

"ADAPTATION"

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Anyone who has ever tried to remove a screw without using a screwdriver knows how good screwdrivers are for this simple but otherwise laborious task. While purists may frown on such shabby practices, most of us also know that screwdrivers are simple enough tools that by adjusting how you hold them, they are adaptable implements, too. They can be crude wood chisels, handy sticks for mixing paint, pry bars for opening tins, punches for making holes, and the list goes on. In short, screwdrivers fit the job they were designed to perform very well and with little or no modification you can make them fit other familiar household chores. Considering the many uses of the lowly screwdriver, anyone can understand why a dictionary says *adaptation* means: **1.a.** The act or process of adapting. **b.** The state of being adapted. **2.** Something that is changed or changes to fit a new situation.

All of these uses of the word are common today in everyday speech. Before Darwin and others changed how we see the world around us, however, adaptation had a deeper meaning, too. It seemed perfectly reasonable to think that life's diversity is altogether purposeful (except our own diversity, of course, which according to the Bible was not part of God's original Plan and which instead is evidence of the price we have paid for our Original Sin of becoming sapient). Adaptations found in the "Book of Nature" exhibiting the delicate fit between organisms and their place in Creation were judged by many to be scientific proof of God's Design.

The notion that adaptation is evidence that we are governed by Design is still accepted by many. There is a continuing tension in Western thought between seeing adaptation the way a dictionary sees it as the state, act, or process of change or changing to fit a new situation; and adaptation as a sign of design and purpose. Nowhere is this tension more evident than in modern archaeology's ambiguous regard for this key concept. Since at least the 1960s, adaptation has been an intellectual hot potato in archaeology (and anthropology), sometimes embraced with almost missionary zeal (Kirch 1980), sometimes rejected as unhelpful, even dangerous or misleading (Dunnell 1980; Shanks and Tilley 1988). Do we need this key concept in archaeology?

Functionalism and the Selectionist Program

Adaptation as a concept plays two major roles in archaeology. Perhaps its

simplest use is the role it plays in our inferential efforts (or desire) to "flesh out" what is left to us from the past, a way of giving artifacts and signs of human habitation meaning, purpose, and historical significance. The basic principle invoked is some version of the idea that if we can define the purpose or *adaptive function* of a thing, we have in a sense found its human soul. A chipped stone wasn't, after all, just a chipped stone; it must have been an end-scraper, burin, knife. Similarly, architecture in ancient Polynesia wasn't just architecture; some would argue that massive stone constructions can be taken as a manifestation of human adaptation to nature or, as we favor nowadays, the environment. While the fit between "Man and the Environment" thus revealed may not be often seen today as scientific proof of God's Design (or alternatively the hand of visitors from outer space), some would conclude we can see therein at least the wisdom of evolutionary theory (Graves and Ladefoged 1995).

The second role that the concept of adaptation plays in archaeology is closely tied to this basic functionalist proposition that artifacts and other traces of the past carry with them evidence of their own design or purpose in the scheme of things. In keeping with the meaning of the word not only as the *state of being* adapted, or suitable, for a given situation, context, or task but also as "the *act* or *process* of adapting," this second usage of the concept is more dynamic. The operative question asked about artifacts and other signs is not only *What was this?* in the sense of *What did this do?* but also *What difference did this make?* The supporting premise for this more profound question is the thought that anything seen in the archaeological record frequently enough to be counted as more than mere happenstance must have been something that worked well-enough (i.e., was well-enough adapted) to be repeated or reproduced, intentionally or otherwise.

Ever since Darwin, there has been at least some acceptance of the idea that things seen over and over again must be adaptively meaningful ("they work") and their meaning as such derives from two of life's most basic truths. First, living things by definition are capable of replicating themselves and they normally strive to do so. Second, because ours is a finite world, all living things do not replicate themselves with equal and unbridled success. What determines the prosperity of any organism-or the popularity of any trait-varies greatly. Yet the bottom line remains the same. Ours is an imperfect world, not the best of all possible worlds, and what we see is in constant flux (Monod 1971). The variety we find around us must only be a restricted or limited selection of the diversity that *could* exist if all things were equally possible and nothing was less perfect than anything else at doing what it had to do to survive and be replicated (Jacob 1982).

But what makes this deeper, more dynamic usage of the word *adaptation* of interest to archaeologists? If adaptation does not show us God's Design, what does it show us? A substantial body of theory in the social sciences is based on the evolutionary premise that what people end up doing is shaped by what people want or need to do, by what people can do, and by how successful they are at doing it. As a case in point, Herbert Simon (1996:53) has written that a human being seen as a behaving system is relatively simple for every person is

an adaptive system. The apparent complexity of our behavior over time is chiefly a reflection of the surroundings within which we find ourselves. To the extent that each of us is effectively adaptive, our behavior will be set by our goals and will reflect the complexity of the environment within which we strive to achieve those goals. If what we want to do is not capricious, there must be direct connections between what we do, where we do it, and what impact it has. Therefore, if we want to understand what people are doing (or more remotely, explain variation in the archaeological record), we must address this natural "logic" (or design) structuring our actions.

Now textbook definitions of adaptation sometimes describe this natural logic-the fit between living things and their surroundings-in words that may lead us to expect that adaptation is a relationship that is simply and easily perceived. Even scholars who are themselves highly critical of "adaptationist thinking" in the biological sciences have written about adaptation in such unhelpfully basic terms as "the good fit of organisms to their environment" (Gould and Lewontin 1979:592).

These words are misleading. Such talk makes it sound like adaptation is only a passive process during which organisms over the course of generations are stretched, shaped, and manipulated by natural selection to fit better into their environment. This fosters the impression that living things are *acted upon* by the external world but cannot *act*, which then makes it appear that living things have just two options in life. Give in and conform to the environment (i.e., to whatever demands get made by the outside world). Or die and go extinct. Looking at adaptation in this limited way carries with it the added implication that the struggle for existence must be constant and severe, so deadly that "small variations in the perfection of adaptation, and in adaptability, make the difference between persistence and extinction" (Ricklefs 1973:71).

In truth, however, adaptive change does not just happen in a manner so simple and direct as "conform or die." A better strategy for survival, after all, is to act on one's behalf, not just let oneself be acted upon. Adaptation of this dynamic kind is a give and take during which living things are not only stretched, shaped, and manipulated but also stretch, shape, and manipulate (Terrell 1986:177-179).

Some archaeologists would dismiss this more liberal view of adaptation by calling it "adaptationism," the notion (they say) that adaptation is "a process whereby humans actively and intentionally direct change in their strategies and tactics of survival" (Jones et al.1995:18). This characterization is unfair. We all know that people can be selective ("adaptive") in what they do according to their whims, aims, and desires. Why would anyone say, as some have done, that an adaptation cannot be an adaptation if it has not been wholly created or historically achieved by natural selection (O'Brien and Holland 1992:38)? Adaptations are not just passive products of natural selection; they can also foster selection.

Before anyone in the audience jumps too high out of their seat, note that both "conform or die" adaptation (natural selection in its crudest form) and "give and take" adaptation (the kind of adaptation that I suspect most historians and

social scientists probably favor, and possibly most biologists, too; see West-Eberhard 1992) are grounded on the same idea, namely the concept of selection by consequences resulting from the adaptive interchange between organisms and their environment (Simon 1996; Skinner 1981).

Therefore, how much or how little it pays us as archaeologists to see people as adaptive agents of history in our efforts to explain variation in the archaeological record is not an all or nothing question. *How much time we should give to weighing the role of human agency depends what we want to explain and how instrumental (or selective) we judge human beings could be in affecting the course of what happened.* I will offer a brief example in just a moment.

Some today nevertheless write as if they wish there were a law in archaeology equivalent to C. Lloyd Morgan's famous law of parsimony in animal psychology. But there is really no widely accepted regulation to the effect that "in no case may we interpret variation in the archaeological record as the outcome of the exercise of a higher psychological faculty, if it can be interpreted as the outcome of the exercise of natural selection acting solely on its own." By the same token, such a rule sounds like a pretty good null hypothesis to keep in mind to avoid overstating your case if you are planning to write about prehistory as a story about human adaptive prowess and intent.

Let us not forget that even Charles Darwin drew much of his inspiration for the theory of natural selection from the intentional selective practices of generations of breeders of fancy pigeons, horses, and dogs (people who were deliberately *selecting for* desirable characteristics). More to the point, the "coinage" of selection is not just direct reproductive success. As B. F. Skinner (1952) loved to argue, *anything* that happens immediately following a behavioral act (or "response") may strengthen ("reinforce") the likelihood that response will be repeated—thereby "selecting" that behavior, however functional or maladaptive. Fortunately, therefore, for those of us who want to use evolutionary theory to help us understand what happened in prehistory, we can do so without having to limit ourselves solely to the study of variation in the archaeological record that we surmise was paid for directly with the biological coinage of survival and reproduction, that is, variation that was shaped solely by natural selection (Maxwell 1995:114-115).[1] If direct biological fitness were the only coin of the realm, there would be little reason for most of us to be here in this room.

Ms Pacman Model of Polynesian Settlement

It is certain that the concept of adaptation continues to have deeper meaning for many archaeologists than dictionary definitions might lead us to suspect. No archaeologist I know is seeking to uncover God's Design or Purpose, but adaptation (or its surrogate, selection) is still seen by many as a way of discovering the purpose and historical significance of what we are finding in the archaeological record. A danger remains, however. We may want adaptation to explain too much of what we find (and please accept that this warning comes from someone who has advocated for a "Darwinian perspective" on our variation

and diversity for all of his professional life). Consider this example.

Just about everywhere today that we excavate in Australia, New Guinea, and the neighboring islands in the southwest Pacific at least as far as the North Solomons, archaeologists are discovering traces of humankind dating back more than 30-35,000 years ago. We have also found, however, that the Solomon Islands evidently formed the eastern edge of the inhabited Pacific until about the end of the 2nd millennium BC. On current evidence, deep-sea colonization of the Pacific Islands beyond of the Solomons only started around 3,000 years ago.

The expansion of human settlement eastward into the region of the Pacific now called Polynesia can be linked archaeologically with the rapid spread of some of the earliest pottery so far found in Oceania, an ornately decorated ware called Lapita pottery. Based on current evidence, it may have taken only a few hundred years, perhaps even less, for people and the art of making pottery to spread all the way from the Bismarck Archipelago-where the oldest Lapita pottery has been excavated-to Tonga and Samoa in western Polynesia, and southward to the archipelagoes of Vanuatu and New Caledonia in eastern Melanesia.[2]

The speed with which people and pottery traveled to previously uninhabited places in the Pacific 3,000 years ago seems remarkable. This expansion is not readily explained as a logical human response, say, to famine or overcrowding in the already settled parts of the Pacific. On the other hand, detailed computer simulations have convinced most of us working in the Pacific that Polynesia could not have been discovered and colonized by people merely by accident (Irwin 1992). These people must have been looking for new places to be but they do not appear to have been driven there out of desperation. Yet right now it is anyone's guess what finally encouraged people making Lapita pottery to leave home in the western Pacific and risk sailing on the deeper waters beyond the Solomons. Wanderlust, a sense of adventure, a pioneering spirit, and similar motivations have all been suggested.

When I say desperation cannot be invoked to account for what happened in the Pacific around 3,000 years ago, I do not mean that adaptation could not have been part of the story. The islands east of the Solomons are generally smaller and farther apart than the islands in the anciently settled Pacific nearer Asia. Geoff Irwin (1992) at the University of Auckland has argued that voyaging conditions east of the Solomons must have been different enough that people experienced to traveling between the islands closer to Asia first had to learn how to sail far offshore and survive. And it seems likely they weren't properly prepared or adapted to do so >30,000 years ago when they first colonized the islands nearer Asia.

Some experts would add that they were also not economically equipped to move on out into the farther Pacific until the 2nd millennium BC (Green 1979; Kirch 1997; Spriggs 1997). According to this argument, it was the domestication-of certain species of plants and animals (notably dogs, pigs, and chickens) in Asia that fueled Lapita's expansion. Lapita, it is said, was a by-product of an Asian "Neolithic Revolution" based on early rice cultivation.

This added incentive, however, may not have been needed to get people moving around the Pacific during the Holocene. By 6,000 years ago, the world's

oceans had filled up again following the Pleistocene, and sea levels had returned to within a few feet of their modern position. We are only starting to document the impact that this new equilibrium may have had on the natural productivity of coastal ecosystems in the Pacific. In my own research area-the Sepik coast of Papua New Guinea-we now think that by the 2nd millennium BC, newly stabilized lagoons in the Sepik basin and along this great island's northern coastline may have reached a level of productivity great enough to support significant human population growth fueled mostly, but evidently not entirely, on wild foods (notably, fish, shell fish, nuts, and edible starch from the pith of the sago palm). We suspect it was not so much the domestication of particular plants and animals (analogous, say, to the domestication of corn in the Americas) that fueled prehistoric culture change in the Pacific after the Ice Age as the naturally increasing abundance of coastal foods and an "opportunistic" approach to nutrition that made "horticulture" the mainstay only where (and when) local circumstances forced the issue.[3]

By 3,000 years ago, according to what I am calling the "Ms Pacman Model"[4] of Polynesian Settlement," natural and cultural changes in the already inhabited parts of the Pacific had led to the development of maritime communities that were living on a broad spectrum of wild, semi-cultivated, and sometimes domesticated greens, tubers, forest nuts, shellfish, and seafoods including turtles, fish, sharks, and porpoises.[5] While the exact dates of their introduction are far from certain, it also looks like chickens, dogs, and pigs-all of which are evidently of Asian origin-had become elements of the local economies of at least some of these ancient maritime communities.

Given this subsistence mix (this adaptation, if you will), people in the Pacific were "on the water" by 3,000 years ago and they had good reasons for being there. Les Groube (1971) observed 28 years ago-as David Burley and his colleagues (Burley 1998; Burley et al. 1995; Burley, pers. comm.; Shutler et al. 1994) are now confirming-that in the scattered archipelagoes of Fiji, Tonga, and elsewhere there is a distinct association between Lapita pottery, rich shell middens, and the first arrival of people. This association encouraged Les Groube to propose his famous Lapita "standlooper" model of Lapita (Clark and Terrell 1978) arguing that the initial settlers of the islands east of the Solomons practiced a restricted maritime/lagoonal economy that directly fostered "the astonishingly rapid colonisation of the western Pacific before 1000 BC by people with Lapita ware" (Groube 1971:312).

It seems improbable that anyone in the Pacific nowadays is living a lifestyle that truly approximates what people were doing during the formative years of Oceanic culture between 6,000 and 3,000 years ago. Unlike Groube's older model, however, my Ms Pacman Model does not tip in the direction of saying that the first colonists to get beyond the Solomons were people "who, like the sealers and whalers in the European period, expanded ahead of colonisation by agriculturalists" (1971:312). My wager instead would be that the ways of life of these pioneers are most closely reflected today in what the maritime peoples of Indonesia, Papua New Guinea, and perhaps even in New Zealand are doing (or were doing until recent times), a variable and "mixed" maritime and

horticultural way of getting along.

While I cannot go into detail, let me quickly add that it seems unlikely that people were driven by compulsion to eat their way across the lagoons and coastal waters of virgin islands in the Pacific 3,000 years ago. Nonetheless, the archaeological evidence coming out of the Tongan archipelago[6], in particular, suggests that these people had a profound and rapid impact on their environment. Like Ms Pacman in the old video game, they appear to have consumed and moved on until within a few hundred years they had to turn their attention more fully to what they could grow on land than what they could harvest from the sea. But my guess would be that they weren't especially hungry in the early days. Rather I think they were looking in less than optimal ways both for abundant foods and also for particular foods-notably sea turtles[7]-that were valued for "cultural" as well as nutritious reasons. I suspect, to be all too brief about it, that certain marine foods together with ornate Lapita pots[8] and other things were some of the ingredients of a fairly well-defined and widely distributed "culture complex" (Sapir 1916) that was not just a component of a single "Lapita culture," "people" or "ethnic group," but rather was some kind of cult, dance complex, or social ritual then widely popular (Terrell and Welsch 1997).

Conclusions

Explaining why it took people so long to get out into the Pacific beyond the Solomons and why, once they did finally do so, people at first moved quickly from island to island are matters of more than parochial interest (Terrell 1998; Terrell et al. 1997). We can explore these questions from an evolutionary point of view (Terrell 1986a). But evolution is the sum (or product) of many things: chance, constraint, adaptation, choice, and circumstance being a few; and it does no good to oversimplify. Evolution is not just a story about adaptation or natural selection.

It may not be farfetched to think that it took people as long as it did to sail beyond the Solomons because they could not do so until they were prepared and ready. But they may have been adaptively "ready" long before they actually did so. Neither chance nor adaptation explains why *Homo sapiens* finally ventured out on the open sea around 3,000 years ago and eventually reached the untouched islands now called Polynesia. We may never know for sure what led them to do so, but to deny that they were pioneers because the evolutionary theory that biologists use may have no place for human motives and intent would give us an impoverished sense of prehistory. We need to give human agency a role to play in the settlement of Polynesia for if we don't we cannot explain the course of what happened.

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[1] Some who endorse the value of evolutionary theory for archaeology are inspired by modern biological evolutionism so directly that they say "applying evolutionary theory to people requires an expansion of classic neo-Darwinian theory to allow for nongenetic mechanisms of transmission and its consequences" (Teltser 1995:5). These scholars may be unaware of other ways of explaining the differential persistence of variation in evolutionary terms—for instance, behavioral psychology's paradigm of "operant conditioning" (Skinner 1952). I suspect behaviorists would say that the vast body of empirical evidence on shaping behavior by operant conditioning adequately explains "the nongenetic transmission of information."

[2] The oldest Lapita pottery in the Bismarck Archipelago dates to around 3,300-3,200 years ago (Specht and Gosden 1997); the oldest such pottery in the Tongan archipelago is around 2,800-2,850 BP (David Burley, pers. comm.; Burley et al. 1995).

[3] Unlike Roger Green (1991:499), I doubt that Lapita pottery was produced by people who were exploiting "a more specialized niche within the broader previous adaptation." It has often been said that the ancestors of the Polynesians could not have colonized the virgin islands of the central and eastern Pacific without horticulture. This assertion, of course, is a fine example of the kind of logically flawed *ex post facto* arguments that have discredited the "adaptationist program" in the eyes of its critics.

[4] The model is under development and is presented here only in the form of a *scenario* (Clark and Terrell 1978:300-301).

[5] "While in most Lapita faunal assemblages a relatively few species are dominant, the diversity is nonetheless remarkable, demonstrating that the Lapita people knew how to exploit the resources of their marine environment to the fullest" (Kirch 1997:197).

[6] Current evidence suggests a similar scenario can be written for the early settlement of western Micronesia (Rainbird 1994, 1995, pers. comm.)

[7] The Polynesians who were descended from Lapita folk "would later develop a highly ritualized feasting pattern based on the annual occurrence of sea turtles, with the first turtles reserved for the chiefs" (Kirch 1997:202).

[8] For additional discussion, see Sand et al. 1998.

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