

REFEREED PAPER

‘Drawing the Coral Heads’: Mental Mapping and its Physical Representation in a Polynesian Community

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Indigenous people throughout the world developed their own mapping skills and systems of knowledge. While Westerners are prone to overlook these communities' geographical knowledge and imagine their mapping activities to be primitive or non-existent, their mental maps are often impressive in sophistication and detailed even if based on cosmologies that are quite foreign to Western thinking. This article depicts a mental map of the ocean floor shared by Polynesians of Anuta, a remote community in the Solomon Islands. It situates Anuta's reef map in relation to academic discussions of indigenous cartography and describes the process that resulted in the map's physical representation.

INTRODUCTION

Prior to the 1990s, cartographers devoted little attention to indigenous understandings of spatial organization. Anthropologists concerned with culture and cognition evince a longer history of interest in the subject. They have, for example, committed a good deal of energy to studying the wayfinding techniques employed by Pacific Island navigators.¹ But even those researchers have often given short shrift to the detailed knowledge of local geography that non-Western and non-literate people frequently carry with them as they go about their daily business. This article depicts a mental map, shared by the Polynesians of Anuta in the eastern Solomons, of the ocean floor within a two- to three-mile radius of their island.

INDIGENOUS CARTOGRAPHY

We now recognize that many peoples outside of the Western tradition engaged in sophisticated cartographic activities well before European contact. Native Americans, for example, used their own equipment and such local materials as sealskin, hide, driftwood, bark and sand to create maps and charts. And the so-called Bushmen of the Kalahari Desert have shown remarkable ability to find their way around in what, to the Western observer, often seems to be an endless expanse of undifferentiated wilderness (Widlock, 1997). Frequently, when compared with maps produced by surveyors using Western technology, the accuracy of indigenous maps is truly impressive (Thrower, 1972, 1996).

Most writings on indigenous mapping by professional cartographers have appeared only within the last few decades. David Woodward and G. Malcolm Lewis (1998) devoted an entire volume of the lengthy *History of Cartography* series

to geographical knowledge in traditional African, American, Arctic, Australian and Pacific societies.² Historical cartographers have attempted to reconstruct the geographical thinking of non-Western peoples in order to gain insight into their beliefs and values. By the time they began to engage in this process, however, many communities with well-developed cartographic systems had vanished or changed to the point that little information was preserved about their earlier ways of thinking and living. Fortunately, durable artifacts, including maps, can sometimes elucidate the spatial knowledge and values of the people who made them. And there still exist a number of societies that have retained much of their traditional knowledge, often relying on visual observation and oral communication for transmission of skills and information.

For centuries, Westerners have speculated as to how other peoples are able to travel over great distances to new areas without such ‘modern’ equipment as a compass, sextant or charts. It is obvious, however, that people who rely on extensive travel, whether by land or by sea, must develop effective wayfinding techniques. Pacific navigators, for example, often spent weeks on the ocean without consulting charts or instruments. They relied on their senses and geographical and environmental knowledge to track their course. They developed conceptual compasses delineating the rising and setting of key stars and constellations. They also used wind direction and studied wave patterns. They looked at cloud formation around islands. They observed birds that nest on land and fish at sea. And they used many other clues provided by the natural environment (e.g., see Gladwin, 1970; Lewis, 1972; Kyselka, 1987; Finney, 1998).

The Anutans’ mental map of the surrounding seabed differs in many ways from the long-distance navigational knowledge and techniques that have been the centerpiece of much writing about Oceania. However, like Gladwin,

Lewis, Finney and others who have written on Pacific seafaring, we document the detailed knowledge of marine geography among people who live close to and depend upon the ocean. Also like traditional navigational skills, the knowledge system we describe was developed without the benefit of Western instruments and has been transmitted across generations without reliance on the written word.

Local Geographical Knowledge

Early European explorers wondered how the people they encountered, lacking the equipment they considered essential for deep sea travel, reached and settled islands spread throughout a vast expanse of ocean. In the 18th century, the British captain James Cook charted many previously undocumented Pacific islands. In the process, he learned enough of the local languages and customs to recognize that the people living on these islands, distributed over thousands of miles, spoke closely related languages and shared similar cultures.

At Tahiti, Cook befriended Tupaia, a dispossessed Raiatean priest. From Tupaia, he learned about the Tahitians' extensive geographical, meteorological and navigational knowledge and produced a chart depicting Tupaia's understanding of his geographical universe. Tupaia's mental map of the Pacific extended over approximately forty degrees of longitude and twenty degrees of latitude — a wider geographical spread than the continental United States. According to Johann Forster, a naturalist on Cook's second voyage, Tupaia, after understanding the importance and the use of charts, pointed to those parts of the heavens

that marked the locations of various islands (Skelton, 1954). By using stars and constellations, Tupaia located and identified many Polynesian islands and guided Cook's ship, *Endeavor*, to Rurutu in the Austral Islands, some 300 miles (c. 480 km) south of Tahiti.³

The Star Compass

Pacific islanders pass navigational information from one generation to the next through a variety of procedures. Master navigators on some islands teach their pupils a conceptual 'star compass' by laying out shells and coral fragments into a circle to signify the rising and setting of the most important stars. A 'sidereal compass' or 'star compass' from the Caroline Islands of Micronesia typically has 32 'compass points'. Those points, as described in most of the literature, are not evenly spaced since each stands for the actual rising or setting point of a particular star or constellation.⁴ Banana fibers might be strung across a kind of diagram to demonstrate the star courses. A small canoe of coconut leaves may be placed into the center, helping the student to visualize himself amid the various star paths. Coconut and pieces of coral may be used to represent as many as eight distinct swell directions. Frake (1995) noted similarities between the Oceanic star compass and those used by Persian, Arabian, Indian and even European navigators.⁵ The star compass provides an abstract structural model of the physical universe — the point is not absolute precision but to provide the navigator with tools that can enable him to reach his destination. Pacific island navigators memorize the rising and setting

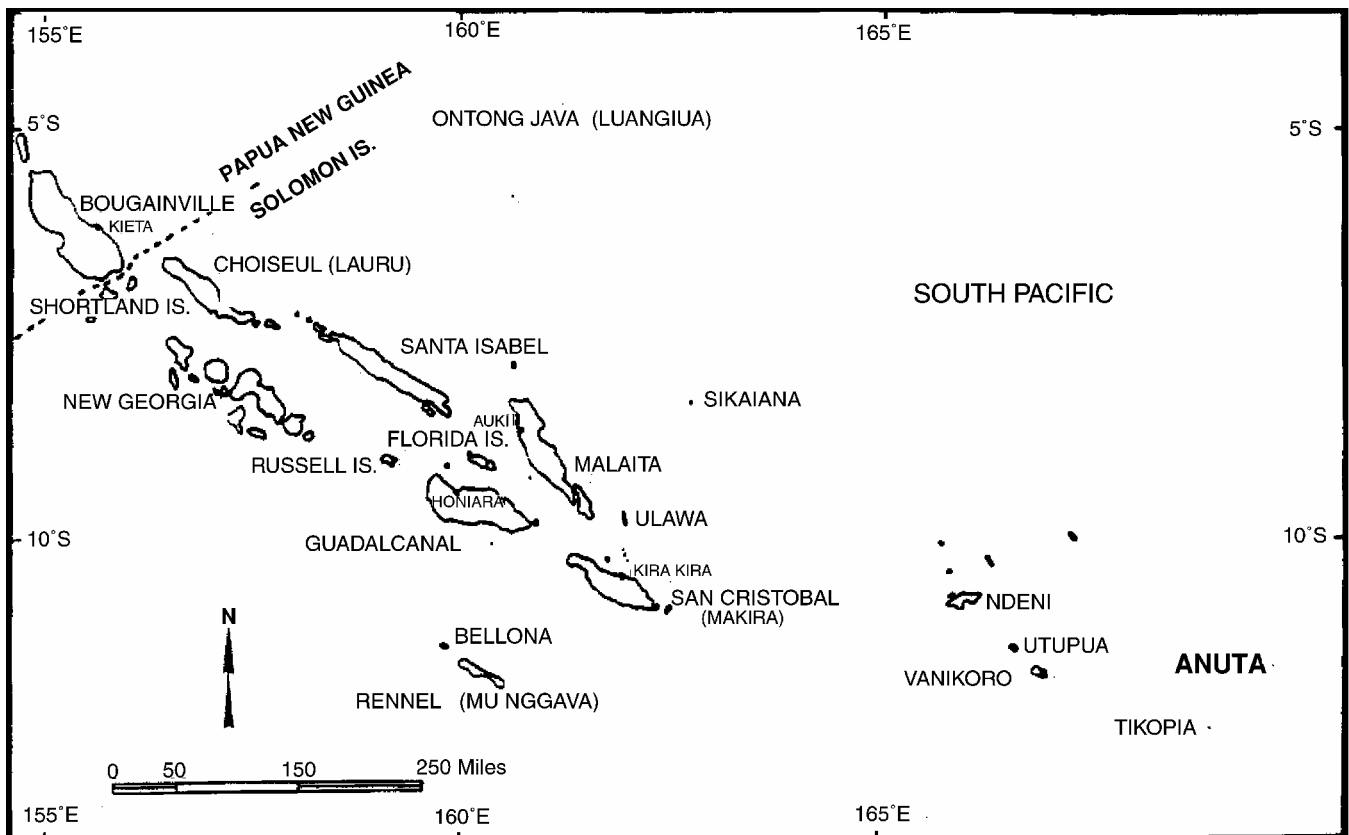


Figure 1. Map of central Pacific Ocean showing relationship of Anuta to other island groups. (Adapted from Yen and Gordon, 1973: 3)

points of the stars and constellations and their positions relative to various islands. Sunrise and sunset are also important directional indicators.⁶

Marshall Island 'Stick Charts'

The star compass is primarily an abstract conceptual scheme. The only physical charts produced by local map makers in the insular Pacific prior to Western influence are the Marshall Islanders' so-called stick charts.⁷ The charts were constructed using fibers from a number of plants, including coconut, pandanus and banana, tied together to point in various directions. The arrangements of the sticks indicated wave patterns. Cowrie shells or pieces of coral represented islands, and sometimes major wave intersections. Some of the fibers indicated the distance at which a particular island comes into sight. This was important because, although distances between the various Marshallese islands are not great in comparison with many other parts of the Pacific, the only land consists of low coral islets which can just be seen from a few miles away by sailors aboard an outrigger canoe.⁸ To locate an island that the navigator is unable to see, he observes the relationship between the swells — driven by prevailing winds — and reflected or refracted waves resulting from the presence of an island (Lewis, 1972; Bagrow, 1985).

Stick charts were of three main varieties: *rebbelib*, *meddo*, and *mattang*. *Rebbelib*, or general charts, displayed a large area, taking in approximately 30 atolls and islands over a distance of about 600 sea miles northwest–southeast and about half that distance northeast–southwest. A *meddo* was a sectional chart of part of an island group. It might be one of a series of charts, and because of the larger scale, it allowed more detail than the *rebbelib*. The third type, the *mattang*, provided a summary of information on wave patterns and islands, and were used for instructional purposes. The information contained in the stick charts might not be precisely accurate in Western cartographic terms. Master navigators used them to teach students navigational skills and as mnemonic aids to be consulted before a voyage (see, e.g., Winkler, 1899; Krämer and Nevermann, 1938; Davenport, 1960; Carucci, 1995; Finney, 1998); they were not taken along when a canoe set sail. The navigator had to know the islands, star positions, swell patterns, wind directions and the many other signs that nature provides.

Methods of making and using these stick charts were a closely guarded secret, handed down from father to son and only revealed to certain influential leaders (Thrower, 1972).⁹ In the aftermath of European contact, Marshall Islanders gradually abandoned making their old charts, which were relegated to the status of curios produced for sale to collectors. Still, local navigators, including some Marshallese captains of European style ships, sail by waves and stars, relying on European maps, if at all, only to learn about relative atoll placement.

ANUTA

Anuta is a remote Polynesian island in Temotu Province, the easternmost political subdivision of the recently independent Solomon Islands. It is a half mile in diameter, 75 miles

(c. 120 km) from its nearest populated neighbor, Tikopia, and over 200 miles (c. 320 km) from the provincial capital. A national census in 2000 found Anuta's resident population to be 340 people. The island's small size, geographical isolation, and absence of significant commercially exploitable resources have limited contact with the outside world. As a result, even at the beginning of the 21st century, Anuta remains one of the most traditional communities in the Pacific.¹⁰

Anutans continue to depend upon subsistence agriculture and fishing, relying primarily on local materials and technology. Would-be visitors must come to the island by boat. At first approach, they see a tiny dome-shaped spot on the horizon that turns into a hill covered with low vegetation and occasional tall palms. When a ship arrives, it anchors perhaps a quarter mile outside the fringing reef. Landing is accomplished either aboard the ship's launch, via a local outrigger canoe, or by swimming through the surf. When visitors arrive on shore, they are greeted by children looking and touching, and by adults shaking hands or pressing noses in the traditional Polynesian manner. When the ship leaves, the island returns to its customary isolation, and it may take several months for another vessel to stop for a short visit.

A society so remote and so dependent on the sea must have an intimate relationship with its marine environment, and its members learn early in life to observe natural signs. One result of that close observation is the mental mapping of the seabed. This differs from 'stick charts' in that Anutans make no attempt to represent submarine features by creating or manipulating physical objects. The map (Figure 3) produced in collaboration with Feinberg, Dymon, Rollins and George is the first attempt to reproduce the Anutans' mental map using any kind of material representation. In that respect, it is more like the expert navigator's knowledge of the locations and trajectories of various stars and constellations, or their understanding of the locations of islands and archipelagoes in relation to the movements of celestial bodies. However, unlike those cognitive constructs — reproduced most famously by Tupaia and Cook — what we call the Anutans' 'reef map' deals with features that are invisible from land and only can be seen when hovering directly overhead in a boat or canoe. Most of these features occur at depths of between 30 and 150 feet (c. 9–46 m) below the ocean surface.

Anutans have no indigenous name for the reef map per se. Rather, they speak simply of *nga rau akau* 'coral heads' and their locations (*nga ngomea nga rau akau e turaki i ei*). In speaking of the paper map that they constructed in collaboration with Feinberg, they might say *te tuti o nga rau akau* 'the writing [or drawing] of the coral heads' — hence, this article's title. Pu Paiaki, as indicated below, was regarded by Anutans as the island's most knowledgeable person with respect to the coral heads, their locations and their relationships to other submarine features. Other Anutan fishermen, however, are aware of the same kind of information, differing primarily in the extent and profundity of their knowledge.

The waters surrounding Anuta are populated by enormous numbers of fish, both in terms of individuals and species. Anutans are familiar with those fish, their habits, and their annual- and life cycles (c.f. Johannes, 1981; Johannes

and MacFarlane, 1991; Lieber, 1994). Most of the reefs appearing on this map, however, are of just one type, known as *nga rau akau vanevane* — coral heads at which *vanevane* are found. *Te vanevane* is a small fish — perhaps a variety of grunt or sea perch — that is especially abundant in those locations.¹¹ When Feinberg suggested including reefs where Anutans go for other kinds of fish, his collaborators responded that there was neither sufficient time nor paper to map *all* of the coral heads.

THE MAPPING PROCESS

One of our authors (Feinberg) has been involved in the anthropological study of Anuta since the early 1970s. Over that period, he has written on such aspects of Anutan culture as language (1977, 1989, 1998), kinship and social organization (1973, 1981a, 1981b, 2003), religion (1995b, 1996, 1998), oral traditions (1976, 1989, 1998), and — most importantly for this article — development (1986, 2002) and navigational techniques (1988, 1991). In 2000, he visited the Solomons to study Anutan plans for a commercial seafood business.

Ethnobotanist Douglas Yen, in collaboration with archaeologists Patrick Kirch and Paul Rosendahl, spent two months on Anuta in 1971 and mapped the island quite thoroughly, indicating the locations of gardens, paths, the 212-foot hill in the north, the coastal flat to the south, and the spring, beach, fringing reef and other prominent geographical features. Based on that work, Yen, Kirch and Rosendahl produced a series of maps that appear in an edited volume on Anuta (Yen and Gordon 1973). Feinberg (1981a, 1988, and elsewhere) relied on their work for maps in several of his publications. In 1972–73, he also developed a detailed map of Anuta's village plan, indicating house and cook-house sites, storage locations for each of the ocean-going canoes and other significant features. In 1998, he published a revised map of the island, indicating the locations of important events cited in Anutan oral traditions. Beyond the fringing reef, however, these maps only revealed two boulders that protrude above the ocean's surface, at distances in the vicinity of a mile offshore.

Feinberg's 2000 study of Anutan plans for a commercial fishing business involved an assessment of the island's marine environment. Anutans had told him of the island's extensive system of reefs, and he made inquiries to discover just how extensive that network was. He began working with Pu Tongotere (Mackenzie Taapipenua) and mapped a couple dozen coral heads off Anuta's southwestern shore. When Pu Tongotere declared that he had reached the limit of his knowledge, Feinberg's friend and custom nephew (*iraamutu*), Pu Nukuriaki (Richard Maraetanu) became involved. However, he did not consider himself extraordinarily knowledgeable about Anuta's marine geography. He consulted with Pu Rangituteki (Reuben Pakapae), and in collaboration with the two of them, Feinberg recorded approximately 60 coral heads. The three of them then enlisted the assistance of Pu Paiaki (Patteson Rautepuri), the man with the greatest knowledge of Anuta's reefs and fishing grounds. The project proved to be a true collaboration. Feinberg formulated the problem and raised the overarching questions. Pu Nukuriaki organized the

personnel and provided logistical support, offering his home as a place where the project could proceed in relative quiet and comfort. Pu Rangituteki, a local school teacher, was the intellectual organizer, the one who figured out how to transfer the knowledge from Pu Paiaki's mind to paper. He articulated specific questions to elicit the relevant geographical information, and he determined out how best to represent that information in visual form. He drew most of the diagrams and instructed Feinberg on where to write the labels. Pu Paiaki was the source of most factual information about Anuta's reefs, their locations, depths, relationships to one another and other pertinent data. Most Anutan fishermen are familiar with dozens of coral heads, their depths and locations and the types of fish that live near each one. Pu Paiaki, however, is widely — and justly — admired by his fellow islanders for the breadth and profundity of his knowledge of Anuta's maritime environment. The initial map took approximately a week for the foursome to complete.

The team was rounded out when Feinberg returned to the US in November 2000 and enlisted his university colleague, Ute Dymon, a geographer and cartographer. Dymon's contribution was to situate the Anutan map in relation to the discourse of her discipline. Matthew Rollins, a student of Dymon's, was responsible for transferring the paper map onto a computer. Further refinements to the map resulted from the work of Feinberg, Dymon and graduate student Brian George.

When Feinberg began the mapping process with Pu Tongotere, he drew a small outline of Anuta's contours and its most outstanding features in the center of a large notebook page. After working with Pu Nukuriaki, the page quickly became cluttered with information, and Feinberg's collaborator advised him to tape two sheets together to provide more space. When the double sheet became filled, Feinberg copied the information over onto a blank sheet approximately two feet by three feet. At that point, Pu Nukuriaki and Pu Rangituteki indicated dissatisfaction with the alignment of many features. They suggested that Feinberg tape two large sheets together, creating a blank sheet six feet long and four feet wide; that he draw an outline of the island in the centre; and that he leave the rest untouched. They would then, with Pu Paiaki's assistance, fill in all the requisite information, starting over from the beginning.

With Pu Paiaki's guidance, Pu Rangituteki began by dividing the Anutan universe into four quadrants called *araavaka* 'canoe paths' to the north, east, south and west. The lines separating the quadrants more or less coincide with major Anutan directions: *tokerau maaro* to the north-east, *tonga maaro* to the southeast, *raki* to the west or southwest, and *pakatinu* to the northwest (see Feinberg, 1988:92–100). He then divided the sea into a series of concentric circles. The first beyond the surf line (*te pati o ngaru*) is *te akau penua* 'the land reef', that is, the portion of sea floor adjacent to the island. Beyond the *akau penua* is *te para penua* 'the land-related sandy floor'. This area is marked by large stretches of sandy bottom, each encircled by coral ridges or coral heads. After the *para penua*, the bottom rises to form a relatively shallow ring known as *te unga o te akau* 'top of the reef', or simply *te akau* 'the reef', before it falls off to *te roto*, the deep sea.

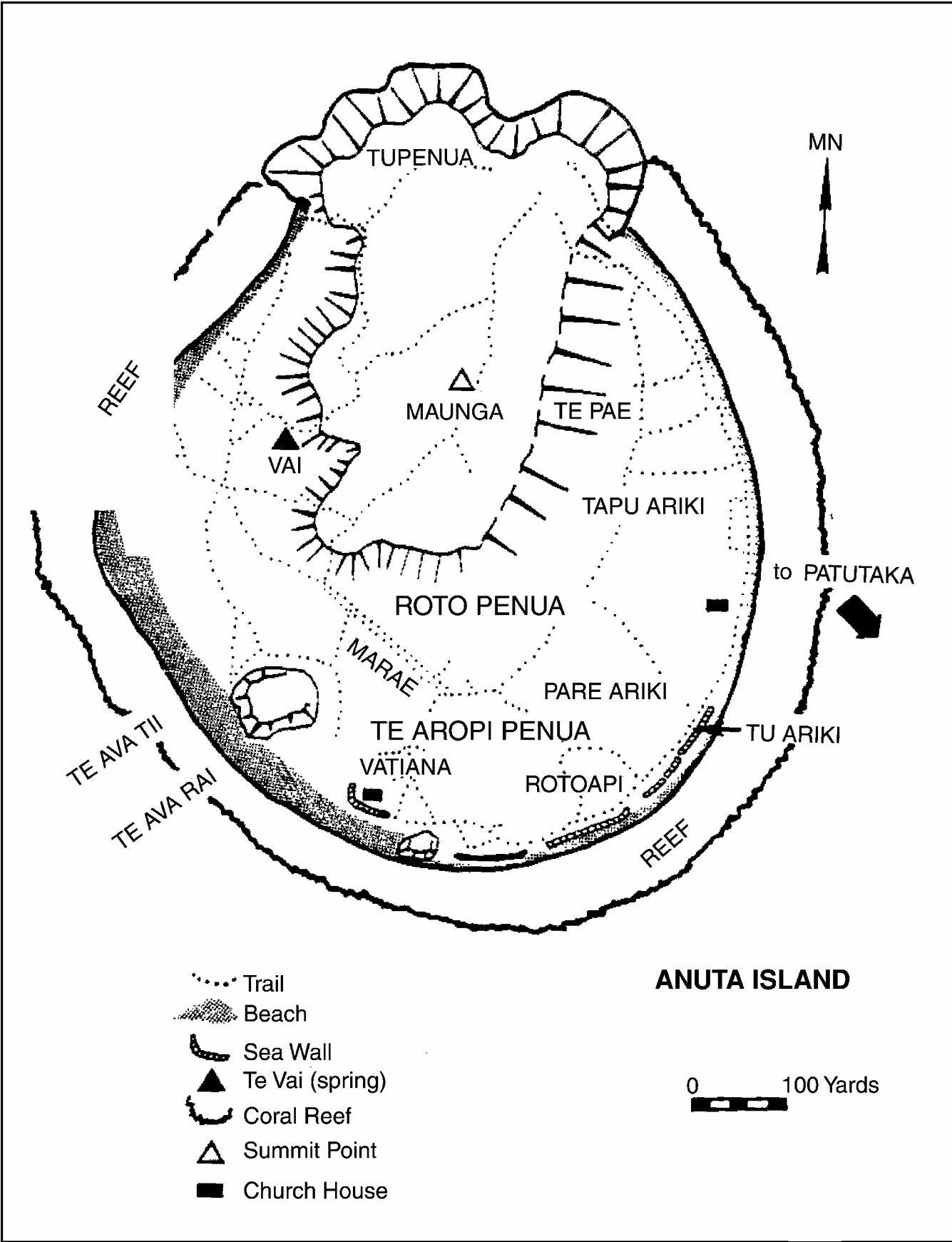


Figure 2. Base map of Anuta Island. (Adapted from Yen and Gordon, 1973: 27)

Once Pu Rangituteki divided the ocean into quadrants, he began by noting reefs just outside the main passage in the area of *nga toka* and *te akau penua*. He then worked counterclockwise around the first concentric ring. At each point, he made sure to line up the marine feature with a visible geographical feature on the island or one of the two offshore boulders, Te Patu o Mangoo and Te Patu o Veu, confirming the correct location at each point with Pu Paiaki. When he had worked his way around the circle, he drew a line marking the *tapatapa*, the point at which one concentric ring gives way to the next, and repeated the same procedure with *te para* and *te punga o te akau*. In this manner, the team mapped approximately 300 coral heads within about a two-mile radius of Anuta plus two large coral banks, Te Aongo and Te Akau Motu, several miles beyond. Te Akau Motu 'The Separated Reef' is far enough away that it could not be drawn on the map, but the route to that coral bank is indicated in the northwestern corner.

INFORMATION GATHERED WITH THE MAPPING TEAM

Feinberg was struck by his Anutan friends' extensive knowledge of the seabed, especially that immediately surrounding the island and for a considerable distance to

the south and west. Anutans have been traveling to other parts of the Solomon Islands for many decades and, as a result, have developed a good understanding of Solomons geography. By contrast, their knowledge of reefs, islands, and the ocean to the east seemed sketchy.¹² This reflects the paucity of contact from the Polynesian heartland over a period of many generations. Oral traditions (see Feinberg 1998) cite visits from Samoa, Tonga, Rotuma and Tuvalu, but few of the visitors remained on Anuta, and the sporadic contact was evidently insufficient to preserve much detailed geographical knowledge of the major Polynesian archipelagos.

In the process of mapping, Pu Paiaki and Pu Rangituteki spoke of many types of marine feature. Some of the more important include:

<i>ainaina</i>	a patch of sand surrounded by reef.
<i>akau</i>	generic term for reef.
<i>akau</i> or <i>te punga o</i> <i>te akau</i>	third concentric circle beyond the surf line, where the reef rises beyond the ring of sandy bottom.
<i>akau penua</i>	'land reef'; first concentric circle beyond the surf line.

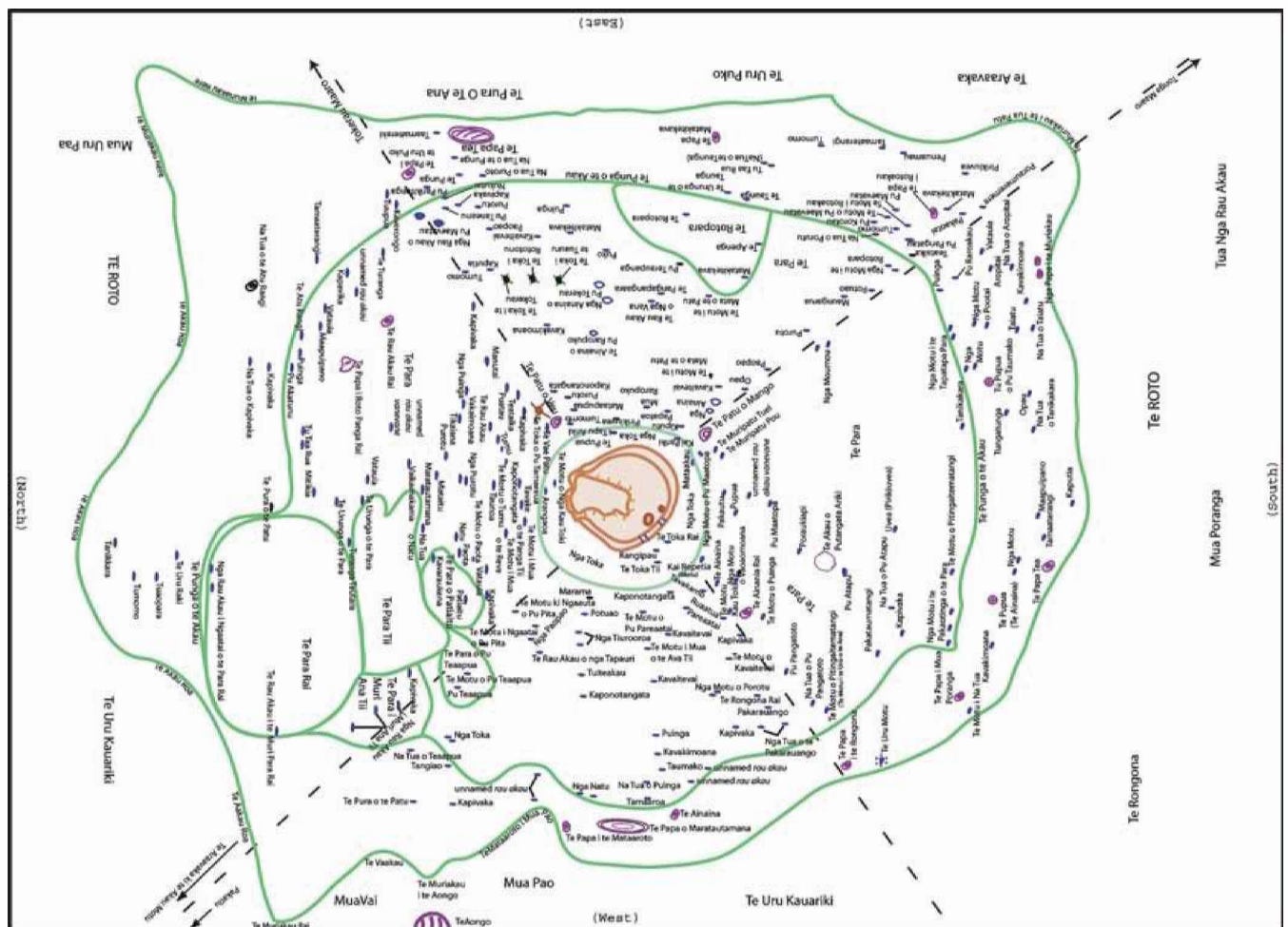


Figure 3. Anutan Reef Map

<i>apenga</i>	a place that successors to an original explorer visit with great frequency (~ <i>taunga</i>).
<i>kau aapua</i>	a patch of sand surrounded by reef — similar to an <i>ainaina</i> .
<i>motu</i>	a small coral head.
<i>papa</i>	a coral patch that is larger than a <i>rau akau</i> . It is either up on <i>te punga o te akau</i> or stands on the top of a <i>rau akau</i> .
<i>para</i>	a very large expanse of sandy bottom, out beyond the <i>akau penua</i> .
<i>para penua</i>	'land-related sandy floor'; second concentric circle beyond <i>te pati o ngaru</i> .
<i>pupua</i>	a small patch of sand surrounded by coral. Like an <i>ainaina</i> except that an <i>ainaina</i> is a long, narrow oval. ¹³
<i>pura</i>	the point from which some landmark first rises into view.
<i>rau akau</i>	an expansive coral head that is fairly flat and close to the bottom. In contrast with a <i>papa</i> , a <i>rau akau</i> stands directly on a sandy bottom (<i>te kau aapua</i>).
<i>roto</i>	the deep sea. This is the fourth concentric circle beyond the surf line.
<i>tapatapa</i>	the end of a reef shelf.
<i>taunga</i>	synonym for <i>apenga</i> . A place that successors to an original explorer visit with great frequency.
<i>toka</i>	an expansive patch of coral that is also high, in contrast with a <i>rau akau</i> ; it sticks up close enough to the surface to cause waves to break during storm conditions.

Unlike many Pacific Islanders, the Anutans do not have a system of marine tenure. Anyone on the island has access to any of Anuta's marine resources. However, particular people, past and present, are associated with particular reefs and fishing grounds. Typically, a reef is named for the first person to fish there: it is either given the name of the fisherman himself or of his canoe. For example, one group of coral heads (*rau akau*) is named *Nga Moumou* after Pu Raropuko Moumouipenua. Another was named after an Anutan with an extensive fungus infection; the spot was called *Kaipaariki*, the Anutan word for ringworm. Some Anutans have been particularly energetic in their search for new fishing grounds, and it may be that one person discovers several reefs. Or a particular canoe may be used by a series of fishermen searching for new spots to fish. As a result, several marine features may share the same name. Anutans avoid confusion by specifying, for example, Kapiwaka behind Pu Aatapu as opposed to Kapiwaka in the Tokerau Maaro.

In some cases, a name is descriptive of a feature's characteristics and location. For example, a *motu* is a very small coral patch, and near the line separating the southern *para* from the *punga o te akau* are two coral heads called Nga

Motu i te Tapatapa Para 'The Small Coral Heads at the Boundary of the Para'. And a reef just offshore from a more prominent named feature is sometimes called the *tua* 'back' of its twin. Thus, a prominent reef in the *para* section south of the island is known as Pu Aatapu, and a smaller one a little farther to the south is Te Tua o Pu Aatapu.

The Anutans have different expressions for different kinds of coral head and different kinds of sandy patch. A *pupua* is a small patch of sand that is more or less oval in shape and surrounded by coral. An *ainaina* is a larger patch of sand surrounded by reef. A *kau aapua* is a patch of sand surrounded by reef and is similar to an *ainaina*. A *para* is a very large expanse of sandy bottom. *Tapatapa* refers to the boundary or end of a reef shelf.

Despite some discussion and occasional debate, by the time they were done, Pu Paiaki and Pu Rangituteki were confident of the locations of the reefs and other map features. After several long days of effort, the team produced a map that included approximately 300 items. Pu Rangituteki proclaimed that they had mapped most of the *rau akau vanevane* (see above). He made it clear that there were hundreds of additional features which could not be entered on the map because of limitations dictated by the size of the available paper and the time that Feinberg had before his scheduled departure from the island. Even the reefs that did appear, he said, had to be compressed in order to fit them onto the 6' × 4' sheet (183 × 122 cm).

MIXING TECHNOLOGIES

In order to preserve the fragile hand-drawn map, Feinberg and Dymon decided to make a facsimile of the original map by redrawing it on a computer. The computerized Anutan reef map shows the locations of hundreds of coral heads, rocks, fishing grounds, and reefs, insofar as they are understood by the Anutan experts — much as did the original map. The handwritten names were typed in order to make them more readable when the map was reduced in size. Pu Rangituteki color coded the original map, a principle that Rollins maintained when he redrew it on the computer (see Figure 3).

MAPPING AND MAP MAKING

Rundstrom (1990: 155) calls mapping 'the fundamental process of lending order to the world'. In saying this, he is referring especially to the making and development of mental maps. While mapping in Rundstrom's sense may be a pan-human activity, different peoples lend order to the world in different ways (L. Irwin, 1994). Anutan seafarers, for example, experience the world far differently from most Americans, and that experience is reflected in their perceptions — as inferred from both the reef map and their oral accounts.

In addition to direct experience, one's mental map is shaped by descriptions and information gathered by others, whether compiled in books or passed on through oral traditions. Through such processes of cultural transmission, places that otherwise might have remained little

more than names are fleshed out and described in detail. This information enables people to identify distant phenomena, including new fishing grounds, material resources and even other communities. In many cases, such as that of the Anutans, precise and detailed mental images or mental maps are passed on both orally and through concrete demonstration — the expert takes the novice to the fishing grounds and *shows* him how to find them by lining up with the appropriate land and sea marks.¹⁴

Like the map resulting from the collaboration between Tupaia and Captain Cook, the Anutan reef map was prepared by a Western researcher and three Anutan scholars. The Anutans' mental map differed from Feinberg's. As a sailor, fisherman and diver, Feinberg probably saw more than most Westerners would have, even from the start.¹⁵ His focus, however, was those parts of the island that are either above sea level or slightly below — such as the fringing reef and contours of the ocean bottom within a few hundred yards of the main passages. Farther out, the sea became a largely undifferentiated sheet of brine. Anutans, by contrast, look to sea and observe an elaborate system of reefs that extends for miles in all directions. Feinberg was well aware that differences in the colour of the water indicate differing depths and the presence or absence of reefs or other bottom features. Still, after drawing the map, the assorted shades of blue and green held far more significance for him than they had previously.

COMPARING INDIGENOUS MAPS TO WESTERN STANDARDS

Historically, European observers thought maps produced by indigenous people to be less accurate than Western ones because they did not adhere to the Western cartographer's Cartesian coordinates and scales (Sundstrom 1996). Belyea (1998) studied American Indian maps and pointed out that while they lack many of the characteristics Western cartographers assume maps must contain, they satisfied the cartographic needs of the people who made and used them, and they apparently did so for hundreds of years.

Wayfinding is an important skill in many societies; indeed, it can often be a matter of life or death. Finding one's way on the ocean poses special problems and requires special skills because one may be out of sight of land for lengthy periods. Under such conditions, it is difficult to maintain one's bearings. Weather can change quickly, and currents may carry voyagers off course without their knowledge. All of these factors can compromise the prospect of successful landfall. Consequently, many Pacific islanders developed sophisticated techniques for plotting their course on the ocean and created complex maps and charts that they carried in their minds when they set sail — whether for nearby fishing grounds or distant shores.

Unlike Western cartographers, Anutans through most of their history have successfully passed seafaring and



Figure 4. Ocean viewed from Anuta's hilltop, with dark patches indicating reefs. (Photograph by R. Feinberg)

navigational knowledge from generation to generation without the benefit of written communication. In that way, their geographical understandings and techniques for dealing with the world around them underscore the contrast between cartographic efforts of one non-Western community and modern academic cartographers. At the same time, they remind us of the remarkable systems of cartographic and navigational understanding that have been lost as a result of European contact and because it simply did not occur to so many of our predecessors to ask the local experts what they knew.

ACKNOWLEDGEMENTS

We are indebted to the people of Anuta, who have extended their hospitality and shared their cultural knowledge over a period of three decades. The Kent State University Research Council and Faculty Improvement Leave Program supported the research that led directly to this article. Graduate student Bryan George of the Kent State University Department of Geography assisted in producing the computerized version of the reef map and preparing it for publication.

ENDNOTES

- ¹ For discussion of the knowledge and techniques employed by Pacific Island navigators, see, e.g., Alkire (1965), Gladwin (1970), Lewis (1972), Levinson, *et al.* (1973), Finney (1976, 1979, 1985, 1998), Finney, *et al.* (1989, 1994), Kyselka (1987), Thomas (1987), Feinberg (1988, 1991, 1995a), G. Irwin (1989, 1992), Turnbull (1991), Frake (1995) and Akimichi (1996).
- ² Others significant contributors to the literature on indigenous mapping include, for example, Lewthwaite, 1966, 1970; Lévi-Strauss, 1967; Waselkov, 1989; Mundy, 1996; Ellen and Fukui, 1996; Warhus, 1997; Widlock, 1997; Ingold, 2000; Bennardo, 2002; and Strathern and Steward, 2003.
- ³ From early on, Tupaia's 'map' generated a number of puzzles that have yet to be resolved (see, e.g., Forster, 1778; Hale, 1846; Lewthwaite, 1966, 1970; Turnbull, 1998). But most scholars agree that, however the 'map' is to be interpreted, it reflects a remarkable accomplishment.
- ⁴ A number of anthropologists have presented detailed discussions of the Carolinian star compass. See, for example, Goodenough, 1953; Gladwin, 1970; Frake, 1995; Finney, 1998. For some Polynesian analogues, see Feinberg, 1988, 1995a.
- ⁵ Following from this observation, Frake (1995) argues cogently that, contrary to conventional anthropological wisdom, the Micronesian star compass in fact is, like the others, an abstract conceptual map of the cosmos in which space is conceived as a circle and divided via repeated bisections into 32 equally spaced points. The rising and setting points of specific stars, according to Frake, are merely names for those points; navigators do not intend astronomical reality to correspond precisely with the conceptual compass points.
- ⁶ For a summary of Pacific navigation as a system of scientific knowledge and a comparison between that system and Western science, see Turnbull (2003, particularly chapter 4).
- ⁷ These charts are, in many respects, unique. Turnbull (1993: 20–21), nevertheless, finds certain parallels between the Marshallese 'stick charts' and carved wooden 'coastal charts' of the Greenland Inuit.
- ⁸ Following the convention widely used by Pacific anthropologists (e.g., see Carroll, 1975), we distinguish between islands, which are unified land masses of volcanic origin or connected to a continental shelf, and islets, which are low, narrow, coralline sand bars, typically rising to only a few feet above the high tide line. An atoll is a ring of islets surrounding an inner lagoon and, itself, surrounded by the open ocean.
- ⁹ Carucci (personal communication), however, has noted the speculative nature of our common understandings relating to the transmission of knowledge about stick charts. He observes that knowledge transmission in the Marshall Islands today may take a number of paths, including grandparent to grandson and mother's brother to sister's son, as well as father to son.

- ¹⁰ The concept of 'tradition' is problematic since it implies an objectively identifiable baseline with which 'modernity' may be compared. In reality, all cultural and social systems are constantly changing, and indigenous concepts of tradition are defined in the present, reflecting contemporary social and political concerns (see, e.g., Hobsbawm and Ranger, 1983; Keesing and Tonkinson, 1982; Keesing, 1989; Feinberg, 1994; Feinberg and Zimmer-Tamakoshi, 1995; Feinberg and Watson-Gegeo, 1996). Still, some communities have clearly incorporated less than others of Western culture and technology into their daily lives. By this criterion, most observers would place Anuta well toward the 'traditional' end of the spectrum of the world's communities.
- ¹¹ *Vanevane*, because of its abundance, is an important fish in the Anutan diet. It is about six inches in length with horizontal yellowish stripes and resembles the French grunts one encounters off the Atlantic coast of the southern US Firth (1985: 591) identifies it as 'a blue-striped perch (*Lutjanus quinquelineatus* or *L. kasmira*). For more on Anutan fish and fishing techniques, see Feinberg (1981a, 2003).
- ¹² For example, several Anutans noted their impression that Rotuma was only slightly east of Patutaka, an uninhabited island approximately thirty miles to the southeast. In fact, Rotuma is over 500 miles east of Anuta. Others voiced the erroneous belief that Tonga and Samoa are single islands rather than extensive archipelagoes.
- ¹³ Despite this description, when Feinberg inspected some of the reefs visually by skin diving after the map had been completed, the one *pupua* that he explored looked more like a not-very-big rock without an obvious sandy spot in the middle.
- ¹⁴ Sea marks (Gladwin, 1970: 162 and passim; Lewis, 1972: 249) are distinctive features associated with a particular region of ocean. They may include deep reefs which can subtly affect the color of the water or create surface disturbances, lines of flotsam that are regularly deposited in the same place because of currents, or even forms of sea life that customarily inhabit certain spots. They may be used in much the same way as land marks to fix one's position at sea and affirm one's course; but they are often more difficult to detect and utilize effectively.
- ¹⁵ Feinberg's experience as a scuba diver was not helpful on Anuta since he would have had no way to fill tanks. However, the *akau penua* is sufficiently shallow (generally not more than thirty to forty feet) that he was able to explore it fairly thoroughly relying on breath-hold dives.

REFERENCES

- Alkire, William (1965). *Lamotrek Atoll and Inter-island Socio-economic Ties*, Illinois Studies in Anthropology, No. 5, University of Illinois Press, Urbana, IL.
- Akimichi, Tomoya (1996). 'Image and reality at sea: fish and cognitive mapping in Carolinian navigational knowledge', in *Redefining Nature: Ecology, Culture and Domestication*, ed. by Ellen, R., and Fukui, K., Berg, Oxford.
- Bagrow, Leo (1985). *History of Cartography*, 2nd edn, revised and enlarged by Skelton, R. A., Precedent Publishing Inc., Chicago.
- Belyea, Barbara (1998). 'Inland journeys, native maps', in *Cartographic Encounters: Perspectives on Native American Map-making and Map Use*, ed. by Lewis, G. Malcolm, University of Chicago Press, Chicago and London.
- Bennardo, Giovanni (ed.) (2002). *Representing Space in Oceania: Culture in Language and Mind*, Pacific Linguistics, 523, Research School of Pacific and Asian Studies, Australian National University, Canberra.
- Carroll, Vern (ed.) (1975). *Pacific Atoll Populations*, ASAO Monograph No. 3, University of Hawaii Press, Honolulu.
- Carucci, Laurence M. (1995). 'Symbolic imagery of Enewetak sailing canoes', in *Seafaring in Contemporary Oceania: Studies in Continuity and Change*, ed. by Feinberg, Richard, pp. 16–33, Northern Illinois University Press, DeKalb, IL.
- Davenport, William (1960). 'Marshall Islands navigational charts', *Imago Mundi*, 15, 19–26.
- Ellen, Roy and Fukui, Katsuyoshi (eds) (1996). *Redefining Nature: Ecology, Culture, and Domestication*, Berg, Oxford.

- Feinberg, Richard (1973). 'Anutan social structure', in **Anuta: A Polynesian Outlier in the Solomon Islands**, ed. by Yen, D. E., and Gordon, J., Pacific Anthropological Records, Number 21, pp. 9–21, Bishop Museum Press, Honolulu.
- Feinberg, Richard (1976). 'Archaeology, oral history, and sequence of occupation on Anuta Island', **Journal of the Polynesian Society**, 85, 99–101.
- Feinberg, Richard (1977). **The Anutan Language Reconsidered: Lexicon and Grammar of a Polynesian Outlier**, 2 vols, HRA-Flex Books, Human Relations Area Files Press, New Haven.
- Feinberg, Richard (1981a). **Anuta: Social Structure of a Polynesian Island**, with foreword by Firth, Sir Raymond, Institute for Polynesian Studies in cooperation with the National Museum of Denmark, Lā'ie and Copenhagen.
- Feinberg, Richard (1981b). 'The meaning of "sibling" on Anuta Island', in **Siblingship in Oceania: Studies in the Meaning of Kin Relations**, ed. by Marshall, Mac, ASAO Monograph Number 8, pp. 105–48, University of Michigan Press, Ann Arbor.
- Feinberg, Richard (1986). 'The "Anuta problem": local sovereignty and national integration in the Solomon Islands', **Man**, 21, 438–52.
- Feinberg, Richard (1988). **Polynesian Seafaring and Navigation: Ocean Travel in Anutan Culture and Society**, Kent State University Press, Kent.
- Feinberg, Richard (1989). 'Possible prehistoric contacts between Tonga and Anuta', **Journal of the Polynesian Society**, 98, 303–17.
- Feinberg, Richard (1991). 'A long-distance voyage in contemporary Polynesia', **Journal of the Polynesian Society**, 100, 25–44.
- Feinberg, Richard (1994). 'Contested worlds: politics of culture and the politics of anthropology', **Anthropology and Humanism**, 19, 20–35.
- Feinberg, Richard (1995a). 'Continuity and change in Nukumanu maritime technology and practice', in **Seafaring in Contemporary Oceania: Studies in Continuity and Change**, ed. by Feinberg, Richard, pp. 159–95, Northern Illinois University Press, DeKalb, IL.
- Feinberg, Richard (1995b). 'Christian Polynesians and pagan spirits: Anuta, Solomon Islands', **Journal of the Polynesian Society**, 104, 267–301.
- Feinberg, Richard (1996). 'Spirit encounters on Anuta, Solomon Islands', in **Spirits in Culture, History, and Mind**, ed. by Mageo, Jeanette Marie, and Howard, Alan, pp. 99–120, Routledge, New York and London.
- Feinberg, Richard (1998). **Oral Traditions of Anuta: A Polynesian Outlier in the Solomon Islands**, Oxford Studies in Anthropological Linguistics, Volume 15, Oxford University Press, New York and Oxford.
- Feinberg, Richard (2002). 'A Polynesian people's struggle to maintain community in the Solomon Islands', in **Constructing Moral Communities: Pacific Islander Strategies for Settling in New Places**, ed. by Modell, Judith, Special issue, **Pacific Studies**, 25, 45–70.
- Feinberg, Richard (2003). **Anuta: Polynesian Lifeways for the 21st Century**, in press, Waveland.
- Feinberg, Richard, and Zimmer-Tamakoshi, Laura (eds) (1995). **Politics of Culture in the Pacific Islands**. **Ethnology**, 34, Special Issue.
- Feinberg, Richard, and Watson-Gegeo, Karen Ann (eds) (1996). **Leadership and Change in the Western Pacific: Essays in Honor of Sir Raymond Firth on the Occasion of his Ninetieth Birthday**, London School of Economics Monographs on Social Anthropology, No. 63, London.
- Finney, Ben R. (ed.) (1976). **Pacific Voyaging and Navigation**, Polynesian Society Memoir Number 39, The Polynesian Society, Wellington, New Zealand.
- Finney, Ben R. (1979). **Hokule'a: The Way to Tahiti**, Dodd, Mead, New York.
- Finney, Ben R. (1985). 'Anomalous westerlies, El Niño, and the colonization of Polynesia', **American Anthropologist**, 87, 9–26.
- Finney, Ben R. (1998). 'Nautical cartography and traditional navigation in Oceania', in **The History of Cartography**, vol. 2, bk 3, ed. by Woodward, David, and Lewis, Malcolm, pp. 443–92.
- Finney, Ben R., P. Frost, Richard Rhodes, and Nainoa Thompson (1989). 'Wait for the west wind', **Journal of the Polynesian Society**, 98, 261–302.
- Finney, Ben R., et al. (1994). **Voyage of Rediscovery: A Cultural Odyssey through Polynesia**, University of California Press, Berkeley, Los Angeles, and London.
- Firth, Raymond. (1985). **Taranga Fakainglisi ma Taranga Fakatikopia: Tikopia-English Dictionary**, Oxford University Press in cooperation with the University of Auckland, Auckland, New Zealand.
- Forster, J. R. (1778). **Observations Made during a Voyage Round the World**, London: G. Robinson.
- Frake, Charles O. (1995). 'A reinterpretation of the Micronesian "star compass"', **The Journal of the Polynesian Society**, 104, 147–59.
- Gladwin, Thomas (1970). **East is a Big Bird: Navigation and Logic on Puluwat Atoll**, Harvard University Press, Cambridge, MA.
- Goodenough, Ward H. (1953). **Native Astronomy in the Central Caroline Islands**, Museum Monographs, University Museum, University of Pennsylvania, Philadelphia.
- Hale, Horatio (1846). **United States' Exploring Expedition during the Years 1838–1842**, Lea and Blanchard, Philadelphia.
- Hobsbawm, Eric J., and Ranger, Terence (eds) (1983). **The Invention of Tradition**, Cambridge University Press, Cambridge.
- Ingold, Tim (2000). **The Perception of the Environment: Essays in Livelihood, Dwelling, and Skill**, Routledge, London.
- Irwin, Geoffrey (1989). 'Against, across, and down the wind: a case for the systematic exploration of the remote Pacific islands', **Journal of the Polynesian Society**, 98, 167–206.
- Irwin, Geoffrey (1992). **The Prehistoric Exploration and Colonisation of the Pacific**, Cambridge University Press, Cambridge.
- Irwin, Lee (1994). **The Dream Seekers: Native American Visionary Traditions of the Great Plains**, University of Oklahoma Press, Norman, OK.
- Johannes, R. E. (1981). **Words of the Lagoon: Fishing and Marine Lore in the Palau District of Micronesia**, University of California Press, Berkeley, CA.
- Johannes R. E., and MacFarlane, J. W. (1991). **Traditional Fishing in the Torres Strait Islands**, CSIRO (Division of Fisheries), Hobart, Tasmania.
- Keesing, Roger M. (1989). 'Creating the past: custom and identity in the Pacific', **The Contemporary Pacific**, 1–2, 19–42.
- Keesing, Roger M., and Tonkinson, Robert (eds) (1982). 'Reinventing Traditional Culture: the Politics of Custom in Island Melanesia', **Mankind**, 13, Special Issue.
- Krämer, Augustin, and Nevermann, Hans (1938). **Ralik-Ratak (Marshall Inseln)**, Friederichsen, De Gruyter, Hamburg.
- Kyselka, Will (1987). **An Ocean in Mind**, University of Hawai'i Press, Honolulu.
- Lévi-Strauss, Claude (1967). 'Do dual organizations exist?', in **Structural Anthropology** by Claude Lévi-Strauss, Basic Books, New York.
- Levinson, M., Ward, R. G., and Webb, J. W. (1973). **The Settlement of Polynesia: A Computer Simulation**, University of Minnesota Press, Minneapolis.
- Lewis, David (1972). **We, the Navigators**, University of Hawai'i Press, Honolulu.
- Lewthwaite, Gordon R. (1966). 'Tupaia's map: the horizons of a Polynesian geographer', **Association of Pacific Coast Geographers Yearbook**, 28, 41–53.
- Lewthwaite, Gordon R. (1970). 'The puzzle of Tupaia's map', **New Zealand Geographer**, 26, 1–19.
- Lieber, Michael D. (1994). **More than a Living: Fishing and the Social Order on a Polynesian Atoll**, Westview Press, Boulder, CO.
- Mundy, Barbara (1996). **The Mapping of New Spain: Indigenous Cartography and the Maps of the Relaciones Geográficas**, University of Chicago Press, Chicago and London.
- Rundstrom, Robert A. (1990). 'A cultural interpretation of Inuit map accuracy', **Geographical Review**, 20, 155–68.
- Skelton, R. A. (1954). 'Captain Cook as a hydrographer', **Mariner's Mirror**, 40, 92–119.
- Stewart, Pamela J., and Strathern, Andrew (2003). **Landscape, Memory, and History: Anthropological Perspectives**, Pluto Press, Sterling, VA and London.
- Sundstrom, Lenea (1996). 'Mirror of Heaven: cross-cultural transference of the sacred geography of the Black Hills', **World Archaeology**, 28, 177–89.
- Thomas, Stephen D. (1987). **The Last Navigator**, Henry Holt and Company, New York.
- Thrower, Norman J. W. (1972). **Maps and Man**, Prentice Hall International, Inc., London.

- Thrower, Norman J. W. (1996). **Maps and Civilization**, University of Chicago Press, Chicago.
- Turnbull, David (1991). **Mapping the World in the Mind: An Investigation of the Unwritten Knowledge of the Micronesian Navigators**, Deacon University Press, Geelong.
- Turnbull, David (1993). **Maps Are Territories; Science is an Atlas**, University of Chicago Press, Chicago.
- Turnbull, David (1998). 'Cook and Tupaia, a tale of cartographic *méconnaissance*?', in **Science and Exploration in the Pacific: European Voyages to the Southern Oceans in the Eighteenth Century**, ed. by Lincoln, M., pp. 117–32, Boydell Press in association with the National Maritime Museum, London.
- Turnbull, David (2000). **Masons, Tricksters and Cartographers: Comparative Studies in the Sociology of Scientific and Indigenous Knowledge**, Harwood Academic Publishers, Amsterdam.
- Warhus, Mark (1997). **Another America: Native American Maps and the History of Our Land**, St Martin's Press, New York.
- Waselkov, Gregory A. (1989). 'Indian maps of the colonial Southeast', in **Powhatan's Mantle: Indians in the Colonial Southeast**, ed. by Wood, P., Waselkov, G., and Hartley, T., pp. 292–343, University of Nebraska Press, Lincoln.
- Widlock, T. (1997). 'Orientation in the wild: the shared cognition of the Hai||om Bush People', **Journal of the Royal Anthropological Institute**, 3, 317–27.
- Winkler, Captain Otto (1899). 'On sea charts formerly used in the Marshall Islands, with notices on the navigation of these islanders in general', **Annual Report of the Board of Regents of the Smithsonian Institution**, vol. 1, pp. 487–508, United States Government Printing Office, Washington, DC.
- Woodward, David, and Malcolm Lewis, G., (eds) (1998). **The History of Cartography, Volume 3**, The University Press, Chicago.
- Yen, Douglas E., and Gordon, Janet (eds) (1973). **Anuta: A Polynesian Outlier in the Solomon Islands**, Pacific Anthropological Records, Number 21, Bishop Museum Press, Honolulu.