

## Chapter 7

# Archaeology, Style, and the Theory of Coevolution

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### INTRODUCTION

Durham's (1991) dual inheritance theory of coevolution provides a coherent basis for applying Darwinian theory to socio-culture change. His theory rests on three hypotheses: (1) Decision making by individuals is the primary but not only cause of cultural evolution. Humans actively choose among alternative courses of action, when they are able; selection is based on evaluation of the consequences of different alternatives. Since knowledge is imperfect, the outcomes will be imperfect. Choices in cultural selection are made on the basis of learned cultural values. Cultural values are socially transmitted between individuals and generations. (2) The relationships between culture and genes are mediated through five modes. These modes constitute coevolution. (3) In general, "cultural variants which improve the reproductive fitness of their selectors will spread through a population by choice or imposition at the expense of alternative variants."

In Durham's theory, cultural selection is the primary force which sorts among cultural variants within a human group. Variants are evaluated against what he terms *primary* and *secondary* values. Primary values are essentially biological—they are the result of natural selection operating on human genotypes. Secondary values are cultural, are learned, and are socially transmitted.

They too change as a result of cultural evolution. Durham's theory integrates biological and cultural evolution without biological determinism.

Coevolutionary theory provides a richer framework for a Darwinian approach to central archaeological issues such as style, than do other, related approaches such as cultural selectionist theories, and other, more narrow applications of natural selection (e.g., Dunnell 1978). This paper provides a sketch of dual inheritance theory, presents an archaeological approach to style based on dual inheritance theory and develops a preliminary application of the approach to the evolution of Northwest Coast art.

## DUAL INHERITANCE

The works of Boyd and Richerson (1985) and Durham (1991) are the bases for the following discussion. The reader is also referred to Bettinger's (1990) excellent recent review and exegesis of Boyd and Richerson. There are differences between Boyd and Richerson, and Durham, and between these and similar theories (e.g., Rindos 1984). However, the intent of this paper is to lay out their fundamental similarities, and to explore some implications.

Dual inheritance theories postulate that, in Durham's words, "...genes and culture constitute two distinct but interacting systems of information inheritance within human populations" (Durham 1991:419-420). Both Durham and Boyd and Richerson go to great lengths to establish that genes and cultures are separate systems which are not completely analogous to each other. Following Durham again, the differences between cultural and genetic inheritance include:

...first, genes and culture each contain information within codes that have very different biophysical properties (DNA versus memes [see below]); second, the information is stored and processed in different, highly specialized structures (cell nuclei versus the brain); third, it is transmitted through space and time by very different mechanisms (sexual versus social intercourse [emphasis Durham's]); and fourth, the information in either system may undergo lasting, transmissible change without there being a corresponding change in the other (Durham 1991:420 [brackets Ames's comments])

In dual inheritance theories, culture is defined narrowly. Boyd and Richerson define culture as:

...information capable of affecting individuals' phenotypes which they acquire from other conspecifics by teaching or imitation. (1985:33)

According to Durham, culture has these properties:

1. Conceptual reality. Culture is "shared ideological phenomena (values, ideas, beliefs, and the like) in the minds of human beings. It re-

fers to a body or a 'pool' of information that is both public (socially shared) and prescriptive (in the sense of actually or potentially guiding behavior)" (Durham 1991:3).

2. Social transmission. To qualify as cultural, in Durham's view, information must be learned from others, not genetically inherited or gained through individual experience. In the same vein, Boyd and Richerson also restrict their concept of cultural transmission to situations in which behavior is acquired "directly from conspecifics by initiating their behavior or because conspecifics teach...by reinforcing appropriate behavior" (1985:35).
3. Symbolic encoding. To Durham, symboling is important because its arbitrariness "enhances the information density of social transmission" (1991:6); cultural information so encoded creates realities and organizes relations. Boyd and Richerson do not believe symboling is necessary to their theory.
4. Systemic organization. Culture is treated as a " 'system of knowledge' [Keesing 1974:89] within a population" (Durham 1991:7) that possesses both a hierarchical structure and coherence "(component beliefs are often linked together and embedded within the whole)" (1991:6). It does not follow from this that the components of a culture will necessarily appear coherent to observers from another culture (e.g., Gellner 1988).
5. Social history. The information that constitutes a culture does not emerge fully formed, like Venus from the brow of Zeus. Rather, the information has been handed down, and is composed of "the surviving variants of all the conceptual phenomena ever introduced and socially transmitted" (Durham 1991:8).

In sum, Durham defines cultures as "systems of symbolically encoded conceptual phenomena that are socially and historically transmitted within and between populations" (1991:9).

Behavior is not part of culture in dual inheritance theory; it is rather an aspect of an individual's phenotype, which, among humans, is the result of the interplay among genotype, culture, and the environment. Dual inheritance theory rejects strictly sociobiological explanations of human behavior (Boyd and Richerson 1985; Durham 1991); in other words, behavior is not the direct consequence of genotype. Humans have a genetically based capacity for culture, and cultural variations among human groups are the result of selection operating on cultural inheritance, not on the genotype (Rindos 1986). On the other hand, behavior is not solely the direct consequence of culture either, but the result of many things, of which culture is one.

From the standpoint of an archaeologist, this means that material culture is not culture, but rather the phenotypic expression of the interplay among cultural inheritance, genotype, and environment. This of course is directly at odds with the definition of culture which forms the basis of processual archaeology (Binford 1962), and may seem at first to be a return to an unadulterated idealism. This is not the case. I will explore this issue in terms of style in more detail below. At this point, it is sufficient to say that symbols in material culture—the letters on this page, for example—are parts of a phenotype, in this case mine. Since they are phenotypic, such symbols cannot be seen as the culture code made manifest, a special window into the information systems that constitutes culture. To harken back to an ancient debate in archaeology, artifact form represents behavior, not a mental template.

Durham identifies two basic categories of cultural evolutionary forces: nonconveyance and conveyance forces. Nonconveyance forces include innovation, synthesis, migration, diffusion, and cultural drift. (Recent discussions of style by archaeologists attempting to build a cultural evolutionary theory [e.g., Dunnell 1978] have emphasized the role of cultural drift in stylistic change. That issue will be the focus of the next section.) Nonconveyance forces are the sources of variation within cultural systems. Conveyance forces produce “differential social transmission of allomemes within a reference group” (Durham 1991:422), and include transmission forces, natural selection, and cultural selection.

Before discussing transmission forces, it is important to discuss what is transmitted and who does the transmitting. Durham defines the *meme* as “the variable unit of transmission in cultural transmission. I [suggest] that meme should refer to any kind, amount, and configuration of information in culture that shows both variation and coherent transmission” (1991:422). The “behaviorally expressed variants of any given meme are its ‘allomeme.’” Durham argues that memes are imperfectly analogous to genes in biological evolution. (Boyd and Richerson eschew any definition of a unit of transmission. It is beyond the scope of this paper to review the pros and cons of this issue.) Durham believes that the notion of the meme will be among the most controversial aspects of his theory and I suspect the meme concept may be anathema to some. However, the concept is an exceedingly powerful one because it focuses attention on the question of what is being transmitted and on what cultural selection is operating. I will return to this question below.

If memes are the unit of transmission in Durham’s theory, then the reference group is the unit of evolution. (In biological evolution, individuals are subject to selection, but they cannot evolve; populations evolve across generations of individuals. Hence, reference groups evolve culturally across generations of individuals.) A reference group is composed of culture carriers with the same range of allomemes, the same range of ecological consequences for those

allomemes, and the same value system (Durham 1991:427). The concept of the reference group also allows us to attack the question of what the locus of the culture change is, or as Dunnell has recently asked, “What is it that actually evolves? (Dunnell 1992)”

In coevolution, the reference group is the lowest unit of information above the organism, and therefore, at that basic level, it is reference groups that evolve. However, reference groups are nested within larger-scale “packages” of cultural information, such as ethnic groups, social classes, dialect tribes, and so on.

Two factors make things even more complex. First, culture is self-selecting. As an individual, one can modify, alter, or even abandon values and memes, while one cannot (without modern medical interference) modify one’s own genotype. Further, secondary values evolve as they are evaluated against primary values, and others against secondary values. Third, an individual may be a member of more than one reference group at a time. In the United States an individual may make contradictory choices based on gender, ethnicity, race, and socioeconomic class. These give the units of cultural evolution a fluidity and slipperiness which is lacking in biological evolution, though, as Dunnell points out, the issue of the units of selection (i.e., are species “real”) has not yet been settled in biology.

However, for coevolution to work, at least one informational level above the individual is required. In the theory of coevolution, culture is transmitted through social learning. The organism therefore must be part of some kind of society, however minimally that society is defined. In Dunnell’s view, the major force of cultural evolution has been natural selection acting on individuals, until the development of complex societies within the last 6000 years, when some form of intersocietal selection developed (Dunnell 1980, 1992). From the stand-point of dual inheritance theory, Dunnell is mistaken; social groups and organization have always been important in cultural evolution.

The capacity for culture evolved naturally sometime during the late Pliocene and early Pleistocene, i.e., it evolved under natural selection. If culture is indeed socially transmitted, then it evolved based on preexisting social behaviors. Social behaviors were co-opted by natural selection for this novel form of information transfer; culture must have evolved through natural selection for social learning and social learners. It follows from this that some social behaviors may be “fixed”: if they do not occur, learning cannot occur; if learning does not occur, culture is not transmitted. The processes by which language is acquired may be some support for this. From the standpoint of coevolution, then, higher-level social entities must exist for transmission to occur.

The minimal unit within which cultural selection occurs is the reference group; but ultimately it is still individuals doing the selecting. The reference group is itself nested, or embedded, in larger-scale social units, and reference groups can

have fluid memberships. This carries the implication that the effects of cultural selection for memes can be at a much larger scale than just that of a particular reference group. This quality may provide us a linkage between *habitus* and large-scale developments.

With this background, it is possible to discuss conveyance forces. Durham divides these into transmission forces: natural selection and cultural selection. Transmission forces arise from the effects of how allomemes are transmitted—socially learned—and the social context in which they are learned. Boyd and Richerson (1985) stress the effects of transmission forces. Of particular interest is their concept of indirect bias transmission. In indirect bias transmission, an individual will adopt a set or complex of traits from a role model on the basis of a single *indicator* trait, or a few such traits, possessed by the role model (Boyd and Richerson 1985). One need only attend an archaeology convention—where academic success is the indicator trait, and the male side of the throng is bearded and be-tweed—to see biased transmission in operation.

Natural selection is the “natural selection of cultural variation.” Durham identifies two modes of natural selection: intrasocietal and intersocietal. In the former, an allomeme aids its bearer to have more offspring than the other allomemes and therefore is learned by more individuals than are other variants. Intersocietal selection “stems from the differential expansion and extinction of whole societies. . . . This force occupies a place in the cultural scheme equivalent to the one species selection occupies in genetic theory” (Durham 1991:431).

Cultural selection is Durham’s primary force of cultural evolution. In cultural selection, people select among available allomemes according to the allomemes’ consequences. These choices may be conscious or unconscious. Cultural selection is guided by the values held by individuals in a reference group. These values are not necessarily, or often, directly related to biological reproduction. In other words, people do not make most of their day-to-day decisions on the basis of long-term reproductive success. Nor are people necessarily aware of the long term ecological consequences of their decisions (Braun 1991). However, it is a key assumption of Durham’s theory that cultural choices will, over the long term, promote reproductive success. There are two categories of the values: primary and secondary. With primary values, evaluation is made directly by the nervous system; with secondary values, evaluation is made against values which are themselves socially transmitted. Secondary values are “cultural standards derived from primary values through experience, history and rational thought” (Durham 1991:432). Secondary values themselves evolve.

Food preferences are obvious examples of primary and secondary values. Humans are notorious omnivores, with particular cuisines shaped by “experience, history, and rational thought,” but the evolution of these cuisines are shaped by the limits in what we can tolerate in taste, what we can digest, keep down, or what will or will not kill us immediately—primary values.

There are two modes of secondary value selection, or perhaps a continuum between free choice and imposition. In the former, individuals make their own evaluations, while in the latter, the choices of some members of a reference group are imposed on the other members, or the choices of one reference group are imposed on other reference groups through the exercise of power. Most societies fall somewhere in the middle of this continuum. The application of the concept of power is one of Durham’s major emendations to dual inheritance theory, and will be discussed below.

## CULTURAL SELECTION, CHOICE, AND IMPOSITION

Cultural selection, in Durham’s theory, is not a simple analogy to natural selection in biological evolution. In biological evolution, natural selection is the result of differential reproductive success. The relative frequencies of genes and their alleles in a population change in frequency through time according to the relative reproductive success of the bearers of those genes.

Natural selection sorts genotypes according to the differential reproductive success of the phenotypes bearing the genotypes. Different genes and alleles potentially will contribute differentially to that success. This potential is measured by the concept of *genetic fitness*, which is the genotype’s *potential* contribution of genes to future generations (Boyd and Richerson 1985; Durham 1991; O’Brien and Holland 1992). As Eldredge (1986) points out, “natural selection is differential reproductive success as determined by economic [read ecological] success—among a collection of (conspecific) organisms” (1986:358). Eldredge views ecology as the economics of nature. In any case, natural (or what Durham calls genetic) selection sorts phenotypes by their ecological consequences.

Durham stresses that cultural selection is “the differential social transmission of cultural variants through human decision making” (1991:198), as people evaluate the consequences of the cultural variants. Durham calls this “selection *according to consequences*.” People evaluate the outcomes of the cultural traits against secondary values. These consequences can be ecological, but they can, and more likely will, be social. In dual inheritance theory, culture change occurs as a result of the *differential transmission* of cultural variants.

The *cultural fitness* of a meme or allomeme is “its overall suitability for replication and use within the cultural system of a given subpopulation” (Durham 1991:194). Cultural fitness may have little to do with biological fitness; cultural selection is by evaluation against secondary values, not directly against biological reproductive success. In other words, natural selection can act directly on cultural traits, but not necessarily. However, since the capacity for culture is an evolved human biological trait, it is unlikely that, over the long

run, cultural traits will have low genetic fitness values (produce behaviors which lead to low reproductive success). However, cultural selection can contradict natural selection in the short run.

To measure the effect of cultural selection on biological reproduction, Durham uses inclusive fitness (Hamilton 1964). As generally understood, inclusive fitness is a genotype's expected contribution to the next generation both through its own reproduction and its effects on the reproduction (genetic fitness) of close kin. In Durham's version of dual inheritance theory, inclusive fitness is "the average of the individual inclusive fitness of all members of a subpopulation who act on the basis of that allomeme as compared to others...[it] is...a measure of an allomeme's effect upon the reproductive fitness of its carriers" (1991:196–197). It is a key postulate of Durham's theory that cultural selection will favor, over the long run, allomemes that promote the inclusive fitness (biological reproduction) of those allomemes.

The question at the heart of applying the concept of cultural selection is which reference group or subreference group is transmitting the particular allomeme. A particular set of memes may promote the inclusive fitness of a particular reference group within a society, and depress or lower inclusive fitness values for other reference groups in that same society, or the allomemes may be neutral to those other reference groups. Transmission of cultural values promoting high levels of energy consumption in industrialized societies like the United States obviously promotes the inclusive fitness of those societies, but may depress those values in other societies. Actually, the situation may be more complex—the existence of industrialized societies may actually promote the reproductive fitness of so-called third world societies (population levels in those societies are increasing rapidly), but in appalling living conditions. Biological reproductive success is not a measure of quality of life.

A reference group's inclusive fitness could be lowered simply by the presence, or existence, of another reference group with different memes, and the simple existence of this other reference group acts as a constraint on the reproductive success of the first. Or, the inclusive fitness of the first is lowered because the allomemes of the second are imposed on the first. The latter reference group exercises some form of power over the first group, and this power negatively affects the reproductive success of the former. Or, conversely, imposition could raise the inclusive fitness of both reference groups. Imposed cultural selection represents the application of the concept of power to dual inheritance theory.

Power can be classified in several ways. Durham uses Lukes's (1974) classification: power may be coercive (choice is determined by threat), force (choice is eliminated), manipulation (values of subordinate reference groups are controlled), and authority (choices are made because commands fit values of subordinate groups). Yoffee (1991) has classified power on the basis of what

is controlled and where in a social system power is applied: social, political, or economic.

Wolf (1990:586) writes of four modes of power. The first "is power as an attribute of a person"; the second is the capacity of an individual to impose their will on another; the third is tactical or organizational power. In this mode, the actor or actors have the ability to circumscribe or control the acts of others in determinate settings. The fourth mode, structural power, is power that structures the political economy; it is power "to deploy and allocate social labor...[s]tructural power shapes the social field of action as to render some kinds of behavior possible, while making others less possible, or impossible" (1990:587).

In both tactical and structural power, some individuals or reference group controls the direction of cultural selection, and the form and direction of transmission. They may control the cultural selection of secondary values, the evaluation of memes against those values, and so forth. They may control the creation and direction of cultural variability, the creation or acquisition of new memes and allomemes. Modern advertising can be seen as the control of culture change by manipulation of social transmission through the production and manipulation of secondary values.

The evolution of the Roman Republic into the Roman Empire may be a classic case of imposition, with important implications for our understanding of large-scale process. According to Millett (1990), the empire resulted from the expansion of the city of Rome from a local center to an imperial city. This expansion was fueled by the internal competition within the oligarchy of the late Republic, in which the success of oligarchs depended on military success, ownership of great tracts of land worked by slaves, the capacity to put on great public displays, and the maintenance of patron–client relationships.

If this interpretation is accepted, then it suggests the Roman Empire was the result of the capacity of a single reference group to impose its culture and interests upon many millions of other human beings rather than the operation of universal social or cultural processes. My point here is to suggest the importance of the concept of power and of imposition for the construction of a co-evolutionary theory of human history.

The central question raised by the concept of cultural selection by imposition is who is doing the selection. Who benefits and why? Coevolutionary theory does not assume that culture is a well-integrated whole, functioning harmoniously for the immediate benefit of all. Rather, it wonders who is benefiting at any given moment. It also assumes, however, that, over the long term, the memes being reproduced must benefit the society as a whole, or the memes will, at some point, be selected against. Thus, in coevolution, the expansion of the Roman Empire must, in some way, be demonstrated to have improved the inclusive fitness values of the majority of people who were part of it. This does

not mean they were happy, lived long and joyful lives, or engaged in meaningful philosophical discourse. It merely means that for a time, being part of the Roman Empire provided immediate culturally defined benefits and long-term biological benefits.

Millett sees "Romanization" as a key process in the success of the Empire. Roman culture became a "cosmopolitan fusion of influences....[w]e must see 'Romanization' as a process of dialectical change, rather than the influence of one 'pure' culture upon others" (Millett 1990:1). As the Roman oligarchy achieved first tactical and then structural power over larger and larger areas, and more and more groups, local elites probably benefited by achieving local tactical power by taking on elements of Roman culture. Why they benefited is the key empirical question to be asked.

## STYLE

### Introduction

Artifact form and the relationship between style and function are central issues in archaeology. All attempts at theory building in the discipline must grapple with style. For this reason style already has a central place in recent efforts at developing evolutionary theory in archaeology by Dunnell (1978) and O'Brien and Holland (1990, 1992). However, I think their efforts will produce a terminological and conceptual dead end, and that an approach based on dual inheritance theory will be more productive. I will illustrate my points with a limited discussion of the evolution of Northwest Coast art

### Style

In an effort to align archaeological definitions of style and function with evolutionary theory, Dunnell argued that function, in archaeology, is "manifest as those forms that directly affect the Darwinian fitness of the populations in which they occur" (1978:199). He defined style as "those forms that do not have detectable selective values" (1978:199). Stylistic traits are neutral, neither contributing to nor detracting from adaptedness. Functional traits, according to Dunnell, are under positive selection<sup>1</sup> because they contribute to the reproductive success of the people who possess the trait—whose artifacts perform that function, as I understand him. O'Brien and Holland (1992) seek to clarify and expand his definition to include situations where the possession of a trait contributes to adaptedness, but the trait is not under positive selec-

<sup>1</sup> Positive selection is selection for the trait; negative selection is against the trait.

tion. They acknowledge cultural choice as affecting style, but deny it the causal role assigned it in dual inheritance theories. Nor do they make the clear distinction between culture and behavior central to dual inheritance theory, which sees style as behavior.

According to these authors, since style is adaptively neutral, stylistic traits will display random changes through time, i.e., style will drift. If stylistic traits should go to fixation, that also will be caused by drift, or accident. The battleship curves of frequency seriation are seen as essentially the consequences of these random or Markovian processes. Conversely, functional changes through time will be the result of selective pressure. As drift is random, the resulting temporal patterns will be Markovian.

There are many problems with this approach. Traits can contribute to adaptiveness at one point, be neutral at another, and contribute, in a new way, to adaptiveness at yet another time. We will have no archaeological language to discuss these shifts if "style" is assigned solely to episodes of cultural drift. Further, as will be discussed below, the neutrality of a stylistic trait does not mean it will drift. Finally, this approach limits the potential range of questions to be asked about stylistic variation. I believe an approach to style closer to that outlined by Davis (1990) will ultimately be more fruitful to an evolutionary archaeology than that of Dunnell and others.

According to Davis (1990:19) "(a) style is a description of a polythetic set of similar but varying attributes in a group of artifacts, (b) the presence of which can only be explained by the history of the artifacts, (c) namely, common descent from an archaeologically identifiable artifact-production system in a particular state or states." Thus, style consists of attributes of artifacts (can be decoration, raw material, manner of execution, context of disposal, and so on) shared among a group of artifacts produced by a common production system. The idea of a production system is important here: a production system can have many steps, and selection can operate differently on different stages of the system. Production systems imply the "systemic knowledge" of Durham's definition of culture. A production system may be transmitted as a single meme, or as many memes. The memes may have few or many allomemes. Thus, dual inheritance theory asks the question, "what is being transmitted to produce this particular style?" The specification of a common history and shared descent is also central to an evolutionary understanding of style. The definition has at its core the historical connections required for evolutionary studies, and allows one to apply the concept of "descent with modification." The memes which contribute to the style are socially transmitted, and the expressed style is produced by the "surviving variants" (see above). We can study the cultural evolution of a style to determine what evolutionary forces have affected it through time without restricting the term to the result of only one force, natural selection (or the lack thereof). Rather, a

style is a set of evolved, historical relationships reflected in the form of material culture.

The objects expressing a particular style are the product of behavior, part of the phenotype. Therefore, an expressed style reflects the interplay among cultural inheritance, genetic inheritance, and the environment (including social and "natural" elements). While the makers of the artifacts in question may have invested the objects they made with symbolic meanings, style itself does not provide a privileged window into the cultural system. The symbolic meaning of a style must be determined separately from the existence of the style. Meaning can be approached through hypotheses about the nature of transmission and the direction of selection acting on the style. Style cannot be directly linked to a "mental template," or platonic essences, nor need it necessarily reflect ethnicity or even vary with ethnicity. The relationship between a particular style and the ethnicity of its producers is an empirical question.

It is easy to imagine a pottery style, for example, which is the result of three memes: one for decorative motifs, one for vessel form, and the third for making the paste. It is also quite easy to imagine that the decorative style could be subject to one set of selective pressures, or to drift, and the paste making to completely different selective pressures. Cultural selection acting on allomemes for decorative motifs could result from ethnicity, while those on paste reflect pot function, irrespective of the ethnicity of the pots' users. Indeed, it should be possible, in principle, to establish the mode(s) of selection operating on particular elements of a style. For example, O'Brien and Holland see the effects of directional selection in the changes in the wall thickness of Woodland Period pottery from the south central United States to be reflecting cooking practices.

Directional selection is only one of the modes of selection. Directional (or directive [Mayr 1982:588]) selection occurs when, in Mayr's words, selection favors one tail of the curve of variation (imagine a bell-shaped curve), and discriminates against the other. The "direction" of selection pulls the mean of the curve toward the favored tail. Stabilizing selection occurs when selection is directed against both tails, "all deviations from the 'normal' are discriminated against" (Mayr 1982:587). Diversifying or disruptive selection occurs when selection favors both tails of the curve over the mean. Mayr also identifies a fourth mode, "catastrophic selection," when a trait at the tail end of the curve permits its carrier to survive some catastrophe which wipes out most of the bearer's conspecifics. Of course, such survival may be related to the trait, or to luck (Gould 1989).

This approach to style subsumes other recent definitions and usages of the term *style*. *Isochrestism*, for example, is Sackett's (1990 and citations therein) term for the constraints placed on formal variation of material cultural objects by ethnicity. He argues that "there normally exists a spectrum of

equivalent alternatives...for attaining any given end in manufacturing and/or using material items, I refer to these options as constituting *isochrestic variation*" (1990:33). According to Sackett, *isochrestic style* is the product of the choices made among *isochrestic variants* by artisans based on their enculturation within their ethnic group. In the words of dual inheritance theory, there are two possible evolutionary forces at work to produce *isochrestic variation*: transmission and cultural selection. (1) *Isochrestic variation* could be produced when only certain memes or allomemes are socially transmitted among members of a reference group which identifies itself as an ethnic group, or (2) a range of allomemes are transmitted, but only a few are culturally selected because of values about what is ethnically appropriate. The first seems closest to Sackett's definition. *Isochrestism* is readily absorbed into a dual inheritance theory of style. *Isochrestism* would give stylistic evolution within a particular tradition an appearance of directionality by limiting variability even though, in Sackett's view, the style does not actively function as an ethnic marker, or have any function at all. *Isochrestism* channels variation in this case, mimicking the effects of selection.

Plog (1990:62), following Weissner (1985), recognizes *symbolic* and *iconological* stylistic variation. Symbolic variation "presents information about similarities and differences that can help reproduce, alter, disrupt, or create social relationships." Symbolic variation is the result of how people learn how to make and decorate objects in a social context by comparing their work with that of others and "then imitate, differentiate, ignore, or in some way comment on how aspects of the makers or bearer relate to their own social and personal identities." This carries the implication, basic to much recent thought (papers and references in Conkey and Hastorf 1990), that style is actively negotiated. Iconological styles are a special subset of symbolic styles which have a specific audience.

From the standpoint of dual inheritance theory these distinctions reflect how cultural selection is operating on the style: i.e., the evaluations of the makers (and the audience) of particular stylistic variants against their secondary values about what material cultural forms are necessary or appropriate in certain broad or narrow social contexts. According to Durham, "cultural selection always involves some kind of comparative evaluation of variants according to their consequences" (1991:199). Crucial here, particularly with regards to the audience, is the mode of cultural selection; is it imposed or not?

## NORTHWEST COAST ART

Northwest Coast art is, of course, one of the best-known art styles in the world. What we usually think of as Northwest Coast art is primarily that of

groups living on the northern half of the coast in the 19th century. This northern style is marked by the use of form-lines and ovoids (Holm 1965) and balanced symmetry and motifs that interlock and flow into each other. In the southern style, motifs appear singly, they do not interlock, and the form-lines and ovoids are rare. The southern style is also more variable, and there may be less art on the southern coast (Borden 1983; Carlson 1983a,b; Suttles 1983, 1990; Ames, in press). The conventions governing the style were much stronger in the north. It is almost impossible to distinguish the tribe of origin for two-dimensional forms (e.g., boxes), though, to a practiced eye, it is somewhat easier for sculptural forms such as totem poles and masks. In the south regional differences can be quite marked, as between the Coast Salish and the Chinook.

Regionalism in the art style is paralleled by other cultural practices during the recent past, including the mutually exclusive spatial distributions of cranial deformation, and labret wear (the former in the north, the latter in the south). These regional patterns have changed across the last several millennia, as will be discussed below. First, I will describe how the current distribution of the regional styles has evolved.

Nineteenth century northern Northwest Coast art is well represented in the world's museums. Though creation of it almost ceased by the early years of this century, it has undergone an explosive revival since the late 1960s. This revival has been fueled, among others things, by:

1. Holm's analysis and codification of the formal rules governing the use of space and of the basic design elements which structure the art (Holm 1965);
2. A concurrent cultural revival of native American societies along the coast, and a renewal of some of the traditional social practices, like potlatches, to which the art was central;
3. A widespread appreciation and interest in the art among Euroamerican and Eurocanadians who see the art as symbolizing the region in which they live, and the use of the art as a marker of civic pride. For example, the logo of the Seahawks (the Seattle, Washington, football team) is in the Northwest Coast style. However, some southern variants of the style have virtually disappeared. In some areas, like the Lower Columbia River of Washington and Oregon, the local variant may be extinct. Thus, in the evolution of Northwest Coast art, one variant has almost become fixed. This situation could change if the other old variants are revived, or new ones develop. Among the reasons for the success of the Northern variant are the following:
  - a. Frequency. In the 19th century, there appear to have been many more pieces of northern art produced. The reason why less art

was produced on the southern coast is interesting (Suttles 1983) but need not detain us here. Thus, there were more objects to end up in museums and collections from the north.

- b. Contact and disease history. The vast majority of materials were collected between 1875 and 1930 (Cole 1985), by which time "the city of Washington contained more Northwest Coast material than the state of Washington, and New York City probably housed more British Columbia material than British Columbia herself" (1985:286). Populations in the far southern Northwest Coast (coastal Washington and Oregon) were decimated and even destroyed by diseases by the early third of the 19th century, while those reproductively viable populations persisted to the north, producing art until the late 19th century. Thus, by the time serious collections started to be made, the art tradition in the far south may have ended or have been seriously disrupted. Increased production of the art may have been one of the directions resistance to European dominance took among northern groups (Cole and Chaikin 1990).
- c. Research history. The focus of early anthropological research and collection on the Northwest Coast was with those still viable, functioning groups on the northern coast, reinforcing the effects of point b. Northern Northwest Coast excited enormous interest in the late 19th century, as it still does. This interest is one factor in the avidity in which the art was collected, and the availability of enormous collections of the northern art for study, and to shape the direction of the revival. In short, when the selective environment changed in the 1960s, and the revival of Native culture began, the northern style was the only variant available to them. The revival also began first among the northern groups who had originally produced the style. Thus, the recent evolution of Northwest Coast is the result of the interplay among intersocietal selection (contact with Europeans, diseases, the effects of European tastes and aesthetic judgments, missionization, and so forth), choice (resistance to contact), imposition (both by Europeans and by natives operating within the traditional prestige system and the need for art object for that system to work) and even chance (the effects of the frequency of art objects on the persistence of the northern style).

Northwest Coast art, or elements of it, may be among the oldest art styles (as the term has been defined here) still being produced in the world. It is possible to establish minimal ages for some elements of Northwest Coast art.



1. Joined nose and eyebrows in relief produced by carving away surrounding material (the creation of negative space [Holm 1965]). Eyes are also in relief. The earliest known example is an antler handle radiometrically dated to between 3000 and 1500 B.C.<sup>2</sup> was recovered from Glenrose Cannery, a site located near Vancouver, British Columbia (Matson 1976). A similar handle was recovered in Prince Rupert Harbor, on the northern coast of British Columbia, which postdates 500 B.C. The same raised brow and nose is present in a carved pumice figurine postdating A.D. 1500 recently recovered near Portland, Oregon. The design element is both geographically widespread and of great time depth.
2. Human and animal figures are commonly joined or intermingled. Antler spoons recovered from the Pender Island Site in southern British Columbia display zoomorphic elements joined at the mouth. Carlson (1991) has dated these spoons to 1650 BC. (The decoration of the ends of the spoons' handles, and other attributes of these spoons, such as the rendering of eyes also fall within the canons of 19th century Northwest Coast art.)
3. Bilateral symmetry and "visual punning." A common feature of the historic art is splitting an animal or human form down its middle and showing the two sides in profile, sometimes facing each other, sometimes facing away. Motifs were polyvalent in meaning, and several forms or elements were combined onto one. A sea mammal bone club displaying these characteristics from southern British Columbia has been AMS dated to 1895 (McMillan and Nelson 1989).
4. Some of the form-line conventions described by Holm for the 19th century art (Holm 1965), specifically the "split U-form" design, are present on an elaborately carved atlatl with a date of A.D. 210-440. This piece also has interlocked motifs, in this case a sea-monster(?) interlocked with a human face, as well symbolism which is readily connected to 19th century themes (Fladmark *et al.* 1987). Form-lines are also present on a red cedar handle recovered from the Lachane site (Gbt033) on the northern British Columbia coast, dating to 1630.
5. Materials recovered from wet sites such as Lachane and Hoko River (Inglis 1976; Croes 1988), as well as isolated pieces like the atlatl described above, clearly indicate that the carving skills and techniques of the 19th century carvers were in use at least 2000 years ago.

<sup>2</sup> All dates are calibrated dates using the University of Washington's Quaternary Laboratory radiocarbon calibration program version 2.1(\*\*)

This list is not exhaustive, but makes the point. It is clear that Northwest Coast art constitutes a style, in the sense of Davis's definition, of great antiquity. However, the history of the regional variants is not known. Generally, the early individual examples of the art, like the spoons from Pender, seem suggestive of the northern style, whatever their provenience. On the other hand, these objects would not raise eyebrows in a collection of 19th century art from the south, either. Northwest Coast art has not been static over the last 4000 years. Some motifs have appeared and disappeared; some categories of decorated objects have appeared and disappeared (papers in Carlson 1983b). In the same way, labrets were originally worn along the entire coast by both sexes; historically the practice was limited to high-status women on the southern coast.

The social context within which cultural selection acted on the art has also evolved. The decorated spoons at the Pender Island site predate the earliest plank house village on the coast by some 800 years. Villages and towns of large, rectangular houses of western red cedar (*Thuja plicata*) planks and timbers were the dominant residential form along the coast at first contact with Europeans. These houses, along with being residences and food processing factories, were the stages on which potlatches and other ceremonies displaying the art were performed. Indeed, these spoons may even predate the heavy reliance on stored salmon on which the Northwest Coast prestige system is supposed to have depended. Croes and Hackenberger (1988) suggest storage of salmon did not become economically significant in the Coast Salish area of the southern Coast (where the spoons were recovered) until perhaps 2000 to 2500 years ago. Further, on the basis of present evidence, the art style predates the evolution of the Northwest Coast's system of social stratification.

Within the coevolutionary framework laid out in this paper, a number of problems arise with regard to Northwest Coast art, given the foregoing discussions. I do not have answers for these questions, but they suggest fertile and substantive research directions:

1. What are the memes and allomemes being transmitted from generation to generation? Can we discern changes in the information content of the memes? For example, Northwest Coast woodworking techniques are independent of the art style, which can be executed in stone, wood, bone, and now in gold and silver among other media. On the other hand, there are some motifs which seem to appear only in stone, for example. What this question requires are data on variation in form, media, and technique which are not currently available. It also requires information on the sampling problems which structure our current data base. An artifact sample of 18,000 tools recovered from nine sites in Prince Rupert Harbor, British Columbia, contains less than 300 objects of stone and bone with any decoration

at all. Why so few? Most decorated objects were wooden and so do not commonly preserve in archaeological sites. In addition, there is evidence that some classes of stone objects were disposed away from residential sites. A coevolutionary approach requires that we control as much of the potential sources of variation and error as possible.

2. What nonconveyance forces have been at work (e.g., innovation, synthesis, migration, diffusion, or cultural drift)? These may be the forces crucial to understanding the regional patterns of Northwest Coast art already described. This also raises issues about innovation, culture contact, and diffusion which have not been fashionable during the past three decades. It is in this context that issues of cultural drift become important, rather than in the single context of style versus function.
3. What conveyance forces have been acting on Northwest Coast art (transmission [Boyd and Richerson 1985], natural selection, cultural selection)? Boyd and Richerson's indirect bias mode of transmission provides a bases for constructing hypotheses about transmission effects. The art may have been an indicator trait (as it currently is) in the *indirect transmission* of crucial Northwest Coast cultural practices—the art may in fact have functioned as an indicator trait for the transmission of sets of cultural values, for other memes in other words.

In this case, as social evolution proceeded on the coast, and stratification evolved, the art continued to play its role in the transmission of socially important memes, but those memes changed. Carlson (1992) has argued that the art was originally shamanic, as much of it was in the 19th century (Jonaitas 1985). If this is so, the art was simply co-opted for the transmission of other memes when social stratification evolved, in a manner analogous to the co-option by natural selection of social interaction for the transmission of culture.

It is also within this problem that we address the question of the *locus* of cultural selection—what are the relevant reference groups? During the late prehistoric and early historic periods we can frame questions about the roles of title holders who commissioned pieces, the specialized carvers who executed them, and the rest of the population that witnessed the results. Indeed, a significant question becomes who produced the art? This is of course relevant to questions about relationships between social evolution and the organization of production (e.g. full-time versus part-time specialists). But it also may be significant for the transmission of the art, and the nature of the culture selection acting on the art. A narrowly based guild of carvers could affect variation in a manner similar to Sackett's isochrestic style, and the differences between north and south reflect the number of specialized carvers. Another way to phrase that

question is whether cultural selection acting on the art was through choice or imposition, and if imposition, was it from the titleholders, the artists, or the rest of society. This could be tested by examining the manner in which the art varied prior to the evolution of social stratification and/or craft specialization, and after their evolution.

It is also possible to suggest hypotheses about the regionalization of Northwest Coast art in the 18th and 19th centuries:

1. The regionalization of Northwest Coast art could be the result of stabilizing selection in which cultural selection against variation was weaker in the south than in the north (e.g., choice versus imposition).
2. The regionalization of Northwest Coast art could be the result of disruptive selection on a regional basis (selection favoring the evolution of regional styles) coupled with strong stabilizing selection on the northern variant. I have argued elsewhere that region was an important aspect of social personhood on the coast (head deformation versus labrets) and that the same selective forces affected the art (Ames in press).
3. The appearance of stabilizing selection is the result of isochrestism operating to limit variation: regional variation reflects the passive effects of ethnicity as expressed regionally.

I have not formalized or tested these hypotheses, because that is beyond the scope of this paper. However, the hypotheses could be formalized and tested using either the formal methods of Boyd and Richerson or the more qualitative methods of Durham. I have elsewhere presented a model to account for some of these patterns (Ames in press).

In any case, I have attempted here to show that dual inheritance theory provides a rich and productive approach to the issue of style which does not require the distinction between style and function developed by Dunnell (1978), and which subsumes many recent developments in archaeological theories of style. Dual inheritance theory is quite robust in this regard.

## SUMMARY AND CONCLUSIONS

I have attempted to do two things in this paper: summarize Durham's theory of coevolution, and to show that an approach to style, based on Davis's (1990) definition, is more appropriate and useful to a Darwinian archaeology than that developed by Dunnell and others. Style was defined above as "a set of evolved, historical relationships reflected in the form of material culture." A key element to Davis's definition of style was that artifacts exhibiting a common

style do so because they either share a common production system, or production systems which are historically linked to a common ancestral production system. Production systems may be encoded in one or more memes (and allomemes) and therefore cultural selection can act differentially on different portions of a single production system.

This approach to style is appropriate to a Darwinian archaeology because it permits one to pursue issues of historical relationships, as well as function and adaptability in a flexible and productive manner. It does not limit "style" to episodes of drift, which, within coevolution, is only one of several nonconvergence forces.

Many of the research questions outlined in the discussion on Northwest Coast art could have been developed within other theoretical frameworks—which suggests that dual inheritance theory is compatible with some other, non-Darwinian anthropological theories. However, in conclusion I would suggest that coevolution has three general advantages over other available theories in Anthropology. First, no other currently accessible non-Darwinian theory allows one to deal with the cultural evolution of Northwest Coast art—and similar matters—and the evolution of the biological foundations of language, cognition, and culture within a single framework. I believe Darwinian approaches generally, and coevolution in particular, will prove extremely powerful in providing answers about the evolution of hominid culture. Second, of available Darwinian approaches, coevolution seems both the richest, and the most likely to be able to absorb and utilize anthropological insights available from other paradigms (e.g., Mithen 1989). It is therefore more likely to be broadly adopted and used, is more compatible with currently available data sets, and does not require abandoning the central core of anthropological and archaeological knowledge about culture.

Third, with Shennan (1989), I believe that coevolutionary theory will eventually allow us to theoretically link our everyday lives with broad-scale social and cultural changes. Shennan has recently suggested that dual inheritance theories provide actual mechanisms by which our everyday practices, the *habitus* (Bourdieu 1977; Giddens 1984), can actually reproduce social structure. He emphasizes Boyd and Richerson's (1985) biased transmission. I add to this Durham's "imposed selection" and power. In this paper, I suggested that the evolution of the Roman Empire was at least in part the result of the *habitus* of the Roman oligarchy. The foregoing discussions carry the implication that our concept of large-scale social processes may, in part, be an issue of our "monitoring position": one reference group's "habitus" may be someone else's catastrophic selection. How events will appear to us will be determined by which reference group provides us our vantage point. Are the evolutionary forces of coevolution sufficient to generate the large-scale events of social evolution? If so, then we can abandon the search for the laws of culture at the heart of pro-

cessual archaeology, and the laws of history at the heart of historical materialism.

What remains a central and exciting challenge then is finding the causes of broad-scale similarities in social evolution (i.e., Johnson and Earle 1987). Braun (1991) has already hazarded an explanation, but it, like all of the foregoing, is preliminary.

## REFERENCES

- Ames, K.M., in press, Art and Regional Interaction Among Affluent Foragers on the North Pacific Rim, in: *Development of Hunting-Gathering-Fishing Maritime Societies on the Pacific* (A.B. Onat, ed.), Washington State University Press, Pullman.
- Bettinger, R.L., 1990, *Hunter-Gatherers: Archaeological and Evolutionary Theory*, Plenum Press, New York.
- Binford, L.R., 1962, Anthropology as Archaeology, *American Antiquity* 2(2):217-228.
- Borden, C.C., 1983, Prehistoric Art in the Lower Fraser Region, in: *Indian Art Traditions of the Northwest Coast* (R.L. Carlson, ed.), Simon Fraser University Press, Burnaby, pp. 131-166.
- Bourdieu, P., 1977, *Outline of a Theory of Practice*, Cambridge University Press, Cambridge.
- Boyd, R., and Richerson, P.J., 1985, *Culture and the Evolutionary Process*, University of Chicago Press, Chicago.
- Braun, D.P., 1991, Are There Cross-cultural Regularities in Tribal Social Practices? in: *Between Bands and States: Sedentism, Subsistence and Interaction in Small Scale Societies* (S. Gregg, ed.), Occasional Paper No. 9, Center for Archaeological Investigations, Southern Illinois University, Carbondale, pp. 423-444.
- Carlson, R.L., 1983a, Prehistory of the Northwest Coast, in: *Indian Art Traditions of the Northwest Coast* (R.L. Carlson, ed.), Simon Fraser University Press, Burnaby, pp. 13-32.
- Carlson, R.L., 1983b, *Indian Art Traditions of the Northwest Coast*, Simon Fraser University Press, Burnaby.
- Carlson, R.L., 1991, The Northwest Coast Before A.D. 1600, in: *Proceedings of the Great Ocean Conference*, Volume 1, The Oregon Historical Society, Portland, pp. 109-137.
- Carlson, R.L., 1992, Paleo-Shamanism on the Northwest Coast, Paper presented at the 45th Annual Northwest Conference, Burnaby.
- Cole, D., 1985, *Captured Heritage, The Scramble for Northwest Coast Artifacts*, University of Washington Press, Seattle.
- Cole, D., and Chaikin, I., 1990, *An Iron Hand Upon the People: The Law Against the Potlatch on the Northwest Coast*, University of Washington Press, Seattle.
- Conkey, M.W., and Hastorf, C.A., 1990, *The Uses of Style in Archaeology*, Cambridge University Press, Cambridge.
- Croes, D.R., 1988, The Significance of the 3000 B.P. Hoko River Waterlogged Fishing Camp in our Understanding of Southern Northwest Coast Cultural Evolution, in: *Wet Site Archaeology* (B.A. Purdy, ed.), The Telford Press, Caldwell, pp. 131-152.
- Croes, D.R., and Hackenberger, S., 1988, Hoko River Archaeological Complex: Modeling Prehistoric Northwest Coast Economic Evolution, *Research in Economic Anthropology Supplement* 3:19-86.
- Davis, W., 1990, Style and History in Art History, in: *The Uses of Style in Archaeology* (M.W. Conkey and C.A. Hastorf, eds.), Cambridge University Press, Cambridge, pp. 18-31.

- Dunnell, R.C., 1978, Style and Function: A Fundamental Dichotomy, *American Antiquity* 43:192-202.
- Dunnell, R.C., 1980, Evolutionary Theory and Archaeology, in: *Advances in Archaeological Method and Theory*, Vol. 6, (M.B. Schiffer, ed.), Academic Press, New York, pp. 35-99.
- Dunnell, R.C., 1992, What is it that Actually Evolves?, Paper Presented at the 57th Annual Meetings of the Society for American Archaeology, Pittsburgh.
- Durham, W.H., 1991, *Coevolution: Genes, Culture, and Human Diversity*, Stanford University Press, Stanford.
- Eldredge, N., 1986, Information, Economics and Evolution, *Annual Review of Ecology and Systematics* 17:351-369.
- Fladmark, K.R., Nelson, D.E., Brown, T.A., Vogel, J.S., and Southen, J.R., 1987, AMS Dating of Two Wooden Artifacts from the Northwest Coast, *Canadian Journal of Archaeology* 11:1-12.
- Gellner, E., 1988, *Plough, Sword and Book: The Structure of Human History*, University of Chicago Press, Chicago.
- Giddens, A., 1984, *The Constitution of Society, Outline of the Theory of Structuration*, University of California Press, Berkeley.
- Gould, S.J., 1989, *Wonderful Life: The Burgess Shale and the Nature of History*, Norton, New York.
- Hamilton, W.D., 1964, The Genetical Evolution of Social Behavior: I and II, *Journal of Theoretical Biology* 7:1-52.
- Holm, B., 1965, *Northwest Coast Indian Art: An Analysis of Form*, Monograph No. 1, Thomas Burke Memorial Museum, University of Washington Press, Seattle.
- Inglis, R., 1976, 'Wet' Site Distribution—The Northern Case GbTo 33—The Lachane Site, in: *The Excavation of Water-Saturated Archaeological Sites (Wet Sites) on the Northwest Coast of North America*, (D. Croes, ed.), Archaeological Survey of Canada Paper No. 50. National Museums of Canada Mercury Series, Ottawa, pp. 71-108.
- Johnson, A.W., and Earle, T., 1987, *The Evolution of Human Societies from Foraging Group to Agrarian State*, Stanford University Press, Stanford.
- Jonaitas, A., 1985, *Art of the Northern Tlingit*, University of Washington Press, Seattle.
- Keesing, R., 1974, Theories of Culture, *Annual Review of Anthropology* 3:73-97.
- Lukes, S., 1974, *Power: A Radical View*, Macmillan and Co., London.
- McMillan, A.D., and Nelson, D.E., 1989, Visual Punning and the Whales Tail: AMS Dating of a Marpole-age Art Object, *Canadian Journal of Archaeology* 13:212-218.
- Matson, R.G., 1976, *The Glenrose Cannery Site*, Archaeological Survey of Canada Paper No. 52. National Museums of Canada Mercury Series, Ottawa.
- Mayr, E., 1982, *The Growth of Biological Thought: Diversity, Evolution, and Inheritance*, Harvard University Press, Cambridge, MA.
- Millett, M., 1990, *The Romanization of Britain, An Essay in Archaeological Interpretation*, Cambridge University Press, Cambridge.
- Mithen, S.J., 1989, Evolutionary Theory and Post-Processual Archaeology, *Antiquity* 63:483-494.
- O'Brien, M.J., and Holland, T.D., 1990, Variation, Selection, and the Archaeological Record, in: *Advances in Archaeological Method and Theory*, Vol. 2 (M.B. Schiffer, ed.), University of Arizona Press, Tucson, pp. 31-79.
- O'Brien, M.J., and Holland, T.D., 1992, The Role of Adaptation in Archaeological Explanation, *American Antiquity* 57(1):36-59.
- Plog, S., 1990, Sociopolitical Implications of Stylistic Variation in the American Southwest, in: *The Uses of Style in Archaeology* (M.W. Conkey and C.A. Hastorf, eds.), Cambridge University Press, Cambridge, pp. 61-70.
- Rindos, D., 1984, *The Origins of Agriculture: An Evolutionary Perspective*, Academic Press, New York.

- Rindos, D., 1986, The Evolution of the Capacity for Culture: Sociobiology, Structuralism, and Cultural Selection, *Current Anthropology* 27:315-332.
- Sackett, J.R., 1990, Style and Ethnicity in Archaeology: The Case for Isochrestism, in: *The Uses of Style in Archaeology* (M.W. Conkey and C.A. Hastorf, eds.), Cambridge University Press, Cambridge, pp. 32-43.
- Shennan, S., 1989, Cultural Transmission and Cultural Change, in: *What's New? A Closer Look at the Process of Innovation* (S.E. van der Leeuw and R. Torrence, eds.), Unwin Hyman Ltd, London, pp. 330-346.
- Suttles, W., 1983, Productivity and its Constraints: A Coast Salish Case, in: *Indian Art Traditions of the Northwest Coast* (R.L. Carlson, ed.), Simon Fraser University Press, Burnaby, pp. 67-88.
- Suttles, W. (ed.), 1990, *Handbook of North American Indians*, Vol. 7, Smithsonian Institution, Washington, DC.
- Weissner, P., 1985, Style or Isochrestic Variation? A Reply to Sackett, *American Antiquity* 50(1):160-166.
- Wolf, E.R., 1990, Distinguished Lecture: Facing Power—Old Insights, New Questions, *American Anthropologist* 92:586-596.
- Yoffee, N., 1991, Maya Elite Interaction: Through a Glass, Sideways, in: *Classic Maya Political History: Hieroglyphic and Archaeological Evidence* (T. P. Culbert, ed.), Cambridge University Press, Cambridge, pp. 285-310.