Pacific Ethnomathematics: The Richness of Environment and Practice

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Abstract

Contrasting geographic features that are evident between atolls and islands in Micronesia and in large Pacific land masses, particularly those of Papua New Guinea, have historically compelled indigenous peoples to apply distinctive linear systems related to distance, place, and ancestral origins. In the Caroline Islands of Micronesia – particularly on the islands of Puluwat and Satawal – traditional land finding techniques have applied linear approaches to the rising and setting of stars as they relate to specific sea routes between home islands and target islands. While linear concepts used in the culturally nuanced, earth grounded sand drawings in the Melanesian nation of Vanuatu are unique in their own right, linear based mnemonic systems for the recollection of ancestral origins and prestige granting cultural knowledge at sea in the Caroline Island and on the ground in Melanesia have interesting similarities. A greater academic concentration on the rich ethnomathematics of the Pacific could yield a trove of revelations in comparative cultural practices.

Atoll Linearity and Distance Calculations in the Caroline Islands

Numerical, spatial, and linear concepts in Melanesia, Polynesia, and Micronesia vary in accordance with distinctive physical environments and the social and cultural histories embodied in these Western assigned boundaries of the Pacific. Counting systems, agricultural calendars, and methods of conveying currency values for exchange are, in a comparative sense, dominant in the scattered ethnomathematical references to Melanesia where Papua New Guinea is predominantly represented. And ethnomathematical concepts and practices related to space, distance, and linearity
generally form the environmental structure of ethnomathematics in Micronesia and Polynesia.

For Oceania, it is of course the environment of islands in a seemingly endless ocean upon which environments are not only known but perceptually understood in the context of cultures, change, and in the acculturating forces that colonial governments have wrought over the centuries. Smaller atolls, for example, hundreds of miles from larger land areas, develop linearity, space, and horizon based concepts for measuring distance or direction and for more immediate measurement ideas. The navigators of the central Caroline atolls of Satawal and Polowat represent not only the past, but also a fairly recent renaissance of indigenous pride over the reality that their ancestors did indeed control their voyages by numerous environmental means including aligning distances with stars and sectionally dividing a journey between two points into several segments using a midway, out-of-sight island that was either real or imaginary.
This technique, known as *etak*, provides the means by which the navigator can tell where he is – essentially which segment (and thus distance traveled) – during a specific voyaging route. This is but one mechanism of orientation in a three-pronged task for leaving and finding land: orientating oneself in relation to a home and a target island, keeping on course through dead reckoning, and achieving landfall. Like the star compass described briefly below, the *etak* technique for understanding one’s progression qualifies as an example or product of a cognitive mapping process that does not follow the
standards of western maps of longitude and latitude but rather mnemonic sources that contribute to the ultimate achievement of landfall. More than anything else, it is a method of organizing information in ways that are primarily concerned with non-instrumental dead reckoning on the way to a target. In the case of etak, the canoe conceptually remains stationary as the stars, particularly those used to mark the location of islands through the places of their rising and setting, remain fixed. (Gladwin [1970] uses the near stationary mountains that a passenger on a train sees as a comparative example.) One out-of-sight island is chosen for each sea route and it serves as a fixed marker for that route. It is ideally located around fifty miles off to the side of the canoe and about midway between the home island and the target island. The star bearings for the reference island are known before departure as are other navigational star positions that the reference island will pass under as this island “moves” during the voyage. Each time the island “moves” under a new, previously known navigational star, this marks one completed etak or segment in the voyage. According to Hutchins (1983), these stars bearings “radiate out from the navigator” as they are applied to the reference island and the segmentation of the journey thus contextualizing the practice as something more than simple line orientation in space.

So, if a particular sea route has four such etak, the completion of the first etak would mean that one quarter of the voyage has been completed. If there were six etak to a particular sea route (as in the illustration above), then one-sixth of the voyage would have been completed. Estimation however of actual distance traveled (as in a western idea of miles or kilometers) is relative to a subjective understanding of wind conditions and the passage of time marked by the movement of stars. (Gladwin [1970] also
compares this subjective understanding to a man walking in a familiar field at night and approximating his position through an innate familiarity with the field.) The etak segments form uneven triangles which are potentially made more uneven, or rather longer, at the start and end of the voyage if the reference island is relatively near to the canoe.

The system of etak is fixed and each etak system is attached to a specific sea route. Early European attempts at understanding the etak system mistook the reference island for a refuge island. However, in order for a navigator to know where the etak reference island is in relation to a specific route, the navigator would also have to know where all of the islands around him are, any one of which could provide a refuge island if sea conditions required it. (Not surprisingly and probably because of the patriarchal nature of voyaging knowledge, women as navigators are not found in European historical references which rarely attempted to interpret these systems.) It is also possible that an imaginary reference island could be employed so long as the same mechanism of the movement of the island under each established navigational star for a specific sea route is conceptually allowed to proceed. Because these etak segments are of temporal duration as the voyage proceeds, the system also allows for an etak of bird segments (designated for an etak near the completion of the voyage where land based birds would likely appear as land drew nearer) or an etak of “sighting” typically for an etak within which a home island or a target island is actually in sight.

The etak system is derived from a larger and more generally applied Carolinian “star compass” (also sometimes referred to as a “compass rose”) whose thirty-two uneven compass points based on the rising and setting of specific stars (the Carolinian prefix tan
is applied to names for rising points and *tubul* for setting points) are traditionally depicted in a circle with pieces of coral representing the stars, eight coconut leaves just inside the ring of coral to represent swell directions, and several banana fibers stretched across the face of the compass to emphasize reciprocal star courses. (See figure 2.) Given the east-west orientation of the Carolinian island chain across Micronesia, reference to a primary star for a particular sea route is always made in relation to its rising in the east. While most depictions of this star compass by western writers is typically circular, very early twentieth century German reports on the subject noted that Carolinian navigators used a quadrangular structure with Alkire (1970) noting that navigators from Woleai Atoll always depicted the star compass in the quadrangular. The four corners actually aided in the memorization of star and constellation point order along the compass’ perimeter (Alkire 1970, 41-43). Finney (1998) also notes that because most scholars consider the quadrangular form to have been original, the eventual presence of the magnetic compass with its thirty-two points may have transformed the quadrangular compass into a circular one.

In applications of the star compass specifically to the *etak* approach, travel time and the actual distance that exists between a home island and a target island are of very secondary importance considering the variables of sea voyaging. However, being able to know the distance that one has traveled in order to fix a position in the context of a sea route is of primary concern. Measuring distance equates to determining one’s location. These rising and setting points are applied to specific voyaging routes, depending upon the target island to be reached. The spacing is “uneven” in terms of the standard expectation that there be even spaces and points on a western mechanical compass since
the coral pieces represent the actual rising and setting of individual stars – none of which are obligated to meet this standard.


**Atoll Mnemonics**

Indigenous principles of mnemonics are integral to the learning, recall, and recovery of components of linear based sequences – whether those sequences involve
etak-like stellar systems of Puluwat to reach specific atolls using star driven courses or the recollections of story-based ancestral names and contexts. As is the case in much of Pacific scholarship, colonial and imperialistic forces have generally shaped the geographical structures of analysis so that a comparative study of, say, the patterns of Yapese formal seating arrangements based on protocols of authority in Micronesia with those found in Fijian formal settings, would require a significant break with the North Pacific’s American dominated scholarship with the South Pacific’s British based analyses and all of the scholarly antecedents from each respective colonial power. Fortunately recent history and anthropological conferences have helped weaken this colonially induced paradigm.

That is what makes Per Hage’s 1978 comparative study of mnemonic systems unique in its analysis of techniques used by the navigators of Puluwat to organize their non-instrumental navigational knowledge as well as prestige granting cultural information and the mnemonic techniques the Iatmul people of Papua New Guinea use to implement their ancestral recall system by employing a name cycle with “phonetically and semantically interacting pairs” and clusters as is discussed in the next section. Although the ideas of cultural recollection are similar between the geographically distinctive societies on Polowat atoll in Micronesia and the Iatmul people on the far greater land mass of Papua New Guinea – this recollection solidifying prestige and power on Puluwat while supporting land claims for the Iatmul – the conceptual diagrams that they produce, not to mention their functionality, are distinct from each other.

The Puluwat people have used points composed of real islands or reefs and imaginary “ghost islands” and fantastic, nonexistent creatures that are joined by lines
representing star courses between these points. This mnemonic system may be a structure embedded in a larger image, such as a trigger fish that encompasses a large sea area of several island destinations or in the movements of a mythical hero or a legendary navigator (or a fish that represents that navigator) along a series of courses. Or five trigger fish, in triangular shape, could be linked together via their dorsal fins, each encompassing the unique elements of these points and lines all the way from the central Caroline Islands to Guam and the Mariana Islands hundreds of miles to the north. This mnemonic device allows for navigators to use a set of locations that are each associated with an “image of an item to be remembered.” Each item is then “recalled by mentally traveling from place to place and observing each item stored there.” (Hage 1978: 87.)
Here, for example, is Saul Riesenbergs rendering (1972) of a Polowat mnemonic scheme using the metaphor of a giant trigger fish envisioned as a diamond – the head, tail, dorsal fin, and the ventral fin representing four different geographical features. (See figure 3.) A fifth feature to the trigger fish is the backbone composed of geographic
phenomena, real or imagined which function as centering agents. None of these geographic places, either real or imagined, lay precisely on these diamond formations. But they are approximations of geographic markers which in the case of these four linked diamonds or rather, trigger fish, would lead a navigator from Polowat in the central Caroline Islands to Guam in the Mariana Islands.

It is important to note that this scheme and others like it also serve important mnemonic functions for recalling important cultural information such as myths, chants, spells, and so forth. While metaphors like this strengthen the recollection of star courses, they also enable navigators to participate in an esoteric language common to their class and to increase their status through demonstrations of cultural recall that these systems enable. Think of it perhaps as individual markers located in a high rise building that, upon reaching, remind the climber of a set of distinct facts or processes for an entire organization. Or a medical student who uses acronyms to remember a series of muscles. Each letter reminds the student of an item from a set of letters that ultimately represents this ordered sequence of muscles. (Hage 1978: 85.)

Another example is the parrot fish metaphor in the Reef Hole Probing system. Initially meant to enable a navigator to find an entrance through the reef into an island’s lagoon, the system is suddenly enlarged when the navigator pokes a stick into a deep hole of that reef, scaring the parrot fish off to the reef hole of another island. When the navigator reaches that island and probes that reef hole with a stick, the parrot fish takes off again to the next island, following the established star course for reaching each island. The navigator reaches that island, probes again for the parrot fish and the parrot fish swims again to the next island and so on until the navigator is back at his starting point.
where he finally catches the fish. Each island point in this sequel of star courses and perhaps at points in between where real or imaginary creatures - such a two headed whale or a spirit in flames - can appear, prompt the mnemonic recollection of a traditional story or other cultural information that strengthens the navigator’s status in his society. Such systems can also include more uncommonly known remote places for the sake of finding the solitude that enables the outlines of the system or systems to remain sharp in the navigator’s mind without interference from others.

**Linearity and Mnemonic Distinctions between Atolls and Larger Land Masses**

Mnemonic systems of the Iatmul people of Papua New Guinea employ name clusters representing “classes of objects conceived as totemic ancestors” (Hage 1978: 88) rather than the fixed location sequences that the Polowatese people use to store and retrieve cultural information. In either case, the mnemonic effect appropriate to their cultural, social, and survival needs is achieved. Recall of Iatmul names is facilitated through story narrative in the same way that the mnemonic structures of the Polowat system is designed to be remembered as a unit. According to Hage, “the names are classes of objects conceived as totemic ancestors. Each name refers to a detail or segment of a myth and groups of names are corporately owned and individually assigned . . . . Iatmul names are patterned in some way, just as the Puluwatese locations are patterned in some way. They are grouped into homogeneous sets – “name cycles” – and within each set they are grouped into phonetically and semantically interacting pairs so that each
name is a cue for the other through sound and association.” As is the case with Pulwatese knowledge of different linear structured destinations to locations of cultural information, recall name clusters achieve the same goal. Those learned in either technique possess various components of cultural knowledge in the case of the Puluwatese and name clusters in the case of the Iatmul – both in large quantities, with a “learned” Itamul person possessing “from ten to twenty thousand names including those of many other clans in addition to his own” (Hage 1978: 88).

For the Iatmul people, legitimate possession of these names becomes dependent upon one social group’s capacity to associate mythology or more appropriately, stories, in greater detail than another group. Almost all of the names, which are arranged in pairs (and “each pair generally resemble each other much as the word Tweedledum resembles the word Tweedledee” Bateson, 1958: 222-223) are compounds composed of four to six syllables. The mnemonic relationship between the names and the myths or stories “appear to be reciprocal in nature,” Hage writes. “The names may be more easily remembered because they are embedded in a narrative. The stories may be more easily remembered because each detail or segment is cued by a particular name or pair of names. This type of reciprocal relation also characterizes the star courses and narrative content in the Puluwatese system . . . . The entire cognitive structure is designed to be easily memorable – as a unit.” (Hage 1978: 89.) The legitimate possession of these names by a social group is eventually confirmed however only through the demonstration of its knowledge of related mythological references in a public debate during which methods of cuing aid one’s cognitive performance. (See Bateson [1958], pages 125-131 for a description of this ceremonial debate.) On Puluwat, such cuing occurs on “learning
mats” upon which shells are placed to help in the memorization and recall of star positions. “In both cases,” Hage observed, “erudition . . . [which] relies exclusively on memory is generalizeable”: Puluwatese navigators may achieve higher status and office and Iatism “learned men,” assert themselves, according to Bateson (1958), “not only in the debates which concern totemic names but also in those on every subject from initiation to land tenure” (Hage 1978: 91). Bateson also points out that “the people are very proud not only of the number of their totemic ancestors and their esoteric exploits in the origins of the world but even of the “straightness” of their song cycles” (Bateson 1936: 128).

Impact of Atoll and Island versus Large Land Environments on Information Recall Systems

Environments and indigenous responses to them reflect forms of ethnomathematical concepts that have often gone unrecognized as such. Nowhere is this perhaps more apparent than when one considers the differences between communal practices in Papua New Guinea, marked by tribally distinguished counting systems for agricultural and inter-tribal exchanges and the comparatively minor role of such systems in the Micronesian islands of Chuuk where the heavens and distinct boundaries of the sky and a unique organization dominate ethnomathematical-like thinking. These two distinct cultural perspectives make considerable sense when one thinks of the massive land of Papua New Guinea with its hills, mountains, valleys, and extensive concentrations of unique peoples as contrasted with the atolls of Chuuk which were traditionally created by the deep, underwater ‘Bearer of Islands’ (Nikowupwuupw Fénú) or simply the ‘Bearer’
or ‘Nurturer’ who heaped stones upon her back and arms until they broke the ocean surface, creating Chuuk. Another interpretation from German anthropologists from the 1920s has The Bearer as a great eel upon whose breast the earth rested (Bollig 1927, 12).

But up and beyond the sea spans Fachchamw – the ‘Under Brow’ just under the arch of heaven where the gods of pre-Christian Chuuk resided, the most prominent being the ‘Great Spirit’ with an assembly of gods and spirits such as ‘Good Determining’ (Óórorofich) who is the brother of ‘Father of Determining’. Other godly residents of the ‘Under Brow’ included ‘Mother Age Worn’ (Inemes) – sister of the ‘Great Spirit’, ‘Lady Wishing’ (Neyáneyán), ‘Rains Father’ (the god of weather), along with ‘Finisher’ (Äremei), ‘Gossiper’ or ‘Babbler’ and ‘Lord of Plover Birds’ (soukuling). ‘Middle of Heaven’ (Nuukevinen) or simply ‘Middle’ served as the Great Spirit’s intervener in human affairs who itself was the originator of various manifestations who served specific functions in these interventions. Goodenough notes that Suuta – one of his informants - associated Fááyiro (meaning the ‘under-arc’ or ‘under-bow’) with a meeting house in 1964. “The implication seems to be,” Goodenough writes, “that people are assembled under the aegis of the arc of heaven and also under the aegis of the Fááyiro school of itang” which is linked to “an outrigger stanchion as a support that serves as the ‘maintainer’ or ‘repairer’ of the land” (Goodenough 318-319). (Itang were political priests holding substantial power who possessed special bodies of knowledge and the rhetorical skills associated with that knowledge.)

This vision of the heavens and thus the inherent attachment of distances to that envisioning also appear in the atolls of Kiribati where the evening sky is likened to a vast
roof supported by imaginary rafters – three on the eastern slope of the roof and three to the western correspondence. (See Figure 4.)

![Figure 4, Roof of Voyaging. From Grimble, page 198.](image)

Drawing from information provided to him by some of the approximately twenty persons on Kiribati still versed in traditional stellar knowledge in the 1920s and 1930s, Arthur Grimble describes the I-Kiribati conceptualization of the night sky as being a vast roof – a vast ‘roof of voyaging’ to be specific - in which the eastern horizon functions as the ‘roof-plate of east’ (*te tatanga ni mainiku*), the western horizon as the ‘roof-plate of the west’ (*te tatanga ni maeao*), and the meridian (*te tabuki*) serving as the ridge-pole for this heavenly roof. The I-Kiribati appear to be more specific than the Chuukese about how this sky is actually held up using imaginary rafters – three on its eastern slope and three on the corresponding western slope with a middle pair of rafters representing the I-Kiribati celestial equator that is about 8 degrees south of the standard Western equator.
The apex of this middle set of rafters is found at the point at which the star Rigel (beta Orionis) crosses the meridian. The point at which the Pleiades crosses the meridian represents the apex of the northern rafters. Antares provides the meeting point for the southern rafters at 18 degrees south of the I-Kiribati equator.

Across these rafters, three series of cross-beams, equally spaced across each slope of the roof, are imagined. Grimble likens them to “steps of a ladder up the sky” of the east (Grimble 216). While the western sky is structured exactly the same, this portion of the sky is envisioned as having numbered purlins leading down from the meridian to the horizon. It is over this tremendous framework that the stars provide a continuously shifting thatch under which the observer can calculate the altitude of a star with the imaginary rafters enabling the individual to also measure the star’s declination. Indigenous names for various points on each purlin across which specific stars move are also used in the system. Before being allowed to identify specific stars upon this imaginary but intricately structured roof, Grimble’s informant was required to memorize the exact names for at least 178 stars and constellations – sometimes using or weaving original tales about the stars as “persons or objects seen during the voyage of some fictitious character” (Grimble 218).

These tales were often transformed into songs whose lyrics functioned as storage containers and apparently enabled ancient voyages by Carolinians to Guam to resume in 1788, at least a century after Carolinians began to steer clear of Guam because of a perceived brutality of Spanish colonialists and then again in 1805 after they had been convinced by a Chamorro administrator (who traveled to Woleai atoll to reestablish connections) that the 1788 fleet that was lost at sea perished because of a storm and not at
the hands of the Spanish or the Chamorros. The songs were definitely used by voyagers from Polowat and Satawal to Guam and the Northern Mariana Islands in the 1960s, 70s, and 80s after a voyaging hiatus of about 90 years.

In contrast, the piecemeal references to ethnomathematical practices found in the ethnographic and anthropological literature of Melanesia (and dominated by references to Papua New Guinea that range from the early 1900 until the present) underline the centrality of geographic context that becomes more apparent when contrasting Micronesian and Polynesian focuses on the heavens and the horizon. Alan J. Bishop’s research (1979) on the visual and spatial abilities of first-year students at the University of Papua New Guinea, for example, demonstrated that not only did these students fail to use roads in drawing a routing map between two points, they lacked indigenous words for “line,” “horizontal,” “vertical,” and “above.” Ten years later, Bishop was offered words by peoples of the Papua New Guinea Highlands for the steepness of slopes but he still failed to find indigenous words that could be used to describe the idea of something being “horizontal.”

In one study of indigenous mathematical, conceptual qualities of Papua New Guinea children – one of the few subjects in Pacific ethnomathematical literature that is responsive to other scholarly efforts – these children were found to have difficulty in “conceptualizing spatial relations in terms of Euclidean and projective relations involving awareness of straight lines, rectangles, metric relations and proportions, unless the circumstances of their material existence demand such conceptualizations.” (Hallpike: 1979, 318.) One could perhaps say that this observation is indicative of Eurocentric expectations not only in what one anticipates seeing and not seeing but setting the
standards for what to look for in the first place. But in this case, the research was set in the context of needing to discover ways to help students enrolled in the western modeled schools of Papua New Guinea.

It is nevertheless obvious that the physical environment of these areas of the Pacific – the natural priority that residents of far flung atolls and islands have placed upon the sea and the horizon in contrast to the priority that peoples of Papua New Guinea have placed upon inland environments of a very large island – have a tremendous, natural impact upon the mathematical and geometric systems that these cultures have developed over the centuries. And certainly the importance of centuries of use and change or sustainability is clearly evident both in the complex network and independence of the numerous indigenous counting systems throughout Papua New Guinea, many of which do not rely on a base ten foundation and in the methods of navigation in Micronesia which today contribute toward building a sense of cultural pride for an indigenous seafaring history.

**Melanesian Linear Concepts and Cultural Practices**

While linear concepts geared toward the horizon can of course differ among Micronesians, lines and linear concepts attached to the earth and things of the earth are at the same time as traditionally bound in Melanesian societies as are traditional hierarchical concepts of the sky or the heavens in Micronesian and Polynesian societies.
Figure 6, from Deacon and Wedgwood, page 148.
This may be most evident in the sand drawings of the Malakula people of Vanuatu (see Figure 6) whose tracings are perhaps most dramatically represented (and from Western eyes, you could perhaps charge exotically as well) by the drawing that the female ghost Temes Savsap half erases and expects each dead soul, based upon his or her fluency in culture, to correctly reconstruct this half before being allowed to pass on to the land of the dead. If the dead fails in this task, he or she is automatically consumed by Temes Savsap. (See Figure 7.)

Temes Savsap was eventually vanquished – at least in the Seniang District of Malakula - by a deceased man who woke up, asked for his bow and arrow, and implored mourners to check to see if the rock of Temes Savsap had fallen into the sea the following morning - thus proving his successful killing of this demonic guardian of the land of the dead – before falling dead again. The rock was found fallen into the ocean, subsequently leaving the design associated with Temes Savsap without function.
The geometric drawings that A. Bernard Deacon studied in the 1930s in Vanuatu are characterized by a central purpose which Deacon stressed was to usually “execute the designs perfectly, smoothly, and continuously” without stopping at any point in the drawing’s composition and with no line ever being traversed twice. The strong symmetry of these designs also include those that are naturalistic in nature which according to Camilla Wedgewood’s study (1934) of these drawings and Deacon’s interpretation are
also more maze-like in an effort to add elements of realism to the depictions of animals and plants.

One cannot simply generalize, however, that because Micronesia’s geographic situation places vast oceanic distances between atoll and islands, a vast cosmology of structure must therefore be birthed by the vastness of the heavens. A grounding of a cosmology and social identity within the landscape of an island - Tanna in Vanuatu – is a good example of how the drawing of distinctions between the linear concept formulations among atoll inhabitants and the more earth focused concepts of larger islands like Papua New Guinea can also become blurred. Although there are some contextual distinctions to be drawn between the anthropological attachment of the rhizomatic model of topographic inscription to Oceanic conceptualizations and practices as opposed to the arborescent or tree-like Western models, the horizontal root stem system that links up and crosses over the territorial creations of primordial ancestors in Tanna have been contrasted and compared with the Dreaming tracks of Australia’s Aboriginal peoples. (Rumsey 2001.) Although the people of Tanna have not historically been subjected to the dispossession of large tracks of land as the Aboriginal peoples of Australia have, their historical resistance of colonialism and Christianization has led to a renewed emphasis on Tannese “Kastom” upon which rests the indigenous ethnographic research and application of chants, traditional stories and narratives in order to apply customary links – and thus identity - to the land and subsequently “marking out the truly settled people of kastom in relation to it” (Rumsey 2001: 39).

On the other hand, while there is no particular order of precedence among Aboriginal origin places, a place called Kwavar (now underwater in the Torres Strait) has
served as a “single origin place for all the Moorehead people.” After survivors of the flood that inundated Kwavar moved to a second place – *Tjuari* – “they moved on to a number of other places, sometimes in linear series but often also in successive phases of proliferation out from common nodes” (Rumsey 2001: 28). Efforts to link ancestral origins and tracks to the land have also been central to the politics of Aboriginality in Australia. Distinct forms of topographic inscriptions are involved in both environments while the emergence and the movement of these ancestors across the landscape are traditionally nonhierarchical and are thus more reflective of the rhizomatic model of topographic inscription than of the arborescence model.

Deleuze and Guattari (1987) have stressed distinctions between rhizomatic and arborescent models as they relate to topographic inscriptions of native peoples. The former is associated with “nomadic socioterritorial regimes” – which characterizes these Melanesian methods of ancestral tracings and subsequent tribal claims to lands. The hierarchical-based arborescent system is associated with a “centralized, state-based” regime (Rumsey 2001: 20) (i.e. “the West”) which may appear to be unrepresentative of what we are describing here. “The tree” in this sense provides a centering system within which units and subunits lead upward toward higher levels of influence to the extent that only higher levels possess higher information as growth occurs along “preestablished paths” (Rumsey 2001: 22). Deleuze and Guattari observe that “the rhizome is reducible neither to the One nor the multiple. It is not the One that becomes Two or even directly three, four, five, etc. It is not a multiple derived from the One, or to which One is added . . . It has neither beginning nor end, but always a middle from which it grows and which it overspills” (Rumsey 2001: 22). Rumsey argues, however, that in forcing this binary
abstraction of the arborescent model of thought representing “the West” and the rhizomatic model representing “the East” (i.e. Oceania), they themselves fall victim to the arborescent mode of thought.

The Morehead River system of totemic landscape or a “system of places” (Rumsey 2001: 27) in Papua New Guinea has an elaborate manner of precedence among origin places. Although there are two tree like indigenous metaphors evoked by this precedence (the Black Palm and the wasur - a type of fig tree), neither assumes the Western tree model but are rather models based, respectively, on a “lineal segmentation from a unity” and, for the wasur, a “scattering or fragmentation from a starting point or center” through which “center places” can be “reconstituted by people moving back to them from the places to which they had dispersed” (Rumsey 2001: 28). (See Figure 8.) No matter how many different strands occur from the universal origin place of Kwavar for all Morehead people, “each episode of differentiation replicates the last,” thus enabling things to “remain in their originary state” (Rumsey 2001: 28). This lineal “system of places” that targets ancestral origins and their emanations through tracks of land as specified and controlled by traditional narratives and chants, mirrors in a sense Puluwatese mnemonic schemes such as the trigger fish track upon oceanic spaces discussed earlier. As Ayres emphasizes, a claim to land on this “system of places” is made “not so much on the site of the story-place itself, but on the secret knowledge about it” (Ayes 1983: 122, 162).
In both the Moorhead and Tanna examples there are also precise differentiations of social space in land challenges associated with mythical recall that do not replicate the rhizomatic model. In the localization of power and knowledge, it is also interesting to note that Westerners in these Pacific contexts are considered to be not of this place and
are therefore nomads of the rhizomatic sense because they are not the indigenous peoples of the land.

Primordial ancestors among the Iatmul people of the middle Sepik, Papua New Guinea originated from a single pit who then moved about, creating various linear paths to specific places and at unique events that each clan claims ownership to. Totemic songs for these places, along with mnemonic devices such as the use of a twine cord with a knot for each named place among the people of Central and Western Iatmul, provide communal connections to this land-based cosmology within which place abstraction is more pronounced than in the forms of Australian Aboriginal topographic inscription. Nevertheless social identity and these cosmologies are indelibly linked.

Ideas of distance and that distance’s linear and horizontal foundations and the cultural complexities that form the marrow of cosmologies in landscape or in the heavens, are the products of their environments to which Pacific ethnomathematical concepts respond to. This is why generalized references to “the Pacific,” or worse, to “the South Pacific” have, in the course of historical Western influence, served to diminish these very intricate similarities and differences that have been represented in this paper by Carolinian etak, star compass, linear mnemonic and I-Kiribati “roof of voyaging” systems and by Melanesian linear information recall systems of the Iatmul, Malakula, and Tannese peoples. It is interesting to consider what cognitive similarities could be drawn, for example, between the Puluwatese linear systems of land-finding and mythical recall for societal standing and the Morehead cosmology of an ancestral origin and subsequent ancestral tracks over the land and how the Deleuze and Guattari models might bring them
closer together in understanding or pull them further apart – if Pacific ethnomathematics is given more concentrated attention.

One can legitimately hope, therefore, that if Oceania gradually receives more attention in the field of Ethnomathematics, these environmental distinctions and the indigenous histories that they pronounce will receive their legitimate place in the study of the many culturally nuanced ways in which Pacific peoples have responded to the unique worlds around themselves.
References


