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MICRONESIAN BIBLIOGRAPHY

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Akerblom, Kjell. 1968. Astronomy and Navigation in Polynesia and Micronesia. Stockholm: Ethnografiska Museet.

Akimichi, Tomoya. 1980. "Fundamentals of Satawalese Navigational Knowledge." Bulletin of the National Museum of Ethnology (Osaka) 5(3): 617-641.

In this overview of Satawalese navigational knowledge, Akimichi includes a discussion of the counting and memorization of stars as they relate to the sidereal navigational compass.

Akimichi, Tomoya. 1980. "Storm Star and the Ethnometeorology on Satawal." Kikan Zinruigaku 11 (4): 3-51.

Akimichi uses several illustrations of the Satawal sidereal compass and semi-circular representations of stellar rising stars to demonstrate the importance of such stars and their pointed positions during different seasons and months when navigators attempt to forecast storms. Illustrations also demonstrate the appearance and disappearance of storms in relation to these stars and the relationship between two primary "storm stars" and the sidereal compass. The storm stars are also represented on a plane delineation to illustrate the dynamics of star rising and setting in relation to storm predicting.

Akimichi, Tomoya. 1985. "Navigational Knowledge of the Yetak System and the Allocation at Sea on Satawal, Central Caroline Islands." Bulletin of the National Museum of Ethnology (Osaka) 10(4): 931-957.

Examines the 'etak' system of determining position and progress in a voyage by using an out of sight reference island whose position in relation to the canoe is determined by use of sidereal compass. Several illustrations of different angles and linear concepts of the etak system are included.

Akimichi, Tomoya. 1988. "Navigational Knowledge of Sea Life (Pwukof) in Satawal, Central Caroline Islands, Micronesia." Bulletin of the National Museum of Ethnology 13(1): 127-182.

Examines indigenous system of classifying sea life and its use in navigational strategies, including as a "cognitive devise for space allocation during a voyage."

Alkire, William H. 1970. "Systems of Measurement on Woleai Atoll." Anthropos 65:1-75

Indigenous measurement strategies for canoes, particularly measurement concepts as they relate to counting, length, time, and distance.

Ascher, Marcia. 1995. "Models and Mapes from the Marshall Islands: A Case for Ethnomathematics." Historia Mathematica 22: 347-370.

Ascher focuses on Marshallese navigational stick charts and the planar representations used to express wave interactions for the sake of establishing the direction and presence of atolls. Includes numerous drawings of planar presentations in these charts and their intended functions.

Bailey, C.R. Kim. 1978. "Traditional Ponapean Music: Classification and

Description.” M.A. thesis, University of Hawai’i.

Bailey provides a structural analysis of a Pohnpeian dance song and tier arrangements of dancers. She also includes detailed descriptions (and indigenous terms) of dance movements, symmetrically performed and the number of musical pulses per song stanza. Includes also a very detailed graphic profile, superimposing “individual dance pulse patterns over poetic text and rhythmic structure.” (pp. 250-254)

Ballinger, Bill S. 1978. Lost City of Stone: The Story of Nan Madol, the “Atlantis” of the Pacific. New York: Simon and Schuster.

Included on page 139 is a table for a counting system on Faraulep (Caroline Islands, Yap state) recorded by the Thilenius South Sea Expedition in 1908. The range of numbers associated with each of the 24 symbols runs from 100,000 to 60,000,000 although Ballinger notes that “symbols for such extremely high numbers have no apparent use in the daily life of a small atoll; they might be remains of the people’s previous culture before their migration to the outer islands.”

Barratt, Glynn. 1988. Carolinean Contacts with the Islands of the Marianas: The European Record. Micronesian Archaeological Survey, Report Series Number 25, August 1988.

On p. 54, Barratt includes a 1819 reference to a Carolinian voyager to Guam using bamboo pieces to construct a compass from which the voyager explains Carolinian interpretations and use of wind directions. The voyager also uses “grains of maize” to represent the position of most of the Carolinian islands.

Bender, Bryon W. 1969. Spoken Marshallese: An Intensive Language Course with Grammatical Notes and Glossary. Honolulu: The University Press of Hawaii.

Bender includes a list of numbers from one to one thousand (by multiples of ten after the number twenty), indigenous terms for days or the week and months of the year, and a few examples of cardinal numbers (pp.53-54, 112).

Black, Peter W. 1977. “Neo-Tobian Culture: Modern Life on a Micronesian Atoll.” Ph.D. dissertation, University of California, San Diego.

On pages 66-67, Black discusses the arrival and the anticipated arrival of the government field trip ship as “the key factor in Tobian time” on Tobi atoll, Palau. He notes how the atoll’s concept of a year is divided into three or four cycles of unequal time periods that are determined by the ship’s arrival.

Bollig, P. Laurentius. 1927. Die Bewohner der Truk-Inseln: Religion, Leben und Kurze Grammatik eines Mikronesiervolkes. Münster: Aschendorffsche Verlagsbuchhandlung.

Bollig provides a figure of 17 knot divination positions shaped in accordance with a legendary sailing canoe with explanations on the application of these positions for predictive and insightful purposes and basic elements of protocol practices between diviner and client.

Brandt, John H. 1963. “By Dunung and Bouj. Water Movements, Stick Charts, and Magic Help Natives Stay on Course.” Natural History 72(2): 26-29.

An overview of different types of Marshallese stick charts that demonstrate the dynamics of different kinds of waves in relation to the location of atolls. The “mattang” chart is described as being geometrically balanced for the purpose of teaching all of the waves and currents.

Brower, Kenneth. 1983. A Song for Satawal. New York: Penguin Books.

Browning, Mary. 1970. "Micronesian heritage." Dance Perspectives 43 (Autumn): 1-50.

Browning summarizes Otto von Kotzebue's 19th century observation of dance and song performances structured around circles of people with movements also occurring within the center of the circle. Also noted is an erotic dance that began with four beat metrical phrases eventually disrupted by pauses that converted the beat into 5/4 time with simultaneous, circular movements of arms and hands (pp. 18, 32).

Browning, Mary A. 1972. "Walab in Medo: Canoes and Navigation in the Marshalls." Oceans 5(1): 25-37.

Includes a concise description of the principles behind navigating by interpreting swells and particularly the "knots" they produce when they meet and are "fighting each other." Discusses the use of the swell's crest line for decisions to sail parallel to northerly winds.

Browning, Mary A. 1973. "Stick Charting" Sea Frontiers 19(1): 34-44.

A discussion of the three main types of Marshallese stick charts and their different approaches to illustrating the interaction of waves around atolls with corresponding illustrations of the charts. Browning also summarizes the mnemonic chanting scheme of syllables to maintain control of voyages and the spirits that surround voyagers.

Bryan, Edwin H., Jr. 1972. "Canoes and Navigation." In: Life in the Marshall Islands by Edwin H. Bryan, Jr. Honolulu: Pacific Scientific Information Center. 144-155.

In summarizing the Marshall Islands section of Hadden and Hornell's Canoes of Oceania, Bryan focuses on the "old sailing canoe" designed for distant voyages with a detailed analysis of the structure and shape of the canoe. Bryan notes the necessary convex curve of the hull facing the outrigger and the other straight side of the canoe for purposes of balance and speed. (p.149) Bryan also discusses the structure and function of Marshallese stick charts for determining wave crests and patterns and the subsequent shape of three different types of stick charts.

Bryan, E. H., Jr. 1938. "Marshall Islands Stick Chart." Paradise of the Pacific 50(7): 12-13.

Emphasizing the parallel position of the main atoll chains of the Marshall Islands, Bryan reviews the basic characteristics of the linear structures and purposes of three types of charts with three corresponding photographs of charts held by the Bishop Museum in Hawai'i.

Buck, Peter H. 1950. Material Culture of Kapingamarangi. Honolulu: Bishop Museum.

In his discussion of canoes and particularly on the shaping of canoe hulls on Kapingamarangi, (pp.175-176) Buck refers to the use of *roho* (arm spans) for measuring the length of a canoe. 3.5 *roho* equaled approximately 21 feet (p.175).

Burrows, Edwin G. 1963. Flower in My Ear: Arts and Ethos of Ifaluk Atoll. Seattle: University of Washington Press.

On pages 100-102, is a traditional seafarer's 'prayer' that includes a chanting by units of one hundred of the number of gods watching over the voyager.

Burrows, Edwin G. and Melford E. Spiro. 1953. An Atoll Culture: Ethnography of Ifaluk in the Central Carolines. New Haven: Human Relations Area Files. 69-99.

Includes an outline of an indigenous cosmology in relation to stellar navigation, details of the Ifalik star compass for voyages within the Caroline Islands with corresponding lines for specific routes, the lowering of coconut leaves in the water to help determine current directions, and an examination of the construction process for all sizes of canoes. The authors distinguish Ifalik canoes from the "proas" of the Marianas through the Ifalik's typical hull design which is symmetrical and longitudinally oriented rather than the proa's asymmetrical design.

Caughey, John L. III. 1970. "Cultural Values in a Micronesian Society." Ph.D. dissertation, University of Pennsylvania.

Caughey describes the three sequential "stones" or interrelated states of mind that make up competitive "strong thought" in Chuukese society and follows this with a square based framework of basic character dimensions of which "strong thought" is only a part (pp.30-33). Caughey also examines the role of the knot diviner (*sowupwe*) in the context of the special, secretive knowledge embodied in the *roog* framework of knowledge, noting the significance of numbers of knots tied in coconut leaflets for predicting the future and understanding hidden causes of events (pp.71-72).

Caughey, John L. 1977. Fa'a'nakkar Cultural Values in a Micronesian Society. Philadelphia: University of Pennsylvania, Department of Anthropology.

Includes a description and diagram of a Chuukese "direction-sector system" with 12 distinct directional points, and a circular diagram of classifying 11 sections of land and their relationships. (pp. 9-10) Caughey also discusses traditional Chuukese cosmology and its central image of the linear structure of the world, spatial classifications, linear diagram of father-to-child links in lineages (p.76) and the traditional practice of knot divination (p.143) using numbers of knots to forecast the future and to determine causes of events.

Colletta, Nat J. 1972. "American Schools for the Natives of Ponape: A Case Study of the Role of Education in the Development of Cultural Character Among the Ponapeans of Micronesia." Ph.D. dissertation, Michigan State University.

In discussing cross-cultural communication challenges, Colletta quotes an "English language expert" on Pohnpei who uses the example of Western and Pohnpeian concepts of a circle. He notes that "We (Americans) mean a flat continuous line, but the Ponapeans include a sphere and a cylinder in the safe definition of a circle." He notes that using the indigenous concept of a circle would probably be more effective in teaching mathematics. (p.119)

Cordy, Ross. 1993. The Lelu Stone Ruins (Kosrae, Micronesia): 1987-81 Historical and Archaeological Research. Honolulu: Social Science Research Institute, University of Hawai'i at Manoa.

Cordy includes a table of shape types (oval, rectangular, lenticular, etc.) of basalt adzes found at the Lelu ruins on Kosrae as well as a table on shapes of blade cutting edges (p.171-173). He also summarizes the dimensions and shapes of the ruin's basalt compound walls. (P.203)

Cunningham, Lawrence J. 1992. Ancient Chamorro Society. Honolulu: The Bess Press.

The ancient Chamorro words for measuring dry volume and length are provided along with a list of Chamorro words for numbers (1 through ten and one hundred) and

comparative numerical terms from the Philippines, Indonesia, Melanesia, and Polynesia. Cunningham underlines the similarities in number words across these geographic areas. He also includes a list of ancient Chamorro words for a counting system for nonliving objects and comparative, contemporary words used by Chamorros. Cunningham also provides a breakdown of an ancient Chamorro calendar with explanations of the meanings behind most indigenous terms for months of the year.

Daiber, Andrew J. 1986. "Significance of Constellations in Carolinian Navigation." Journal of the Polynesian Society 95(3): 317-378.

Daiber focuses on circumpolar star movements in order to derive north-south noninstrumental navigational strategies from Micronesian east-west astronomically based voyages. He maintains that using established star routes is problematic near celestial poles because of the lack of circumpolar stars. It is the angular movement of circumpolar stars around the pole that circumvents their usefulness in terms of the Micronesian star compasses' dependence on the linear rising and setting of stars.

Davenport, William H. 1960. "Marshall Island Navigational Charts." Imago Mundi 15: 19-26.

Davenport argues that the Marshallese interpretation of swell actions in relation to atolls represents a limited but "true cartography" and uses numerous illustrations of these swells and their representations by stick charts to support his point. Three drawings of Marshallese stick charts include detailed section labeling and linear relationships between types of swells represented on three different types of charts.

Davenport, William H. 1964. "Marshall Islands Cartography." Expedition 6(4): 10-13.

Focusing on swell patterns that are reflected in Marshallese *mattang* stick charts, Davenport demonstrates that the symmetrical relationship patterns reflected in the *mattang* are rarely realized in perfection at sea. Several illustrations of the chart and of the refraction motions of swells from an atoll are included.

Davidson, Graham R. 1983. "Cognitive Mapping Features of Micronesian Navigational Systems." In Thinking: The Expanding Frontier, Proceedings of the International, Interdisciplinary Conference on Thinking held at the University of the South Pacific, January, 1982. William Maxwell, editor. Philadelphia: The Franklin Institute Press. 79-88.

Davis, Charles. 1964. "Stick Charts of Micronesia" Navigation: Journal of the Institute of Navigation 11(1): 32-37.

Discusses basic principles of Marshallese stick charts using photographs of two early charts with some attention also paid to the presence of sea luminescence and its influence on using charts for navigation at night.

De Brum, Raymond. 1962. "Marshallese Navigation" Micronesian Reporter 10(3): 18-23.

Focuses on the interpretation of wave movements for finding land, including the recognition of forty-five degree angles of different waves emanating from atolls. Includes numerous illustrations of different wave refractions and movements.

Doran, Edwin, Jr. 1975. "Puluwat Canoe Speeds." Geoscience and Man 12: 83-89.

Distinguishing between the "Lamotrek" and "Puluwat" schools of canoe construction on Polowat in the central Caroline Islands and the social "filtering mechanism" that may

influence the transmission of canoe knowledge between these schools, Doran focuses on how intricate differences in canoe structures might influence speed performance of canoes from the two schools. Doran includes several detailed line drawings of canoe hulls from each school, a calculation of speed index for 15 canoes from several different canoe houses, and a correlation table of speed index, known speed ranking, and the builder's school.

Doran, Edwin, Jr. 1976. Wa, Vinta and Trimaran." In: Pacific Navigation and Voyaging. Ben R. Finney, compiler. Wellington: The Polynesian Society Incorporated. 29-46.

In comparing the single outrigger Carolinian 'wa' canoe and the double outrigger 'vinta' of the Sulu Archipelago in the Philippines, Doran focuses on their potential performances for long distance voyaging in terms of leeward and wind angles as well as speed. These performances are then compared with the modern trimaran. Doran provides numerous line drawings of multiple hull contours.

Ellsworth, John C. 1987. "Ancient (Pacific Island) and Western (traditional and modern) Navigation: A Reflection of Cultural Perspectives." Ed.D. diss., Columbia University Teachers College.

Erdland, P. August. 1910. "Die Sternkunde Bei den Seefahrern der Marshallinseln." Anthropos 5: 16-26.

Emphasizing the greater secrecy assigned to stellar navigational knowledge as opposed to knowledge of ocean swells, Erdland focuses on navigation by star and numerous lists of stars and constellations he obtained from navigators. He notes the application of a star's position over the island of departure and the extent of its value based on its linear use as the voyage progresses. He also discusses indigenous beliefs on the influence of stars on weather and the degrees of height required for stars so that winds can move freely.

Farrall, Lyndsay A. 1978. "Knowledge and Its Preservation in Oral Cultures." In his Unwritten Knowledge: Case Study of the Navigators of Micronesia. Victoria, Australia: Deakin University. 41-57. Also in Oral Traditions in Melanesia, D. Denoon and R. Lacey, editors. Port Moresby: Institute of Papua New Guinea Studies. Part 2. 91-111.

Farrall, Lyndsay. 1984. Unwritten Knowledge: Case Study of the Navigators of Micronesia. Victoria, Australia: Deakin University, School of Humanities.

This school course text overview of navigational knowledge includes a discussion of how the Micronesian system of *hatag* to keep track of position of sea "differs from modern mathematics in ways which suggest possible effects of literacy on modes of reasoning." (p.16)

Finney, Ben R., et al. 1986. "Re-Learning a Vanishing Art." Journal of the Polynesian Society 95(1): 41-90.

Finsch, Otto. 1887. "Canoes und Canoebau in den Marshall Inseln." Berliner Gesellschaft fur Anthropologie Verhandlungen. 22-29.

In discussing drift voyages from the Marshall Islands, Marshallese canoes, and canoe construction tools, Finsch includes illustrations of the sections and dimensions of a large canoe from Jaluit atoll.

Fischer, John L. 1954. "Language and Folktale in Truk and Ponape: A Study in Cultural Integration." Ph.D. dissertation, Harvard University.

Fischer examines the concept of structural levels in Chuukese and Pohnpeian folktales and speech (Chapter 5).

Freeman, Charles T. 1980. "Pacific Ethnonavigation." Ph.D. dissertation, Graduate School, School of Education, Health, Nursing, and Arts Professions, New York University.

Frake, Charles O. 1995. "A Reinterpretation of the Micronesian 'Star Compass'." Journal of the Polynesian Society 104(2): 147-158.

In arguing that the stars of the Micronesian 'star compass' "provide the names, not the positions, for abstract conceptual segmentations of the horizon circle into 32 equally spaced points," Frake notes a similar perspective gleaned from star compasses from Arab navigators and examines the difficult relationship between the "shape of a cognitive system and the shape of the physical cues in the external world that provide input to the operations of the system" (p.148). This shape is the Micronesian star compass with its circular illustrations demonstrating directions being defined by the actual rising and setting points of specific navigational stars and not by the degrees of a circular rendition of the European compass. The 32 points (a number that reoccurs in ancient star compasses of the Indian Ocean) are not the product of exact segmentations of a circle but are instead based upon "the intersections of the parallel paths of select navigational stars with the horizon" (p.152). Frake focuses his discussion around illustrations of the Micronesian star compass.

Fritz, G. 1904. "Die Chamorro." Ethnologisches Notizblatt (Berlin) 3: iii, 25-100. (Partial English translation. At Richard F. Taitano Micronesian Area Research Center, University of Guam.)

This partial English translation in draft manuscript form of the above German document includes a list of numbers used in simple Chamorro grammatical phrases. Chamorro measurement terminology is also used for length, time, position, and calendar date. Direction terms and terms for phases of the moon are also used (pp. 123-127).

Fritz, Georg. 2001. The Chamorro: A History and Ethnography of the Mariana Islands. Saipan: CNMI Division of Historic Preservation.

On page 45, Fritz describes the *Chonka* game played by Chamorros in which seven "small stones or shells" are placed in the seven depressions in each of two rows on a wooden board. He explains the objectives of the game in moving the stones or shells around the board. He also briefly describes the terms and concepts related to money, measurements, and weights (pp.52-54), noting that "measurement generally means (in the Chamorro language) *chinagi*, derived from *chagi*, 'to prove'."

Furness, William H. 1910. The Island of Stone Money: Uap of the Carolines. Philadelphia and London: J. B. Lippincott Company. (pp. 94-106).

In his description of *fei*, Yapese "stone money," Furness describes details of the circular structure of the *fei*, size variations of the structure, and the inner circle of the *fei* for inserting a pole to move the *fei* from one place to another as well as representative transactions and payment sizes and amount of *fei* for various items. Furness also touches upon the function of "stone money" for demonstrating a person's wealth. He notes that the value of the *fei* are determined by their diameters measured in spans "which in Uap [sic] means the stretch of the index finger and thumb." (p.96) ("A three span *fei* of good whiteness and shape ought to purchase fifty "baskets of food." p.101)

Furness also discusses the value of the large pearl shell whose “value is estimated by measuring them on the arm from the finger-tips” (p.103).

Gladwin, Thomas. 1958. “Canoe Travel in the Truk Area: Technology and its Psychological Correlates.” American Anthropologist 60(5): 893-899.

In the context of his discussion of the interrelated nature of the Chuukese personality, social organization, and navigational (particularly stellar) skills, Gladwin discusses the geometric nature and design of canoes, particularly the attributes of the V-shaped hull and variations in curvatures.

Gladwin, Thomas. 1970. “East is a Big Bird. Part II.” Natural History 79(5): 58-69.

Focuses on processes and cognitive and visual tools for the dead reckoning navigational system on Polowat, including the use of the vertical movement of equatorial stars and the major and minor stars of a sidereal compass.

Gladwin, Thomas. 1970. East is a Big Bird: Navigation and Logic on Puluwat Atoll. Cambridge: Harvard University Press.

In critically examining the potential inequality that standardized tests hold for students of low income levels in the United States, Gladwin draws upon cognitive issues involved in noninstrumental navigation on Polowat in an effort to highlight similarities in thought processes between these students and problem solving approaches used by noninstrumental navigators. Gladwin subsequently points out related areas of cognition that remain untested by these standardized tests and which fail to acknowledge problem solving skills employed by economically underprivileged individuals in America. Within this theme is a rich source of information on conceptualization practices in the natural oceanic environment around Polowat used by navigators, with several of these practices - particularly in relation to the sidereal compass and the *etak* reference island scheme - involving linear, mathematical concepts. See in particular Chapter 5, “navigation under the Big Bird” (pp.144-213). Gladwin pursues his comparative arguments on tests and problem solving perspectives in the book’s final chapter, “Perspectives on Thinking” (pp.214-232).

Goodenough, Ward H. 1951. “Native Astronomy in Micronesia: A Rudimentary Science.” Scientific Monthly 73(2): 105-110.

Examines primarily the use of indigenous astronomical concepts to use a star compass for sailing directions and the creation of almanacs and a calendar in accordance with star movements. Includes detailed illustrations of the 32 point Carolinian star compass (with stars named only when it is useful to do so), and the Carolinian calendar with variable length of its 12 “star-months.”

Goodenough, Ward H. 1953. Native Astronomy in the Central Carolines. Philadelphia: University of Pennsylvania Press.

Focuses on Central Carolinian astronomy and use of a widely spread sidereal compass for directional purposes in navigation as well as for purposes of time and calendars. Goodenough includes a detailed drawing of the sidereal compass of the Central Caroline islands (with each of the 32 stars numbered) along with corresponding notes to early German references to compass positions and their indigenous names from various Caroline islands.

Goodenough, Ward H. 1986. “Sky World and This World: The Place of Kachaw in Micronesian Cosmology.” American Anthropologist 88(3): 551-568.

In this argument against attributing ‘Kachaw’ in the oral history of Chuuk and

Pohnpei to the island of Kosrae, Goodenough discusses the traditional sky world of the Chuukese cosmology that was shaped as a “disc bounded by the horizon.” In association with this cosmology, “the expanse of heaven was likened to a great, upturned bowl” with the zenith divided into several layers. Goodenough expands upon the geometric dimensions of this conceptualization of the sky.

Goodenough, Ward H. and Stephen D. Thomas. 198? “Traditional Navigation in the Western Pacific: A Search for Pattern.” Expedition. Vol. 30 (pre-print copy).

Several illustrations are provided in this overview of Carolinian navigational concepts and techniques. These include a two dimensional projection of pathways of the Carolinian compass stars from the points of their eastern risings, an “island looking exercise” with linear relationships of places and living seamarks (called ‘aimers’) as one looks out from Woleai atoll, and a schematic representation of the “trigger fish” conceptualization of an alternative, cognitive sea chart of islands within Carolinian navigational knowledge. This latter representation of any set of islands and their locations is understood in terms of the trigger fish’s head, tail, backbone (marking a voyage’s midcourse), and fins and essentially provides an schematic mental map of select routes between islands. Also included is an illustration and discussion of “the great trigger fish” representation of the navigational world of the central Carolines reaching up to Saipan in the Northern Mariana Islands and a meridian and horizon linked depiction of a sidereal calendar and its concepts of “fighting stars” that bring stormy weather. Other linear depictions include the use of sectional “drags” from an out-of-sight reference island to determine distance traveled on a voyage, “aimers” used on a course from Polowat to Eauripik, and course adjustments made in response to ocean swells.

Goodenough, Ward H. and Hiroshi Sugita, compilers. 1990. Trukese-English Dictionary (Pwpwuken Tettenin Fóós: Chuuk-Ingemes). Supplementary Volume: English-Trukese and Index of Trukese Word Roots. Philadelphia: American Philosophical Society.

Goodenough and Sugita include numerous indigenous terms for phrases involving numbers, particular for seven and nine - for example - “*ttiweféw*: nine lumps or globular shaped objects; *ttiwesángá*: nine basketfuls of fish; *ttiwemmék*: nine fragments; *fuuwut*: seven chunks of cooked breadfruit; *fúúfóch*: seven cylindrical, sticklike, or long rounded objects (e.g., cigarettes, sticks, trees, vehicles, canoes, teeth, arms, legs),” and so on. Also included are phrases related to numbers themselves such as: “*iteyita*: total count, total number, all, each and every one; *éwérúúw*: the combined number one-two in serial counting by twos (formed from elements from both one and two).

Goodenough, Ward H. 2002. Under Heaven’s Brow: Pre-Christian Religious Tradition in Chuuk. Philadelphia: American Philosophical Society.

Goodenough explains the fundamentals of the system of number divination (*pwee*) in Chuuk used for several purposes including predicting the weather, the outcome of a battle, the identity of a thief, the probability of a good fishing day and many other issues and events. Fundamental to this system of divination with knots tied to coconut leaves was the counting of knots by fours using four coconut leaflets which provided 256 possible number combinations. Goodenough also discusses variations on this approach and permutations used in practice. He includes a table of indigenous names for combinations of numbers in a divination routine using snail shells arranged in 17 positions in accordance with a celestial derived canoe. He also provides a diagram of these positions, discussed cultural protocols in transactions with knot diviners and discusses a legend related to *pwee* divination.

Gunn, Michael J. 1970. "Etak and Other Concepts Underlying Carolinian Navigation." M.A. thesis in anthropology, University of Otago.

Hage, Per. "Speculations on Puluwatese Mnemonic Structure." Oceania 49(2): 81-95.

Important mnemonic structure graph on p. 83 and discussion on this structure throughout the rest of the paper.

Halpern, Michael. 1986. "Sidereal Compasses: A Case for Carolinian-Arab Links." Journal of the Polynesian Society 95(4): 441-460.

Halpern looks for a common origin or area of transmission of the similar sidereal compasses of the Carolinian and Arab navigational star systems, focusing on the common 18 points out of each compass' exactly 32 point structure. He factors in changing star patterns that have occurred over several millennia in pointing out commonalities. Also examined is the potential influential contacts Carolinians and Arabs had which lead to the possibility of a single point of transmission between the two systems somewhere north of the equator.

Hambruch, Paul. 1912. "Die Schifffahrt auf den Karonlinen-und Marshallinseln." Meereskunde Sammlung Volkstumlicher Vortrage zum Verstandnis der Nationalen Bedeutung von Meer und Seewesen 66: 1-40.

Hambruch discusses the Chuukese cosmology and conceptualization of the sky as a roof extending to the outer world but still enabling outside voyagers to slip into Chuuk primarily from the west. Hambruch also discusses visualized star lines between the rising and setting points of stars with many stars forming a vertical position against the horizon and making up part of the Chuukese compass rose that Hambruch illustrates.

Harrison, Sheldon P. 1976. Mokilese Reference Grammar. Honolulu: The University Press of Hawaii.

In his chapter on "Quantification," Harrison explains the classification of numeral prefixes in accordance with the kind of noun being referenced to. Distinctions and thus the word for each number from one through nine result from classifications such objects, persons, and animals. He examines the presence and use of morphemes in numeral prefixes and numeral classifiers with examples and a diagram of the construction of numeral classifiers using three morphemes. Also discussed is the construction of higher numbers from simple base ten arithmetic and the construction and use of three countable bases with an illustrative diagram of this construction. Harrison also explains serial counting numbers in Mokilese, fractions, ordinal numbers (with a corresponding diagram), positions of numbers in phrasing, and the use of numbers as nouns. Also included are examples of quantifiers for referring to objects without using specific numbers.

Hines, Neal O. 1952. "The secrets of the Marshallese Sticks." Pacific Discovery 5(5): 18-23.

Using four stick charts illustrated in Schück's 1902 Die Stabkarten der Marshall-Insulaner and several others, Hines emphasizes the uniqueness of each chart that may or may not be fully understood by other navigators. These variations underline the changing geometric structures of the older wave illustration charts still in existence.

Hops, A. 1956. "Die Polyesische und Mikronesische Seefahrt." Der Seewart 17(3): 86-93; 17(4): 125-134; 17(5): 172-183.

Discusses similarities and differences between Polynesian and Micronesian navigational schemes and concepts. Hops contrasts, for example, the Polynesian three star triangle method for keeping on a set course with the Carolinian sidereal compass and the Carolinian strategy of keeping an unseen reference island off to the side [etak] to determine known points in a particular voyage between one island to another. Includes illustrations of the three star triangle, Marshallese stick charts and distinctive cloud formations used in navigation.

Hops, A. 1956. "Über die Einmaligkeit der Marshall Stabkarten im Stillen Ocean." Zeitschrift für Anthropologie, Ethnologie und Urgeschichte 81: 104-110.

Hops examines the geographic structure of the two archipelagoes of the Marshall Islands in which their northwest-southeast extensions come in contact with northeast swells and determine the structure of navigational stick charts. These charts are meant to illustrate swell movements and change in relation to atolls. Hops also discusses the four major swells within these archipelagoes and the formation of swell 'knots' used to determine the position of an out of sight atoll. Includes corresponding illustrations.

Hutchins, Edwin. 1983. "Understanding Micronesian Navigation." In: Mental Models, edited by D. Gentner and A.L. Stevens. Hillsdale, NJ: Lawrence Erlbaum Associates. 191-225.

Emphasizing differences in computational styles between navigational techniques used by Micronesians and by Western navigators, Hutchins focuses on the use of star positions in relation to the horizon to determine one's position at sea in a voyage, for achieving landfall after a voyage divided into segments defined by these star positions and an unseen reference island, and for tacking toward an out-of-sight island while maintaining direction. Frake includes several drawings to illustrate his points including a traditional box shaped star compass with a triangular center and the depiction on the compass of directions between specific islands represented within the box. Other illustrations include a quarter circular representation of navigational stars for tacking upwind, schematic representations of the Carolinian star compass, and a linear depiction of the associations of a reference island, a canoe moving from one island to another, and navigational stars that break the voyage into distinguishable segments.

Jackson, Frederick H. and Jeffrey C. Marck, compilers. 1991. Carolinian-English Dictionary. Honolulu: University of Hawaii Press.

The compilers provide two and a half pages of Carolinian terms relating to the use of numbers in a variety of situations and in reference to numerous kinds of objects such as "*álimoowal*, the fifth general object in a series; *esetil*, one portion or piece of something; *eel*, the number three in abstract or serial counting."

Keate, George. 1888. An Account of the Pelew Islands.... London: G. Nicol.

Includes a limited "vocabulary" with 'Pelew' words for numbers from one to ten and from twenty to one hundred in ten number intervals.

Krämer, Augustin. 1906. "Der Haus und Bootbau auf den Marshallinseln (Ralik-Ratak-Inseln)." Archiv für Anthropologie 31: 295-301.

Drawing from time spent watching canoe builders on Jaluit atoll in the Marshall Islands, Krämer stresses the asymmetrical aspects of three different types of canoes and how the asymmetrical approach improves speed and maneuverability.

Krämer, Augustin. 1932. Ergebnisse der Südsee-Expedition 1908-1910: II. Ethnographie: B. Mikronesien Band 5. Hamburg: Friederichsen, De Gruyter & Co.

Krämer provides numerical combinations and indigenous names for 16 knot divinations as well as detail on the laying out of shells in the shape of a celestial canoe for divination purposes with each position representing one of sixteen number combinations (pp.336-340).

Krämer, Augustin and Hans Neverman. 1938. "Ralik-Ratak (Marshall Iseln)." Ergebnisse der Sudsee-Expedition, 1908-1910, II-B-11, pp.215-232.

In their examination of Marshallese society as derived from the studies of the 1908-1910 South Sea Expedition, the authors discuss the function of stars in Marshallese navigational knowledge and education, noting the perceived influence of the height of stars on weather and wind. Stars that are low on the horizon, for example, tend to 'clog' the sky. They also discuss the use of the eastern 'head' and western 'base' of an atoll to coordinate a departure with star points in relation to these geographic points. The points and swell representation lines of the Marshallese stick charts are also discussed as is the practice of canoes to sail diagonally in relation to each other in order to enhance chances of landfall.

LeBar, Frank M. 1963. "Some Aspects of Canoe and House Construction on Truk." Ethnology 2(1): 55-69.

Includes several drawings and associated explanations of indigenous measurement standards for outrigger booms and men's houses.

Lee, Kee-Dong. 1975. Kusaiean Reference Grammar. Honolulu: The University Press of Hawaii.

Lee discusses the use and terminology for cardinal numbers, numerals, quantifiers, and fractions in the Kosraean language as well as the process of number formations. The two types of cardinal numbers (soko and sie) are explained in terms of the types of nouns to which they relate. Also examined is the formation of numbers using multiples of ten, hundreds, thousands, and millions along with examples of the expression of intermediate numbers.

Lessa, William A. "Divining from Knots in the Carolines." Journal of the Polynesian Society 68(3): 188-210.

Illustrations of knot combinations, names of knot combinations of totals ranging from 3 to 8 in Ngulu, Yap, Fais, Chuuk, and Namoluk and discussion of cultural significance. Such significance is derived in part from the numerical nature of these combinations and their application to deal with spirits and voyaging.

Lessa, William A. 1975. Drake's Island of Thieves: Ethnological Sleuthing. Honolulu: The University Press of Hawaii.

Lessa includes a 1839 drawing of a Carolinian sewn canoe depicting linear sewing patterns on the hull and a 1895 detailed drawing of a Palauan "racing canoe" using points on the drawings and describing associations. Lessa also

Lévesque, Rodrigue. 1992 - History of Micronesia: A Collection of Source Documents.

Volume 2 - Prelude to Conquest 1561-1595.

Contains a list of Chamorro words from a 1565 logbook, including the Chamorro words and their pronunciation for the numbers one through ten. (p. 97)

Volume 5 - Focus on the Mariana Mission, 1670-1673.

Includes description and words for the "only four direction terms in the Chamorro language" and illustrated by two maps of Guam (pp.388-390), a 1672 reference both to

a circle formation among Chamorros for singing (p.481), and to a practice among Chamorro women of tying their own cut hair into knots for keeping track of the number of nights that have passed since their husbands died. (p.482) Also includes a 1672 reference to measuring the width of a canoe by using palm leaves. (p.492)

Volume 10 - Exploration of the Caroline Islands, 1696-1709.

Contains an early European attempt to draw a map of the Caroline islands from indigenous Carolinian concepts of space, direction, and distance (p.114) as well as a description of such distances from various points on the map (p.115). Also on page 217 is a description from 1699 of the geometric proportions of a Chamorro canoe. Includes also a 1708 documentary description of an attempt by Carolinian to describe the places and particularly the number of their islands by using "some pebbles on the beach" (p.588) as well as a corresponding map based on those pebbles (p.589) along with conjectures on sailing times between specific points (p.589-590).

Volume 12 - Carolinians Drift to Guam, 1715-1728.

According to a 1721 "treatise" on the Caroline islands, there were two "houses" on Yap "assigned for the education of boys and girls who are taught some vague principles of Astrology, to which are dedicated almost all of the people of these islands, because they are useful for navigation. The teacher has a sphere upon which are shown the main stars, and shown the winds that must be followed according to the various courses they must take." (p.247)

Also describes the 'row' formations of armies in combat (p.248). The historically important 1721 description of Carolinian drifters to Guam by Father Gian Antonio Cantova includes a detailed diagram of the linear structure of a Carolinian voyaging canoe (p.452) and a basic description. Cantova also describes his request to the Carolinians to "draw me the layout of their islands with grains of corn . . . I also questioned them many times in great details about the rhumbs of their mariner's compass that has 12 winds." (p.457). Levesque reproduces a star compass from Ward Goodenough's 1953 "Native Astronomy in the Central Carolines." (p.470)

Volume 13 - Failure at Ulithi Atoll, 1727-1746.

Includes a drawing of large latte stones on Tinian (p.490) and a 1742 description of their dimensions and structure. Also includes detailed line drawings of a Chamorro "flying proa" (canoe) and a reef outrigger canoe. The arrangement of the rows of latte stones is also described in a 1742 document on p. 544.

Lewis, David. 1971. "Expanding' the Target in Indigenous Navigation." Journal of Pacific History 6: 83-95.

Lewis, David. 1976. "A Return Voyage Between Puluwat and Saipan Using Micronesian Navigational Techniques." In Pacific Navigation and Voyaging, Ben R. Finney, editor. Wellington: The Polynesian Society Incorporated. 15-28.

In his description of a navigator's conceptualizations of a star route in a voyage from Polowat atoll to Saipan in the Northern Mariana Islands, Lewis includes an illustration (from Goodenough 1953) of the Carolinian 32 point stellar compass and applies this compass to decisions made by the navigator in route. Lewis maintains that almost every navigational strategy used in Micronesia was matched by similar strategies in Polynesian with the notable exception of the Micronesian etak method of using a out of sight reference island to establish segments in a voyage.

Lewis, David. 1977. "Mau Piailug's Navigation of Hōkūle'a from Hawaii to Tahiti." Topics in Culture Learning 5: 1-23.

Besides a detailed tracking analysis of Piailug's position estimations on the voyage from Hawaii to Tahiti, Lewis also examines (with illustrations) points of the Carolinian

star compass and its practical use, and the strategy of etak that uses an out of sight reference island to determine position through linear concepts. Also discuss determining latitude without instruments.

Lewis, David. 1978. "The Pacific Navigators' Debt to the Ancient Seafarers of Asia." The Changing Pacific, G. Gunson, ed. New York: Oxford. 46-66.

Includes comparisons of Micronesian and Arab star compasses and comparative shapes and shaping of sails in the Pacific, Mediterranean and Indian Oceans.

Lewis, David. 1979. We the Navigators: The Ancient Art of Landfinding in the Pacific. Honolulu: University Press of Hawaii.

This is a rich source of concepts and the processes of conceptualization for noninstrumental navigation throughout the Pacific. Like Gladwin's East is a Big Bird, We, the Navigators is a major book on this subject. Sections relevant to Micronesia can be found in Chapter 2, "Steering by the Stars" (pp.45-82), including illustrations and discussions related to the use of the Carolinian sidereal compass and its use for maintaining direction and finding one's position between islands. Drawings are provided of the rising of stars in relation to sections of the canoe and its mast when viewed from the stern (p. 51 and 55), five stellar steering points of the Southern Cross represented by semi-circular bases (p.66), and a customary rectangular representation of the Carolinian sidereal compass and linear representations of navigational connections between stars and specific islands. Marshallese navigational stick charts are also illustrated and examined on pages 201-205 along with illustrations of 'knot' swells and "the four lines of 'remarkable swells'" (p.197).

Lewthwaite, Gordon R. 1967. "Geographical Knowledge of the Pacific Peoples." In: The Pacific Basin: A History of Its Geographical Exploration. New York: American Geographical Society. 57-86.

Micronesian navigational systems and mnemonic devices covered on pages 72-78.

Luck, Michael F. 1972. The Preliminary Foundation of Puluwatan Navigational Cognition. M.A. Thesis, Southern Illinois University.

Luschan, F. von. 1900. "Stabkarten der Marshallaner." Berliner Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Verhandlungen 32: 86-86.

Luschan stresses the linear patterns ocean swells form in relation to atolls, discusses the representation of these patterns in Marshallese stick charts, and notes distinguishing characteristics of the three main types of stick charts.

Lyons, Henry. 1928. "The Sailing Charts of the Marshall Islanders." Journal of the Royal Geographical Society 72: 325-328.

In his attempt to describe the uses of five of the Marshallese stick charts discussed by Albert Shück in 1902 (Die Stabkarten der Marshall-Insulaner), Lyons stresses the cartographical nature of the charts and the distinctive angles of palm leaves used to represent different swells in the three main types of charts with accompanying photographs of each.

Malone, Mike and Carlos Viti. 1983. "Micronesia's Star-Path Navigators." Glimpses of Micronesia 23(4): 12-18.

Matsuoka, Shizuo. 1915. Navigation Techniques of the South Sea Islanders. Tokyo: Imperial Navy Headquarters, War History Division.

McGrath, Thomas. 1977. "The Proas of the Marianas." In: Father San Vitores, His Life, Times and Martyrdom, Emilie G. Johnston, editor. Mangilao, Guam: Micronesian Area Research Center, University of Guam. 37-49.

In summarizing several early European observations of the Chamorro 'proa' canoe, McGrath notes their references to shapes related to canoe and sail structures and the asymmetrical design of these 'pre-contact' and early contact canoes which gave them the speed and maneuverability that typically impressed European explorers. He also includes early speed and canoe length estimates. A detailed 1742 line drawings of the proa, including its outrigger is included.

McKnight, Robert K. 1961. Mnemonics in Pre-Literate Palau. (Anthropological Working Papers Number 9). Guam: Office of The Staff Anthropologist, Trust Territory of the Pacific Islands.

Among the mnemonic devices and concepts McKnight discusses is the use of a "series of scars" on stone to enable "elder experts" to anticipate "certain meteorological events and festivals," the association of the piercing of ears with the memory of events, and acknowledging the positions of the moon and stars to provide calendar based time-markers. McKnight also discusses the tying of 10 knots in twine (*teliakl*) to mark the completion of the turtle egg-laying cycle, a synchronization of these knots between male and female "clubs" to orchestrate the "kidnaping" of females to play "hostess" to male clubs in other villages, and the use of the *teliakl* to schedule village council meetings and for elderly Palauan women to establish and maintain seasonal almanacs.

Motoda, Shigeru. 1938. "On the Canoes of Micronesia." Minzokugaku Kenkyu 4: 302-319.

Motoda includes several diagrams, drawings, and photographs of canoes in Yap, Palau, Chuuk, Pohnpei and the Marshall Islands with an emphasis on distinctive designs (including spatial concepts), structures, and functions.

Mulford, Judith H. 1980. "Lava Lavas of the Western Caroline Islands." M.A. thesis, California State University, Northridge.

Besides including an illustration of a basic seven stripe lava lava as constructed in the western Caroline Islands (p.28), Mulford discusses and illustrates a quadrilateral shaped 'warping board' used for making lava lavas. The use of its four points (a fifth is added when making men's lava lavas) are explained with accompanying drawings (pp.110-115).

Nakayama, Masao and Frederick L. Ramp. 1974. Micronesian Navigation, Island Empires and Traditional Ownership of the Sea. Saipan: Fifth Congress of Micronesia.

In exploring the concept of indigenous ownership of ocean areas, the authors provide detailed commentary on indigenous stellar navigation, etak, and swell interpretation. The segmenting of a voyage through the etak system allows voyagers to know distance traveled. They emphasize the importance of vertical ascent and descent as a central component of the Carolinian navigational star system. Also discussed is the strategy for compensating for lateral drift and travel ranges between specific islands and atolls in Micronesia - both in a contemporary and historical sense.

Nason, James D. 1975. "The Effects of Social Change on Marine Technology in a Pacific Atoll Community." In: Maritime Adaptations of the Pacific, Richard W. Casteel and George I. Quimby, editors. The Hague and Paris: Mouton Publishers. 5-38.

In examining the impact of outside technical influence on canoe construction and navigational knowledge on Etal atoll in the Mortlock Islands, Nason includes several tables and related discussion on not only the use made of traditional and contemporary canoes of Etal but also measurements of numerous canoes classified by age. Tables concerning the size of canoes and the number of men typically used to launch and then operate canoes are also included. These are examined in relation to changing patterns of canoe construction on Etal.

Newell, J.E. 1895. "Ancient Polynesian Chart." Journal of the Polynesian Society 4: 236-237.

Newel describes a Marshallese stick chart (with photograph) that once belonged to Robert Louis Stevenson.

Oatley, Keith. 1974. "Mental Maps for Navigation." In: Unwritten Knowledge: Case Study of the Navigators of Micronesia. Victoria: Deakin University Press. 58-65.

Oatley stresses the importance of recognizing the dynamics of spatial thinking that occur in the Carolinian dead reckoning system that is encompassed in the sidereal compass and etak journey segmenting and position finding strategy.

Oda, Takeo. 1935. "Charts Drawn by the Marshall Islanders." The Globe 25(3): 222-238.

Included with his descriptions of the Rebbilib and Meddo types of Marshallese stick charts are numerous hand drawn charts including positions of atolls as well as intricately labeled parts and movements of swells that are meant to describe 12 different types of swells and their use for finding land. Oda also examines the vertical movements of swells in relation the unique geographic presence of atolls in the Marshall Islands.

Oliver, Douglas L. 1989. Oceania: The Native Cultures of Australia and the Pacific Islands. Volume 1. Honolulu: University of Hawaii Press.

Besides a brief discussion of the Carolinian sidereal compass with its 32 points "marking the rising and setting of sixteen guide stars or constellations" (p. 418), Oliver discusses the Carolinian concept of etak for finding one's position during a voyage and the use of mnemonic devices and classification schemes centered around metaphorical themes to maintain mental maps of voyaging routes. In this later approach, Oliver notes the frequent association that is made in this navigational approach with the breadfruit picker who uses a long pole with a lashed stick at the end to secure the breadfruit. As Riesenbergs has described it, "a breadfruit picker," in the imagination of the navigator, "reaches out in a straight line under a particular star to one place after another till it turns in a new direction under another star or till it finally exhausts the inventory of known places" (p.418-419). The etak system for segmenting a journey into unequal parts based on the presence of guiding stars and out-of-sight reference islands is also discussed with an accompanying illustration (p.419-422).

Parmentier, Richard J. 1987. The Sacred Remains: Myth, History, and Polity in Belau. Chicago and London: The University Press of Chicago.

In his "four diagrams of social relations," Parmentier focuses on four diagrammatic icons of social relations. The visual schema (illustrated on p.110) of these relations represents the compositional arrangements of elements in communal relations of Palau. In the "path" schema, points linked together on the icon demonstrate a "degree of structural homology and hence positive cultural identity." He also discusses the sequential precedence of viewing linked elements in each icon as well as the organizational impact of a linear linkage in the "paths" schema. Parmentier also

discusses the “four cornerposts” diagram of social relations that represent four coordinated elements supporting a total structure of relations and examines the larger/smaller models in these schema that express the “Belauan image of hierarchy, seen as a syntagmatic chain of co-occurring elements that asymmetrically imply each other.” (pp. 108-113)

Playdon, George W. 1967. “The Significance of Marshallese Stick Charts.” Journal of Navigation (London) 20(2): 155-166.

Playdon stresses the presence and functional nature of mnemonics in Marshallese stick charts, particularly as they relate to the actions of swells in relation to Marshall Islands geography and methods used by the three main types of stick charts to reflect those dynamics. Playdon notes extensive processes of memorization involved in chants related to knowledge of natural phenomena and magic. Several related illustrations of stick charts are included.

Rehg, Kenneth L. 1981. Ponapean Reference Grammar. Honolulu: The University Press of Hawaii.

In the section “Numerals” (pp. 124-135), Rehg expounds upon the elaboration in the use of numerals in the Pohnpeian language. He examines the Pohnpeian “multiplicity of counting systems” beginning numeral classifiers in which although *ehu* is used for the number one, *emen* is used to count animate things (with *emen* representing one in this context), and *oumw* used for counting baked foods (with *oumw* also representing one in the context of counting baked foods). He includes a table of 1 through 10 and appropriate number terminology for each of these counting systems. Rehg also breaks down these counting systems into morphemes with detailed discussions on other counting systems, using the basic numbers of one through nine. A total of 29 different systems are listed. Rehg also discusses the user of numeral classifiers in Pohnpeian in which “the selection of the classifier depends upon which aspect of the noun a speaker wishes to emphasize” (p.136), and the use of higher numerals, fractions, ordinal numerals, preposed numerals, and quantifiers in the language.

Riesenberg, Saul H. 1950. “The Cultural Position of Ponape in Oceania.” Ph.D. dissertation, University of California.

Briefly described (pp.90-91) is the shape and use of a ‘compass’ for digging disks and rings out of a tortoise shell. Riesenberg describes its U-shape with one of its sharpened legs serving as the axis to the compass.

Riesenberg, Saul H. 1972. “The Organization of Navigational Knowledge on Puluwat.” Journal of the Polynesian Society 81(1): 19-56. (Also in: Pacific Navigation and Voyaging, Ben R. Finney, compiler. Wellington: The Polynesian Society Incorporated. 91-128.

Riesenberg examines the classification of geographic knowledge by the people of Polowat atoll through mnemonics, particularly the organizational structures of star courses for voyaging. Riesenberg stresses the use of metaphor in most of the eleven categories of information that he describes in detail. He lists the 32 primary stars used in Central Carolinian navigation with their European compass positions. Riesenberg provides a diagram of the course followed in the “Sail of Limahácha category of navigational information that depends on following the Limahácha fish. He also includes three other detailed course diagrams centered on the voyaging image of certain fish and provides very detailed component listings of star and fish based courses - both imaginary and regularly pursued - with their integral relationships between spaces emphasized.

Russell, Scott. 1998. Tiempon I Manmofo'na: Ancient Chamorro Culture and History of the Northern Mariana Islands. Saipan: Division of Historic Preservation.

Russell includes several illustrated reconstruction diagrams of Chamorro latte houses including one with a ten stone arrangement of latte stones, a twelve stone latte house with possible framing configuration and latte superstructure configurations using perimeter extensions and pyramidal and A-frame structures. He also provides a copy of the "only detailed drawing of a traditional Chamorro canoe known to exist" that offers different detailed angles of the canoe including its asymmetric hull (p.200, 203). He contrasts this with the simple dugout canoe that did not need an asymmetrical-shaped hull as did the Chamorro proa canoe. Also included is a traditional Chamorro calendar with traditional names, meanings, and modern monthly equivalents.

Sanches y Zayas, E. 1866. "The Mariana Islands." Nautical Magazine (London). 35: 253-266.

In this description of Sanchez' impressions of the Carolinian voyagers in the Mariana Islands includes descriptions of their canoes and a star compass of 24 indigenously named points divided into four quadrants. He also describes the use of a cane filled with water and used for the purpose of observing zenith stars.

Sarfert, E. 1911. "Zur Kenntnis der Schiffahrtskunde der Karoliner." Korrespondenz-Blatt der Deutschen Gesellschaft für Anthropologie, Ethnologie und Urgeschichte, Brunswick 42: 131-136.

In association with his discussion of spatial relationships among stars in the Carolinian stellar compass rose, Sarfert lists and selectively discusses over three dozen stars and the constellations and mythologies which many such stars are associated with. Illustrations include the compass rose of Palau and a line grid compass rose for a voyage from between two points in the Palau island group. Sarfert also notes a 8.5 degree discrepancy on the east and west lines which navigators adjust for in the overall compass rose.

Schück, A. 1882. "Die Astronomischen, Geographischen und Nautischen Kenntnisse der Bewohner der Karolinen- und Marschallinseln." Aus allen Welttheilen 13: 51-57.

Drawing from early European accounts, Schück discusses the knowledge and use of the various points in the rising and setting of stars in relation to the horizon as well as the use of important stars for 12 wind directions. One 1817 European reference noted that an elderly man of Wotje in the Marshall Islands was able to understand a magnetic compass in relation to navigational stars and directions after having seen such a compass for the first time. Schück also discusses European recordings of indigenous knowledge and use of stars, planets, and constellations, the construction of a stellar compass with bamboo sticks, and the usage of tattoos as geographical registers in the Carolines. Includes illustrations of Marshallese stick charts.

Schück, A. 1887? "Die Entwicklung Unseres Bekanntwiedens mit den Astronomischen, Geographischen und Nautischen Kenntnissen der Karolineninsulaner, im Westlichen Grossen Nord-Ocean." Tijdschrift van het Koninklijke Nederlandsch Aardrijkskundig Genootschap te Amsterdam 1(2): 226-251.

In summarizing early European documentation on the navigational abilities and exploits of Caroline islanders, Schück notes the division of the horizon into 12 directions, indigenous names of 23 stars and constellations prominent in stellar phases

of navigation, the use of the height of stars to reach a target island's latitude, the use of stick charts during voyages to determine direction, and the conceptualization of the earth as a disc on whose edge the sky rests.

Schück, A. 1902. Die Stabkarten der Marshall-Insulaner. Hamburg: Kommissionsverlag von H.O. Persiehl.

As one of the first European attempts to describe and understand Marshallese navigational stick charts and their uses, Schück includes numerous linear drawings of Marshallese stick charts located in European museums. These drawings follow Schück's extensive, exploratory discussion of how the sticks and their different angles within the context of the three main types of Marshallese stick charts represent ocean swells and their refractions from out-of-sight islands that the navigator is attempting to locate. He also provides historical background to early European references to the stick charts and discusses the naming of swells in accordance with the directions from which they come and go.

Severance, Craig J. 1976. "Land, Food and Fish: Strategy and Transaction on Micronesian Atoll." Ph.D. dissertation, University of Oregon.

Included in this dissertation is a circular monthly calendar representing perceptions and actions on Losap and Pis atoll for subsistence cycles. Trade winds and tide periods of the ocean are influential factors in the types of fishing and agriculture pursued (pp.23-25).

Sohn, Ho-Min and Anthony F. Tawerilmang. 1976. Woleaian-English Dictionary. Honolulu: The University Press of Hawaii.

Included in this dictionary are several terms related to "numeral classifier" such as "numeral classifier for an arm length - *paiu*; numeral classifier for forearm lengths, from elbow to the end of forefinger - *mwaliu*; numeral classifier for lines, processions, layers - *tal*" and so on. The dictionary also includes number expansions from basic numbers one through ten such as: "four hundred: *faabiugiuw*; four hundred thousand: *faalob*."

Spennemann, Dirk H. R. 1992. Marshallese Tattoos. Majuro, Republic of the Marshall Islands: Ministry of Internal Affairs, Historic Preservation Office.

Spennemann includes numerous illustrations of geometrically based tattoo patterns of chiefs and commoners from several Marshallese atolls, particularly Mile and Jaluit (pp. 64-77). Detailed descriptions of these patterns are also included. Triangular designs are particularly prominent.

Sudo, Ken'ichi. 1980. "Canoe House of Satawal Island." Kikan Zinruigaku 11(3): 177-182.

General description of a canoe house on Satawal with a focus on construction processes and canoe house dimensions and measurements with two corresponding illustrations and diagrams.

Sudo, Ken'ichi. 1979. "Canoe and Kin in Satawalese Society, Central Caroline Islands." Bulletin of the National Museum of Ethnology 4(2): 251-284.

Several diagrams of kinship structures and canoe designs and measurements are included in this ethnographic discussion of kin relations involved in determining division of labor for building canoes on Satawal.

Sudo, Ken-ichi. 1979. "Canoe and Legend - A Study of Traditional Navigation Method in the Central Caroline Islands." Newsletter of the National Museum of

Ethnology 4: 36-55.

Three detailed diagrams of canoe structures and parts with indigenous names and a detailed kinship table are included in this discussion of two Satawalese legends that relate to the naming of canoe parts.

Sudo, Ken'ichi and Tomoya Akimichi. 1983. "The Art of Navigation in Micronesia - In the Wave of Modernization." Shizen (April), pp. 32-93.

Authors discuss spatial concepts and execution of navigational strategies based on these concepts in the context of the star compass (with discussion organized around four distinctive schools of knowledge needed for judgements), the segmenting of a voyage through etak and an out-of-sight reference island, and the interpretation of ocean swells. They also discuss distinctive characteristics of single outrigger and double canoes including structures.

Thomas, Stephen D. 1987. The Last Navigator. New York: Henry Holt and Company.

Thomas, Stephen D. 1982. "The Puzzle of Micronesian Navigation." Pacific Discovery 35(6): 1-12.

Thomas, Stephen D. 1985. "The Sons of Palulap: Navigating without Instruments in Oceania." Oceanus 28(1): 52-58.

Topping, Donald M. 1973. Chamorro Reference Grammar. Honolulu: The University Press of Hawaii.

Topping draws upon William Safford's work of the early 19th century on the Chamorro language, noting Safford's observation that the Chamorro language "has a purely decimal system." He lists the ten basic numerals in Chamorro (compare these with Levesque, volume 2, Chamorro numbers recorded in the year 1565), along with a comparative list of Spanish numbers to emphasize the influence of the Spanish period on the numerical expressions of Chamorros. Also included is a list of Chamorro ordinal number terms.

Topping, Donald M. 1980. Spoken Chamorro. Honolulu: University of Hawaii Press.

In a brief section on Chamorro number formation (p. 241), Topping provides a list of decade numbers, the process of number formation from base numbers one through nine and the use of articles in this formation.

Turnbull, David. 1990. Mapping the World in the Mind: A Case Study of the Unwritten Knowledge of the Micronesian Navigators. Victoria, Australia: Deakin University.

University of Pennsylvania Museum of Archaeology and Anthropology. 1997. Traditional Navigation in the Western Pacific.

Several pages on this web site provide brief but active illustrations using linear and circular figures to demonstrate the functioning of the sidereal compass, keeping track of one's position at sea through reference to rising stars and their interrelatedness to an out-of-sight reference island, predicting the weather using stars just before dawn and the process of schematic mapping. The latter involves using fish figures and their parts as cognitive substitutes for printed maps or charts.

Ushijima, Iwao. 1982. "The Control of Reefs and Lagoons: Some Aspects of the

Political Structure of Ulithi Atoll.” In: Islanders and Their Outside World: A Report of the Cultural Anthropological Research in the Caroline Islands of Micronesia in 1980-1981. Tokyo: Committee for Micronesian Research, St. Paul’s (Rikkyo) University.

In describing the division of turtle meat on Mogmog (Ulithi archipelago, Yap State) in accordance with social hierarchical organization, the author uses an illustration of a turtle divided into six parts that represent the island’s social and political *heilangs* (pp. 55-57). The author also describes a similar division of parts from a large fish with an illustration of a six part, divided fish that marks specific sections given to chiefs. Also included are two additional fish diagrams with divisions with three and seven parts for distributions to heads of *heilangs*.

Viti, Carlos. 1975. “Voyage from the Last Century.” Glimpses of Guam 15(2): 17-24.

Winkler, Captain. 1901. “On Sea Charts Formerly Used in the Marshall Islands, with Notices on the Navigation of These Islanders in General.” Smithsonian Institute Report for 1899. 54: 487-508.

In attempting to understand and explain Marshallese stick charts through both conjecture and indigenous comment, Winkler includes several drawings of the charts, detailing sections and discussing their numerous linear relationships. Also included are several drawings meant to illustrate distinctive swells generated by atolls in relation to incoming waves and their detection and use by navigators looking for land. Also included are several photographs of stick charts held by American and European museums.

Wright, Carleton H. 1948. “Sailing Canoes of the Marshall Islands.” U.S. Naval Institute Proceedings 74(12): 1528-1531.

Several photographs of Marshallese canoe accompany Wright’s discussion of the building processes for canoes with an emphasis on their nonsymmetrical structures.

Yamaguchi, Osamu. 1967. “The Music of Palau: An Ethnomusicological Study of the Classical Tradition.” M.A. Thesis, University of Hawai’i.

A figure of the “parametrical and componential structure” of musical sounds in traditional Paluan music is included (p.63) that is arranged through emic and etic relationships of tones and further defined by componential and parametrical elements of this music.

Yawata, Ichiroo. 1932. “The Art of Navigation and Marine Chart of the South Sea Islanders - Marshallese Thousand-Mile Navigation.” Kagaku Gahoo 19(6): 773-777.

Yawata focuses on the distinctive geographic elements that were meant to be conveyed by three distinct stick charts of the Marshall Islands. He includes several linear illustrations of stick charts and of the role of atolls on swells and wave knots that these charts are intended to demonstrate. Illustrations are very detailed in terms of specific linear sections of each chart. Three complementary photographs of actual charts are also included.