 27). And places may often be related to mythical events of the past. The Australian Dreamtime is the best example (see e.g. Tonkinson 1978: 90), but there are others: the G/wi, for example (see Silberbauer 1981: 96) or the Toedökadö Paiute, who referred to an enormous sand dune in their territory (now

known as Sand Mountain) as *K*$^{w}$*azi*, referring to the snake who inhabited it and who formed the dune's sinewy "backbone" (Fowler 1992: 40)

Places may also be remembered in terms of events in the recent past that have meaning to the speakers. The Toedökadö referred to one place as *nimi?oho*, "people's bones," referring to a place where many people died when the Carson River was allegedly poisoned in the 1880s. Among California's Atsugewi "every small hill or flat seems to have had a name of its own," names that were sometimes descriptive and sometimes related to mythical events (Garth 1953: 195). Relying on her experience with the Ju/'hoansi, Biesele (1993: 55–6) argues that dramatic stories retain information better than other mnemonic devices. She shows that new stories are inventive retellings that incorporate new experience, and thus that oral traditions must be flexible to serve as a way to memorize information, including that of landscapes.

Sometimes places acquire names that are handed down but whose associated stories are not. Silberbauer (1981: 97) notes that there were several pans with names for which no one knew the origin; there was even one name for which no one knew the literal meaning. While I was in southwest Madagascar with the Mikea (Kelly *et al.* 1999; Poyer and Kelly 2000) I came to know a stretch of forest as "Antaitsoavaly," meaning "place of horse feces." There are no horses in the area today, and although young men knew the place and used its name, they had to ask the village's elder for its story (it had to do either with a horse-mounted foreigner who was looking for gold or silver [personal fieldnotes], or with the horses used when a footpath was widened to accommodate oil exploration [B. Tucker, personal communication, 2001]).

A landscape as a remembered surface of named places may become more important and prevalent as the land becomes more and more geographically monotonous. Returning to southwest Madagascar, the landscape there is thick, tangled forests with no significant topography. I once traveled with some Mikea along a 40 km stretch of forest trail that crossed named places every 2–3 km (data collected by Jim Yount). Most of these places were singularly undistinguished (to me), or referenced ephemeral things that no longer existed, such as a particularly large tree that was long since cut down.

Hunter-gatherers have terms to refer to compass directions, although these can vary from as few as two, normally east and west (e.g. the Siriono [Holmberg 1950: 120] or the Californian Shasta [Holt 1946: 343]) to as many as twenty-two (the Chukchee [Bogoras 1904]). However, as is true for other small-scale societies, foragers tend not to use compass directions when talking about location (Brown 1983). Most of the time direction is relational, given with reference to geographic features, as among the G/wi (Silberbauer 1981: 98), the Tanana (McKennan 1959: 113), the Ingalik (Osgood 1936: 102), and the Kutchin (R. Nelson 1986: 184). Distance, too, is relational and is measured in terms of how long it takes to travel from one place to another under different conditions rather than in specific terms. Thus, distance varies depending on whether a person is traveling alone or with children; burdened or unburdened; in good or bad weather; across steep or flat terrain; with dog-assisted transport or not (e.g. Silberbauer 1981: 98; Carpenter 1955: 133; Holmberg 1969: 122; Osgood 1959: 56; Honigmann 1949: 213; Garth 1953: 196). In sum, for hunter-gatherers (as well as for any persons who do not use printed maps) landscapes

are sets of named and/or "storied" places. These are generally made into a cognitive map, not necessarily as a two-dimensional map but as a relational set: one place is known as being a certain distance (or time) and direction from another place.

There are two factors to remember here. The first is that it takes time to learn landscapes. Learning a landscape begins with children (Tonkinson 1978: 31) and can take many years. Men tend to travel further and cover more terrain than women do, either through hunting or through trading, visiting, or wife-seeking trips that take them to other bands a long distance away. Boys learn the landscape by accompanying their fathers on hunting trips. In the Arctic, this does not happen until the boys are 12 years of age or so (e.g. Murdoch 1892: 417). While it would seem that younger boys could accompany their fathers in less severe climates, this is only sometimes true. Kutenai informants recalled that boys accompanied their father by the age of six (Turney-High 1941: 117). Although Klamath boys received their first bow by age six, they did not accompany their fathers until "several years later" (Pearsall 1950: 343). Neither Ju/'hoansi nor Australian Aboriginal boys accompany their fathers until they are about 12 years old (Marshall 1976: 322; Berndt and Berndt 1964: 133). This is important, because learning the environment takes some amount of time, and the earlier a child starts, the more he or she will learn. Nelson (1986: 184) states that a Kutchin man's familiarity with an environment takes many years:

> A man learns to find his way around in an area after a couple of years, but it takes much longer to become highly efficient as a hunter-trapper. Knowledge of the landscape is almost as important to successful exploitation of the boreal forest environment as knowledge of hunting and trapping techniques.

And since the landscapes are learned as a set of places that are connected to or exist as "remnants" of secular stories or sacred, mythical "adventures" of the past, one has to know not just simple geography but also extensive folklore and/or religious information as well.

Second, some kinds of terrain are easier to learn than others. R. Nelson (1986: 184) makes this point in talking about hunting and trapping among the Alaskan Kutchin:

> An old Kutchin said that he could trap successfully far up the Black River even though the terrain is unfamiliar, because in that mountainous country it is easy to find the way. It is undoubtedly less difficult to learn to orient oneself by the configurations of a few dozen mountains than by an infinitude of local forest configurations.

The same difference exists in the tropical deserts of Africa, where the broken hill country of the Hadza is apparently easier for children to learn than the monotonous, rolling sand hills of the Ju/'hoansi's territory (Blurton Jones *et al.* 1994). Among the Inuit, Nelson (1986) notes that indicators of cardinal directions, such as the position of the sun and stars, and wind direction, are used for orientation, while the Athapaskans in the northern forests use topography – trails, lakes, meadows, and rivers. The simple reason is that on the Arctic ice and tundra there are fewer

topographic indicators; these cardinal directions and their relationship to wind and the common direction of weather, such as snowstorms, are especially important for sea-faring Inuit. (One can see this in some of the terms used. For example, according to Boas [1888: 235] the Central Eskimo term for east-northeast, the direction from which snow comes, is *qanara*, "is it snow?")

I have experienced these differences myself. I have spent a fair amount of time in the outdoors, and pride myself on not getting lost. But I have spent most of my time in mountainous country, where direction is easier to reckon. In southwest Madagascar, however, I experienced the unfamiliar, and frightening, feeling of disorientation several times. For example, on one foraging trip with a Mikea man I was shocked when after a few hours we suddenly emerged from a thicket into the camp that we had left. We had completed a circular route when I thought we had been walking all the while in a straight line out from camp.

## Landscape learning

Geographers recognize at least six different ways that humans "wayfind" (Allen 1999: 48–50). This categorization was developed, understandably, with urban or suburban dwellers in mind, or, at least, without hunter-gatherers in mind. Likewise, it was developed, again understandably, in terms of an individual's immediate behavior rather than in terms of the data of archaeology, where we see patterns that document not individual behavior but the aggregate result of the behavior of many individuals. Even when dealing with living individuals it is often difficult to sort out which wayfinding strategy is being used (Allen 1999: 50). I suspect there might be even more overlap when considering ancient peoples who did not use printed maps.

In thinking about the wayfinding issues that confront foragers, and especially those who were exploring new terrain or traveling to novel destinations, it seems that the development of a cognitive map of some area is most critical. In developing that map for an unknown region foragers would have to rely on oriented search, using information gathered during forays as a way to find their way home (keep the forest on your left, then, when you return, keep the forest on your right). Such trips would also undoubtedly involve some level of what geographers call path integration, in which a forager takes his or her ever-changing speed and direction into account to calculate where they are on a grid and to use that information to calculate a new direction home rather than following the outbound path (I walked at a constant speed over level terrain into the morning sun for two hours, then with the sun to my right or above me for two hours, so if I now walk with the late afternoon sun ahead of me and to my right I should be home in a bit under three hours [by walking the hypotenuse of the right triangle and assuming that time equals distance in this case]). Finally, a forager would certainly pilot between landmarks, using rivers or mountains, for example, to help locate him- or herself and return home. The less familiar a forager is with an area, the more prominent those landmarks would have to be. Following river systems is perhaps the most simple case, because if one goes upstream on the way out, one simply has to go downstream to return home.

The ease with which a landscape can be learned and converted into a cognitive map is related to the geography of the landscape itself as well as the amount of time available to a person to learn it. What strictly geographic factors might influence the ease with which a landscape could be learned? From the above discussion, two factors stand out. The contrast between the Hadza and Ju/'hoansi suggests that the presence of topographic relief aids in landscape negotiation, and possibly memorization. Landscapes that are flat and monotonous are more difficult to navigate and memorize. To an extent, this will be corrected for through keener perception that picks out more subtle topographic features for navigation. For example, at the 1990 International Conference on Hunting and Gathering Societies (CHAGS) in Alaska I was listening to a paper on northern Scandinavia. The slide that was projected had been taken from a boat facing the shoreline, and it showed a wide expanse of water with a very low terrestrial horizon that I perceived as "flat." Two Inuit from northern Canada entered the session after the speaker had been introduced and, after looking at the slide a few moments, asked me if the paper was about a particular place on the north Canadian coast. When I replied no, one commented to the other that the hill in the photo looked just like a particular place near the MacKenzie Delta. I had to look again at the slide to see, indeed, a slight rise in the middle of the photo that to me was meaningless as a topographic marker. Nelson's account above also suggests that in such situations non-topographic factors such as wind direction and sun position (both of which could vary, depending on the season) will be used to determine direction and the relative positions of places on a landscape. Still, it seems to me that the initial learning of a landscape would be more difficult where navigation required the use of subtle geographic features, or the use of those features in combination with atmospheric or solar patterns, than in places where topography was more dramatic and differentiated.

But too much topography, or topography with no larger pattern, may create its own problems. Ernest Shackleton and members of his failed Imperial Trans-Antarctic Expedition learned this lesson as they (eventually successfully) piloted their way across the uncharted mountainous interior of South Georgia Island in the 1910s. They had to repeatedly backtrack and try other routes to find a way across glaciers and arretes. In that case, the topography also presented a problem by requiring enormous physical effort to traverse it.

Badlands may not require such heroic effort to cross, but they are an example of a case where the topography has no larger plan to it, and where one could easily get lost until acquiring familiarity with it. Compare such badlands with the mountains of the Great Basin in the western USA, where all the ranges are linear, with normally a single spine running north–south, and all canyons running either to the west or to the east. People entering a new continent may have avoided areas where the local topography could not be connected to some larger topographic scheme. In this regard, linear mountain chains (or their foothills), major rivers, and coastlines might provide the easiest topography to navigate and to relate to other known places: "Just follow the coast north and you can't miss it" would be good, useable advice. Languages of Oceanic peoples, in which directions are commonly given in terms of "seaward" or

"sea-side" and "inland" or "mountain-side" (see Hill 1997), demonstrate this approach to the construction of cognitive landscape maps.

Vegetation might also make some landscapes more difficult to negotiate by obscuring prominent topographic features that could be used for piloting. Of course, this could be compensated for by simply climbing a tree (something everyone who has spent time doing archaeological survey in forested areas has done). But if heavy vegetation were combined with flat topography, then I would expect that major geographic features, especially rivers, would become the primary way of constructing a cognitive map. Harrison (1949: 135) asked a group of Penan foragers in Borneo – a tropical forest environment, albeit one with considerable relief – to construct a map of their territory with twigs and leaves for the purpose of tracking their annual settlement system. His rendering shows that rivers form the major feature of their cognitive map. In more open terrain, smoke from a camp's fires would also provide foragers with an easy way to locate themselves and find their way back to camp.

A second issue for colonizing foragers concerns the effect of having sufficient time to learn an environment. What if individual foragers do not have sufficient time to learn a landscape? What if, by the time a boy reaches 12, an age at which he can accompany his father on hunting and landscape-learning forays, his band shifts their territory to someplace new, where even his father is a novice? Again, Nelson (1986: 275–6) gives us a clue by contrasting the landscape knowledge systems of the Inuit and the Kutchin:

> The Eskimo devotes a lifetime to learning more and more about the habits of the animals and about the mobile sea ice on which he hunts, whereas the Kutchin spends a lifetime learning more and more about the landscape. The key to success in the high Arctic is knowledge of the game, current, ice, and weather – the major factors influencing resource availability; but in the boreal forest the key to success in hunting and trapping is knowledge of the landscape. The Indians must know where to find the trails, lakes, hills, valleys, forests, and meadows and the most stable concentrations of edible plants and game.

From this astute observation one might gather that where an adaptation forces movement into new terrain the ability to gather knowledge would be limited, and people would have to rely on a generalized and transferable system of knowledge of weather, animal behavior, and ecological relations that could be extrapolated from one area to another, rather than on region-specific knowledge. My guess is that in these circumstances people might very well develop cognitive maps that cover vast areas, but with only a few prominent landmarks and several major paths defined by geography – rivers, most notably. Within this landscape, my guess is also that a few known places would be used repeatedly, not necessarily because they are the best places, but simply because they are known and use of them reduces the risk that would be entailed in trying to locate critical resources, for example sources of raw material for stone tools. Risk reduction might be a more relevant factor for colonizing groups in new landscapes than for groups in known landscapes (Meltzer 2001).

Testing ideas about the effect of landscape learning against archaeological data is difficult. Most archaeological sites, especially those of ancient foragers, record long spans of time: we cannot see the first years of occupation without their effects being blotted out by the archaeological effects of later adaptations. Thus, we need to ask how landscape learning might affect large-scale patterns in the archaeology of a colonizing population. Two areas that may be useful here are studies of group size and mobility.

## Group size

How many foragers does it take to learn an environment? In entering new land, it would obviously be useful to have as many people as possible out gathering information. Ethnographically known hunter-gatherers tend to live in groups of about 25 persons, or perhaps a bit larger. There could be a number of reasons for this (see Kelly 1995: 209–13), but Winterhalder's (1986) discussion of reducing the risk associated with foraging probably provides the most accurate explanation. Assuming that foragers share their food resources, Winterhalder argues that the greater the number of active foragers, the lower the risk of anyone going hungry, because someone will bring home something. But, of course, the more people there are, the more rapidly an environment is depleted of food, the lower the return rates of the foragers, and the higher the frequency of residential mobility. At some point, a balance has to be struck between reducing the risk associated with foraging and the rate of local resource depletion.

Using simulation, Winterhalder shows that even at high levels of variance in individual foraging rates there is not much reduction in post-sharing return rates after a group contains 7–8 foragers. When children and the elderly are accounted for, a group containing 7–8 active foragers translates into a residential group of about 25–30 persons (Kelly 1995). The so-called "magic number" of 25 appears to be grounded in the reality of foraging.

But this sets up another problem. A group of 25 is fine for foraging, but not for reproduction; it is probably too small to be demographically viable (Wobst 1974, 1976). Hunter-gatherers solved this problem by customs that ensured extensive social contacts (e.g. marriage practices that forced people to look elsewhere for mates, and seasonal aggregations where mates could be found). However, a colonizing hunter-gatherer population would in all likelihood be small, and individual foraging groups might be spread far and wide across the land. MacDonald (1998) argues that this is precisely the situation that would have resulted in long-distance social networks and mating distances for Folsom peoples (not a colonizing population, but certainly one that existed at a very low population density). Indeed, using ethnographic data MacDonald shows a strong inverse correlation between population density and mating distance: as population density declines, mating distance increases.

But wide social networks might have been very difficult to maintain under conditions of low population density and territorial shifting (see below), where the landscape may not be known well enough to permit accurate long-distance travel. This is a particular problem, because any such travel requires that foragers be able to predict what group will be where. Ethnographically known foragers can make such predictions

because they have more-or-less redundant settlement patterns; members of a particular group can always be found at a particular spring or water-filled pan during the dry season, for example, or at a particular seed-gathering locality in the late summer, a stand of willows in the winter. They are not hard to find. But this may not have been possible for colonizing populations. Although colonizing foragers may have been more residentially mobile than later foragers (Surovell 2000), and hence may have increased the probability that they would run into one another, that seems too risky. Small groups who relied on chance for encountering other groups in which they could find mates may very well have found themselves alone and have become extinct. One way to reduce that risk would be to live in larger groups than are commonly recorded ethnographically. These larger residential groups may also have assisted with the landscape-learning issue by increasing the number of people searching a region at any one time. Some might even have been specialized information collectors. But this response to the demographic problem creates a problem alluded to above. The rate of local resource depletion would have increased and thus increased the need to move – into unknown territory at times, which would have started the process all over.

So, perhaps it is more likely that people lived in sets of small groups that were not spread far across a landscape and so could have remained in close social contact without placing such a strain on local foraging. I suspect that this pattern would be more likely than having groups of say, 60 to 100 individuals living together, because those large groups would have lowered the immediate, i.e. daily, return rate of foraging, which in turn would have increased the social tensions that among ethnographically known foragers often lead to group fissioning. Small but socially linked sets of foraging groups would also have helped create a shareable knowledge base about the landscape.

However, this approach might assume that groups were moving as coordinated sets. If one small group ventured alone into new territory it would run the risk of extinction. But such coordinated movements seem unlikely, unless there were some process at work at a higher scale. Perhaps Beaton's (1991) notion of "megapatches" is useful here, in which foragers adapt to gross environmental categories and learn enough about the nature of animal and plant behavior in these environments to be able to transfer that knowledge and push migration along them. These environments might include such gross categories as coasts, rivers, mountains, plains, or deciduous forest. Clearly, at times, people moved into new environments, but perhaps that was a secondary adaptation. If this were how humans compensated for the landscape learning conundrum of colonization, then there should be some clear implications in terms of geographic patterns and dating of movements, as well as the geographic distribution of artifact styles.

## Mobility

How mobile would a colonizing population be? The above hypothesis about group size has implications for mobility, for a larger group would more rapidly deplete local resources and require a higher degree of residential movement. Such movement

would make it more difficult to acquire knowledge of a landscape and negate the use of previously acquired knowledge. In such a case, there might be less of a premium on acquiring landscape knowledge and more on resource knowledge. Elsewhere, in discussing the specific case of the colonization of North America I have suggested that residential mobility would have been high and that territories would have shifted frequently (Kelly and Todd 1988; Kelly 1996, 1999). This was a function of a hunting-adapted people moving into an environment that was more similar across larger areas than today's biomes, and with a fairly high animal biomass that was naive of human predators. Under such circumstances, we could expect hunters to move fairly quickly across a continent as a combination of hunting-related pressures and the late Pleistocene environmental changes (which almost certainly played a role in the extinctions) that conspired to reduce animal biomass locally and make hunting in virgin territory more attractive than remaining in place and accepting lower return rates.But, if this reconstruction is correct, the lifeway it depicts is partly a product of the particular historical circumstances surrounding the colonization of the western hemisphere – namely, that the colonization was by an Arctic-adapted people who had no choice but to move quickly into the lower forty-eight United States. Serious questions are now being raised about the timing of the opening of the ice-free corridor, and we now know that the west coast of North America was free of ice earlier and more extensively than previously thought, perhaps making the latter a more viable route than the former. But in either case, people would have moved along a fairly narrow geographic passage into an environment south of the ice sheets that would have been significantly different from the Arctic they had just left.

In cases elsewhere in the world, people may have moved into environments that were more similar to the one they were leaving, and they could have moved into them more slowly. The colonization of western Beringia was very slow compared with that of the western hemisphere (Kelly 1996, 1999). The colonization of Australia, as another example, would have entailed migration of people from New Guinea who would have moved between roughly similar environments and been able to make a slow transition to the deserts and other environments of Australia. Likewise, the movement from New Guinea to northern Australia would not have seemed such an "all-or-nothing" affair as it may have for the colonizing population moving south of the ice sheets in North America. Not all colonizing populations confront the same landscape learning, mobility, or demographic problems.

However, it is likely that most colonizing populations would have experienced relatively high population growth, as Surovell (2000) has argued for North American Paleoindians. Such high growth would certainly not be out of line with that of other organisms that find themselves occupying an empty niche in new lands. Such growth would promote a continuous colonizing push across a continent by placing demographic pressure upon a local food base. So, in any case, we can expect a colonizing population to find itself moving into unknown terrain and to need to adapt itself to that circumstance. A key factor here, of course, is what sorts of constraints this places on a population. What do foragers need to know about their landscape and what do they have to do to get information?

## Conclusions

The rate of colonization is critical, because if it were fast, and it does appear to have been so in some cases, people would not have been able to learn their landscapes, since learning requires personal experience that is gathered from a very early age and that is encoded in folklore that requires some time depth for its development. If the environment cannot be learned, then people will need to rely upon a more generalized knowledge, resulting in a more regionally uniform, and perhaps less "optimal," adaptation (see Webb and Rindos 1997).

As an aside, the lack of a knowledge system rooted in geography would also result in a lack of geographically based ritual (and, I suspect, a lack of rock art) and the lack of a geographically based esoteric knowledge system. That is, a landscape mnemonic such as the Australian Dreamtime would not have been present in a rapidly moving colonizing population. (There's much more to Dreamtime theology than its function as a mapping device, but the point is that a theology could not contain a landscape component if sufficient time did not exist to permit development of landscape-based stories.) I would also expect that logistical mobility would provide a more rapid way to acquire landscape knowledge, since it is most likely that men would not be burdened with children and could therefore move faster and farther, and take more risks – as when they might try to return to camp by dead-reckoning their way from a river across a mountain range.

Regions that presented especially difficult landscape learning challenges may have been avoided if the risk associated with them was perceived as higher than some other area or the current "megapatch." My best guess, then, is that large-scale movements would be along easily traceable geographic features – rivers would be the most obvious one (see Anderson and Gillam 2000), but also linear mountain chains, or clear ecological zones, Beaton's "megapatches." But in addition to expecting colonizers to move along environment "corridors" whose resources were known, we might also expect them to move where the landscape is more easily internalized into a cognitive map. This means, coincidentally, that the nature of the adaptation brought with a colonizing population will have a strong influence over the initial choices made.

But if some areas are not considered habitable to a colonizing population because of perceived landscape learning impediments, then this also means that a colonizing population will have a smaller area of land available to it than might otherwise appear to be the case. If, for example, a colonizing population had a coastal adaptation, it might consider movement into the interior to be too risky if that interior presented (or appeared to present) relatively large landscape learning problems. Consequently, that population could be expected to move fairly rapidly, because they have for all intents and purposes relatively little land at their disposal.

It is difficult to rank environments on a simple scale of landscape-learning difficulty. In general, I would expect land without significant topographic relief or substantial waterways to be difficult places to learn initially (this doesn't mean that they can't be learned – obviously people did in places like Australia's Western Desert – it just means that, given a choice and holding other factors constant, people would turn away from such environments in favor of another). Heavy forest cover might

make such flat landscapes even more difficult. But at the same time I would expect places with too much topography or places without any obvious "scheme" to their topography to also be avoided. Again, heavy forest cover could make this sort of topographic situation worse.

Weather and seasonality would also condition the ease with which a landscape could be learned and cognitive maps generated. Arctic environments, for example, are not very forgiving; misjudgments might have severe results. Less seasonal environments, on the other hand, might tolerate greater error and permit one to move into an environment with less knowledge of it. This could mean that migration would be faster in tropical environments than in Arctic environments. But water will be another major conditioning variable. One can go without food for some time, but not for very long without water or some viable plant substitute, such as melons or water-engorged tubers. Extreme deserts could have been perceived by a colonizing group as entailing too much risk, and may have been colonized later, through demographic pressure, but also more slowly, as they are explored (whether this would be detectably slow using the chronometric scales of archaeology is hard to tell).

In closing, let me bring up a problem that Meltzer (2001) deals with in greater detail. In this paper we have treated landscape learning as a problem at the level of the individual standing before a vast prairie or mountain chain that he or she knows nothing about. We have asked, how would such individuals behave? What choices would they make? There is, perhaps, no other way to ask the question; or perhaps the fear (or excitement) that such a situation might generate leaves us too exhilarated to think of it in any other way. And even though the archaeological record is the conglomerate product of individual behaviors, it is not clear whether that record reflects those decisions or whether it reflects some other level of behavior – simple return-rate maximization or risk-minimization approaches, for example. Maybe landscape learning is a relevant problem, but it is not one that can be studied from archaeological data. Other chapters in this volume will take up that torch.

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## Note

1 Actually, Tindale (1974: 87) offers a brief account of the Nakako, who moved into an area that had been abandoned for some time. Unfortunately, all Tindale says of this group is that 'they found themselves unable to find mining places for new stone. They had, therefore, been compelled to glean old implement stone pieces from archaeological campsites and remake them...'

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