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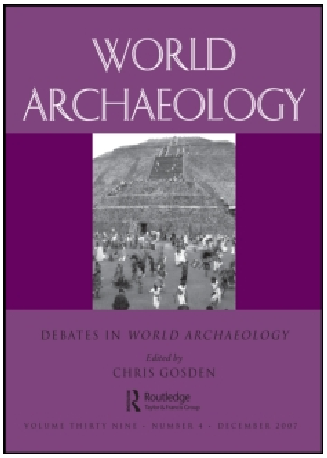

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Evolutionism and North America's archaeological record

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Evolutionism and North America's archaeological record

Michael J. O'Brien

Abstract

The archaeological record of North America has long been a laboratory for evolutionary studies. Beginning in the late nineteenth century, culture historians would regularly turn to evolutionism as a source of archaeological explanations. Sometimes the explanations were broadly Darwinian in nature, with reference to processes such as selection and genetic transmission, and other times they were based more on the evolutionism of the classic nineteenth-century culture theorists. The archaeological literature of the closing decades of the twentieth century and beyond suggests a heightened interest in employing Darwinian theory. No one, however, has suggested that Darwinism can solve all of archaeology's problems. Rather, advocates have pointed out that it might solve some of archaeology's historical – read *evolutionary* – problems. Despite the interest shown thus far, evolutionary archaeology needs to move beyond a narrow reading of Darwinism and become a more inclusive approach. Examples from North America underscore the point that studies of cultural transmission and human behavior are important components of an evolutionary archaeology.

Keywords

Darwinism; drift; evolution; phylogeny; selection; transmission.

A sizeable literature (see references in O'Brien and Lyman 2003a) suggests that a growing number of archaeologists working in North America are interested in incorporating elements of Darwinism into their work. This interest is not a new phenomenon but one that has been around in various guises for over a century. With the benefit of hindsight we can see the fits and starts that characterized early Americanist efforts aimed at incorporating basic tenets of Darwinism into archaeology (Lyman and O'Brien 1997). With rare exceptions, the results were less than satisfying. Although culture historians paid lip service to Darwinian principles, the brand of evolution on which they relied comprised the unilinear schemes of classic nineteenth-century cultural evolutionism.

A general lack of progress in formulating a workable evolutionism that did more than pigeonhole cultures and artifacts into a linear developmental sequence was evident to Kidder (1932), who pointed out that, although archaeologists talked about the evolution of culture, they had not figured out how to mirror their biological colleagues in terms of philosophical and scientific sophistication. In Kidder's view:

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> the sooner we roll up our sleeves and begin comparative studies of axes and arrowheads and bone tools, make classifications, prepare accurate descriptions, draw distribution maps and, in general, persuade ourselves to do a vast deal of painstaking, unspectacular work, the sooner shall we be in position to approach the problems of cultural evolution, the solving of which is, I take it, our ultimate goal.
>
> (Kidder 1932: 8)

A few of Kidder's contemporaries were trying to do exactly that: the painstaking, unspectacular work that hopefully would bring cultural evolution under a Darwinian umbrella. Working in the Hohokam area of Arizona (Fig. 1), Gladwin and Gladwin (1934) created a Linnaean-like taxonomy for organizing archaeological culture units. Although they believed that all prehistoric groups in the Southwest had passed through the same cultural stages but at different times in different places (classic unilinear cultural evolution), they recognized the phylogenetic implications of this process – hence their unabashedly biological system of cultural classification. They also developed a binomial system of pottery classification modeled on the biological genus-and-species concept (Gladwin and Gladwin 1930). Similar biological undercurrents ran through the southwestern pottery classification developed by Colton and Hargrave (1937).

In the Midwest, McKern's (1939) 'midwestern taxonomic method' also was inspired by the Linnaean taxonomic method, and to most archaeologists it was similar if not identical

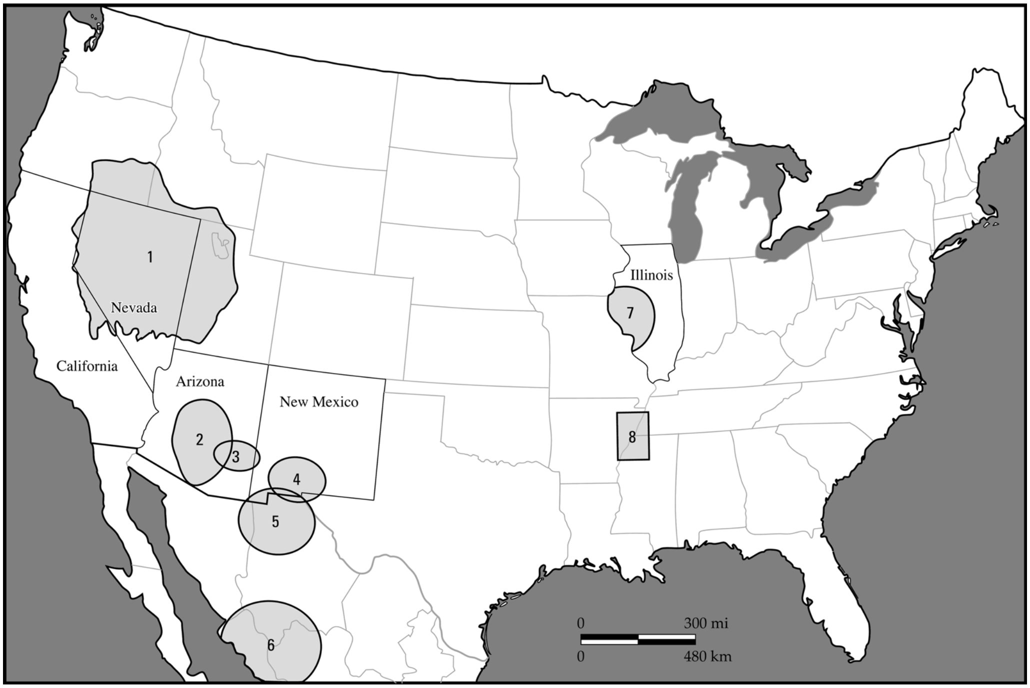

Figure 1 Map of the United States and northern Mexico showing locations mentioned in the text: 1 Great Basin; 2 Hohokam area; 3 Salado area; 4 Mimbres area; 5 Casas Grandes area; 6 Comala phase; 7 west-central Illinois; 8 Mississippi River valley.

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to the schemes in use in the Southwest. McKern had the same motivation for devising a taxonomy that the Gladwins had – the need for a method of keeping track of archaeological variation – but any similarity between schemes was in terms of architecture only. Whereas the Gladwins believed their taxonomy had explicit phylogenetic implications, McKern was more hesitant. He did not deny that some of the groupings undoubtedly did have phylogenetic implications, but this was a separate issue from the taxonomy itself, which was founded purely on formal similarity of units. In modern biological terms, the method was an application of phenetics, although without a means of measuring similarity (Lyman and O'Brien 2003).

Some of McKern's contemporaries – Kroeber (1940), for example – were quick to point out that the failure to measure similarity quantitatively was a major flaw of the method. This was not, however, an endorsement of biologically based models of cultural phylogeny. Culture historians viewed culture as an evolving entity, but any similarity between biological and cultural evolution was strictly metaphorical (Kroeber 1923). They saw biological evolution as being inextricably linked to genetic transmission, whereas cultural evolution was not. Thus, any attempt to link Darwin's mechanism for change – natural selection – to the evolution of culture was nothing more than misapplied biology.

Steward was forceful in his criticism of Colton's biologically based taxonomic schemes for the Southwest:

> It is apparent. . .that strict adherence to a method drawn from biology inevitably fails to take into account the distinctively cultural and unbiological fact of blends and crosses between essentially unlike types. . ..A taxonomic scheme cannot indicate this fact without becoming mainly a list of exceptions. It must pigeon-hole. . ..[which] inevitably distorts true cultural relationships.
>
> (Steward 1941: 367)

Brew wrote a similar review of the various south-western 'evolutionary' systems, pointing out that any evolutionary implications derived from those systems were unacceptable for the simple reason that 'phylogenetic relationships do not exist between inanimate objects' such as pot sherds (Brew 1946: 53). The only defense that Brew could see for even thinking of using an artifact-classification system 'based upon phylogenetic theory is that the individual objects were made and used by man' (1946: 55) – a point that, to Brew at least, was so obvious as to be trivial. As we shall see, however, that point is the keystone to applying Darwinism to the archaeological record.

Given the nature of both anthropological and archaeological training in the 1940s, as well as the lack of agreement in evolutionary biology between the Darwinian naturalists and the Mendelian geneticists, it would have been almost impossible for Brew or anyone else to make the conceptual leap between Darwinism and the archaeological record. Even today it is difficult to make that leap. There are several reasons for this. First, Darwinism is a radically different kind of theory from what most archaeologists are exposed to. Second, Darwinism is not a monolithic theory that was complete on delivery when Darwin published *On the Origin of Species* in 1859. Any history of biological evolutionism will document the rough waters that it went through until the 1940s, when population geneticists provided the means of bridging the gulf between the theoreticians and the

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experimentalists. Even then, the door was thrown open for more debate over such things as speciation and the species concept – issues that are more contentious today than they were sixty years ago. We should not expect things to be easier in archaeology. Third, and related, in its classic formulation Darwinism is a theory about why particular organisms do better in particular environments than other organisms and hence over time leave more descendants. The theory says nothing about the archaeological record. Thus, evolutionary archaeologists have had to spend considerable time in constructing theoretical and methodological arguments as to how Darwinian theory can be applied to the study of artifacts.

My modest goal in this paper is to show how that application has furthered our understanding of select aspects of North American prehistory. Several years ago (O'Brien et al. 1994) I drew a parallel between the infant state of evolutionary archaeology and biologist Richard Lewontin's metaphor for the beginning stages of population genetics:

> Occasionally some unusually clever or lucky prospector would come upon a natural outcrop of high-grade ore, and part of the [ore-processing] machinery would be started up to prove to its backers that it really would work. But for the most part the machine was left to engineers, forever tinkering, forever making improvements, in anticipation of the day when it would be called upon to carry out full production.
>
> (Lewontin 1974: 189)

As I hope this overview shows, the integration of Darwinism into archaeology has led to the manufacture of some useful products. Importantly, some of them are being turned out by archaeologists who would not identify themselves as evolutionists in a narrow sense. This underscores my growing belief that the labels we as archaeologists use to identify the kind of work we do, while useful as shorthand notations, have become obstacles to integrating Darwinism into archaeology. We need to jettison both labels and rhetoric and, to echo Kidder's (1932) remarks, get on with the job.

The evolutionary premise

Darwinian evolution can be defined as:

> any net directional change or any cumulative change in the characteristics of organisms or populations over many generations – in other words, descent with modification. It explicitly includes the origin as well as the spread of alleles, variants, trait values, or character states. Evolution may occur as a result of natural selection, genetic drift, or both.
>
> (Endler 1986: 5)

Darwinian evolutionary studies encompass 'description[s] of the historical patterns of differential trait representation and arguments as to how evolutionary [processes] acted to create those patterns' (Jones et al. 1995: 29). Both steps employ concepts embedded within evolutionary theory, such as (a) lineage, or a line of development owing its existence to heritability; (b) natural selection, which is a mechanism of change; (c) a transmission

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mechanism, which itself is a source of new variants; (d) invention/innovation, another source of new variants; and (e) heritability, which denotes continuity such that similarity is homologous. Heritability ensures that we are examining change within a lineage (or a set of related lineages – what biologists refer to as a 'clade') rather than merely convergence, in which case similarity is of the analogous sort. This perspective is really no different from what Kidder (1932) was getting at: cultures evolve; they have a heritage, or lineage; and it is the archaeologist's job to describe that lineage and determine why it took the form it did.

Evolutionists study populations of things, and in archaeology the population, not surprisingly, consists of artifacts. It is 'the differential representation of variation at all scales among artifacts for which [evolutionary archaeology] seeks explanations' (Jones et al. 1995: 28). One might ask why analytical emphasis is placed on artifacts, when it is the makers of the artifacts who are evolving. Evolutionary archaeology rests on the premise that objects in the archaeological record, because they were parts of past phenotypes, were shaped by the same evolutionary processes as were the somatic (bodily) features of their makers and users. This is a shorthand way of saying that the *possessors* of the objects were acted on by evolutionary processes. Recall that this is the conceptual leap that Brew and others were not pre-adapted to make when they objected to the use of phylogenetically based classifications in archaeology. They realized that humans were responsible for the products and by-products recovered archaeologically, but this seemed like such a trivial point that it deserved no further exploration. It was not until the mid-1980s that the connection was made between artifacts and human phenotypes (Leonard and Jones 1987).

That artifacts were once part of phenotypes is non-problematic to most biologists (e.g. Bonner 1988; Dawkins 1990; Turner 2000), who routinely view such things as a bird's nest, a beaver's dam, or a chimpanzee's twig tools as phenotypic traits, and it certainly is not problematic to paleobiologists, who have to rely on the hard parts of phenotypes (shells, for example) to study the evolution of extinct organisms and their lineages. Archaeologists should have no trouble accepting that the behaviors that lead to creation of a ceramic vessel or a stone tool are phenotypic. Accepting the *results* of behaviors as phenotypic, then, requires only another small step. Once one makes that step, one can begin discussing such things as selection and drift in terms of how they shaped the variation that shows up in the archaeological record – variation that provides the phylogenetic clues that one looks for to reconstruct evolutionary history.

Evolutionary explanations, as is usual in science, are theoretically based, meaning that whatever is viewed as the cause of change is lodged in theory as opposed to in the things being explained. To put it differently, cause is seen as being external to the things being examined. With respect to cultural phenomena, Darwinism lodges cause in such processes as natural selection and drift as opposed to in the minds and actions of humans. As seemingly innocent as this statement is, it has caused no end of arguments in American archaeology. The arguments are of two kinds. Some critics of evolutionary archaeology (e.g. Pauketat 2001; Spencer 1997; Watson 1986; Wylie 2000) have variously suggested that it is too narrow and empirical and exhibits classic signs of scientism, but they have not flatly claimed that Darwinism is totally misplaced in a cultural setting. Others (e.g. Bamforth 2002) have resurrected the argument made by Kroeber, Steward, and Brew that, because humans are culture-bearing animals, they are qualitatively different than all other organisms. Specifically, they argue that intelligence and motivation exempt humans from

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the evolutionary processes – selection, drift, and the like – that work on other organisms. These critics argue that, although one might speak of human features such as language as 'evolving', it is evolution only in the metaphorical sense of change over time.

No doubt humans are adaptively plastic – probably more so than any other organism – but this does not mean that they are not subject to natural selection and drift. The conclusion that adaptive plasticity shields humans from evolutionary processes is an empirical generalization founded on temporally limited observations of micro-evolutionary processes (O'Brien and Lyman 2002). To suggest that humans can dodge natural selection by making choices regarding behaviors is to suggest that artificial selection and natural selection are separate and distinct, when modern biology takes the former to be a special case of the latter. Merely because people can eliminate some possible behaviors from consideration based on knowledge of possible outcomes of acting out those behaviors in particular situations does not mean they will always choose a behavior that is immune to natural selection – or that they always make the optimal choice. Evolutionary archaeology asks what processes might have channeled intentions in a certain way in the first place and, just as important, did the intentions produce the 'intended' outcome or a different one?

Broadening the scope

Much of the quibbling that has taken place in American archaeology among evolutionists, behavioralists, and processualists obscures the fact that there are broad areas of agreement (O'Brien and Lyman 2002; VanPool and VanPool 2003). It also obscures the fact that evolutionary archaeology has expanded considerably in scope since its resurgence in the late 1970s. Several collections of essays published over the last decade (Barton and Clark 1997; Hart and Terrell 2002; Hurt and Rakita 2001; Maschner 1996; O'Brien 1996; O'Brien and Lyman 2003a; Teltser 1995) testify to this expansion, highlighting the diversity of evolutionary theory's underpinning assumptions and versions within the human sciences. At this point it seems more profitable for those interested broadly in evolutionary issues to delineate areas of sharp disagreement but equally to emphasize areas of agreement and work toward a synthesis of the sort that occurred in evolutionary biology in the 1940s.

Schiffer (1996) advocated this position in an article that pointed out similarities between what evolutionary archaeologists were trying to do and what behavioral archaeologists were doing. Both approaches have as a central focus the behaviors of tool manufacture and use – whether the tools be fish hooks (e.g. Allen 1996), pots (e.g. Dunnell and Feathers 1991; Schiffer and Skibo 1987; Skibo et al. 1989), or metates (e.g. VanPool and Leonard 2002) – and the processes that lead to certain behaviors outcompeting other behaviors in the cultural arena. The basic difference between the behavioralists and the evolutionists is over inference. Although both programs employ inference, behavioral archaeology makes no distinction between configurational properties – those that are temporally and spatially specific – and immanent properties – those that are timeless and spaceless. Evolutionary archaeology does make such a distinction.

There also is considerable overlap between evolutionary archaeology and human behavioral ecology (Boone and Smith 1998; Broughton and O'Connell 1999) – the latter

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an analytical framework that has seen considerable success in anthropological circles since its introduction in the mid-1970s (Winterhalder and Smith 2000). Models grounded in behavioral ecology make two assumptions: (1) that many human behaviors were built by natural selection and thus are relatively efficient (see below); and (2) that much if not most of the variation in human behavior inferable from the archaeological record is a reflection of adaptive plasticity rather than evolutionary change produced by natural selection (Boone and Smith 1998). Evolutionary archaeologists agree with the first point but would expand it to include adaptively neutral traits – sometimes referred to as 'stylistic' traits (Dunnell 1978). Some evolutionary archaeologists (e.g. Neff 2001) agree with the second point, preferring to focus primarily on the 'replicative success', or fitness, of artifacts. Others suspect that the fitness of artifacts often influences the fitness of the people who make and use them (e.g. Leonard 2001; Lyman and O'Brien 1998).

One interest that human behavioral ecology brings to the discussion is foraging theory, which in American archaeology has been used to study such things as changes in the size of prehistoric groups on the Northwest Coast (e.g. Butler 2000) and how groups in the Great Basin (Fig. 1) and others parts of the West responded to changes in available prey (e.g. Broughton and Grayson 1993; Cannon 2000). Human behavioral ecology makes use of optimal foraging theory and models generated from it to create a yardstick of objective economic rationality that is used as a basis for the comparative study of behaviors (Bettinger 1991). Behavioral ecology has been successful because it 'has proceeded by constructing and testing models that have a substantial empirical content (and thus are falsifiable)' (Kelly 2000: 65).

There is, however, an important caveat that needs to be inserted here: although some of the models used in human behavioral ecology are based on the principle of optimization, human behavioral ecology and optimal foraging theory are two different things. Optimal foraging theory, as the name implies, deals with how an organism or group of organisms might optimize its return from foraging if it acts 'rationally'. But no behavioral ecologist has ever suggested that humans always act rationally and in strict accordance with a list of resources ranked in terms of net rate of energy gain. Humans are not automatons, and it is the reasons behind their deviations from optimality that are of primary interest.

Models derived from the behavioral-ecology perspective are valuable for emphasizing adaptational aspects of an archaeological approach that seeks to adopt various Darwinian tenets. Because foraging theory derives from observations of living organisms, hypotheses are written in the equivalent of ethnographic terms and at the scale of ecological time. Human behavioral ecologists are not unaware of the disparity between ecological and evolutionary time, nor are they unaware that behavior evolves. Their response is that foraging theory and diet-breadth models are simply starting points for behavioral analysis (e.g. Kelly 1995).

Archaeological products

Of all the products that have come to the archaeological marketplace as a result of the efforts of those interested in evolution, I would choose as the most significant those that deal broadly with cultural transmission. I make that choice because Darwinian evolution

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depends on a means of replicating variation. Organisms can be successful in their niches as a result of the characters (traits) they possess, but if there is no means of passing on those characters to succeeding generations, there can be no evolution in a Darwinian sense. Genetic transmission works vertically, or between generations; cultural transmission can work both between and within generations. Regardless of direction, transmission creates lineages by acting as the glue that bonds individual organisms to one another.

Genetic transmission is tied directly to the fitness of organisms, which is the Darwinian yardstick for measuring success. Cultural transmission likewise has a direct bearing on human fitness. As Bettinger and Eerkens (1999) put it, cultural transmission affects Darwinian fitness, just as Darwinian fitness also bears on cultural transmission. Further, as with sexual reproduction, 'the human use of cultural transmission is simply the exploiting of an evolutionary opportunity. To deny that would imply that the culturally mediated evolutionary success of anatomically modern humans is merely serendipitous happenstance' (Bettinger and Eerkens 1999: 239).

American archaeologists have long had a standing interest in cultural transmission, which, after all, is really nothing more than a new term for 'diffusion' in its many guises. Hector Neff (1992), an evolutionary archaeologist, could be mistaken for almost any culture historian of the mid-twentieth century when he states that it is transmission that allows a community or localized group of communities to produce a style of pottery so distinctive as to be easily distinguished from the pottery produced by other centers. Compare Neff's statement with those of culture historians Phillips et al. when they noted that vigorous centers of ceramic production 'impress their ideas on less enterprising neighbors', 'popularity centers will be seen for different styles', and 'between these centers, styles vary and trend toward those of other centers in rough proportion to the distances involved, subject of course to ethnic distributions and geographic factors' (1951: 62). Phillips and his two colleagues were joining a long list of archaeologists who saw style – specifically, pottery decoration – as a means of identifying prehistoric social groups. This tradition continues unabated in the archaeology of North America (e.g. Barton 1997; Bettinger and Eerkens 1999; Braun 1985; LaMotta and Schiffer 2001; Lipo et al. 1997; Neiman 1995; Plog 1990; Shott 1997).

Despite advances made by archaeologists in understanding transmission, the most significant theoretical advances from an evolutionary standpoint have been those made by non-archaeologists, including Cloak (1975), Cavalli-Sforza and Feldman (1981), Durham (1991), and Boyd and Richerson (1985; Bettinger et al. 1996; Richerson and Boyd 1992). This collective work often is referred to as 'dual-inheritance theory' (Shennan 2002), and, although there are significant differences among the various authors in terms of how they view the transmission process (Winterhalder and Smith 2000), there are enough similarities that they can be viewed here as complementary. Dual-inheritance theory posits that genes and culture provide separate, though linked, systems of inheritance, variation, and evolutionary change. The spread of cultural information is viewed as being affected by numerous processes, including natural selection, decision making, and the strengths of the transmitters and receivers.

One interesting study, by Bettinger and Eerkens (1999), applied Boyd and Richerson's models of cultural transmission to the archaeological record of the Great Basin (Fig. 1). The bow and arrow replaced the atlatl around AD 300–600 in the Great Basin – a

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replacement documented by a reduction in size of stone projectile points. The weight and length of points manufactured after AD 600, however, is not uniform across the region. Rosegate points from central Nevada vary little in weight and basal width, whereas specimens from eastern California exhibit significant variation in those two characters.

Bettinger and Eerkens proposed that the variation is attributable to differences in how the inhabitants of the two regions obtained and subsequently modified bow-related technology. In eastern California bow-and-arrow technology was both maintained and perhaps spread initially through what Boyd and Richerson (1985) refer to as 'guided variation', wherein individuals acquire new behaviors by copying existing behaviors and then modifying them through trial and error to suit their own needs. Conversely, in central Nevada bow-and-arrow technology was maintained and spread initially through 'indirect bias', wherein individuals acquire complex behaviors by opting for a single model on the basis of a particular trait identified as an index of the worth of the behavior. Bettinger and Eerkens proposed that, in cases where cultural transmission is through guided variation, human behavior will tend to optimize fitness in accordance with the predictions of the genetic model – individual fitness is the index of success, with little opportunity for the evolution of group-beneficial behaviors. In instances where transmission is through indirect bias, which tends to produce behaviorally homogeneous local populations, conditions may be right for the evolution and persistence of group-beneficial behaviors.

Any evolutionary account of transmission must be built around, at a minimum, models of archaeological formation processes (Shott 1997) and models of the mechanisms that introduce variants into a population – for example, innovation and inter-group transmission – and then sort them. 'Sorting' is a winnowing process whereby some variants increase in relative frequency over time while others decrease. There are different sorting agents, two of which are selection and drift. Numerous archaeologists have begun modeling random drift and culture change (e.g. Bentley and Shennan 2003; Bentley et al. 2004; Shennan and Wilkinson 2001), several of whom have used North American data sets. Neiman (1995) modeled cultural transmission relative to decorative diversity and inter-assemblage variation in ceramic assemblages from west-central Illinois that date roughly 500 BC–AD 800. He found that the highest levels of social interaction occurred during the Middle Woodland period (200 BC–AD 400) and the lowest levels occurred during the Late Woodland period (AD 400–800) – findings that are at odds with conclusions arrived at during the 1970s and 1980s (Braun 1985) but that mirror earlier conclusions of cultural historians (e.g. Wray 1952).

Using Phillips et al.'s (1951) ceramic data sets from the lower Mississippi Valley, Lipo and his colleagues (1997) seriated collections from numerous sites in a 75-by-140-km section of the valley (Fig. 1) to determine whether they could define spheres of community interaction and transmission and thus identify social units. Not surprisingly, those sites that were closest together geographically were also those that had the most similar pottery assemblages. Although such a result may seem trivial in some respects, it most definitely is not for several reasons. First, theory dictated which kinds of units should be used – in this case, selectively neutral decorative types. Second, archaeology, not anthropology, provided an analytical technique – frequency seriation – that was implicitly yet strongly founded in evolutionary theory (Lyman et al. 1997).

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Some previous efforts to measure transmission rested on concepts such as horizon styles (Willey 1945), thus depending solely on how items were classified. If two artifacts from spatially distinct sites were categorized as members of the same horizon style, then the implication was that people at one site had 'influenced' people at the other site. The inference was based on common sense and founded in ethnographic observations of diffusion rather than in theory; hence, there was no way to test such inferences. It has long been recognized that changes in community interaction influence the results of frequency seriation – thus the requirement that seriated collections come from the same local area. The importance of Lipo et al.'s work lies in the fact that they developed an analytical method for determining that historically contingent local area.

Cultural transmission creates lineages, whether they be lineages of ideas, recipes, or objects. One method that is seeing increased usage for formulating hypotheses of cultural descent is cladistics, a set of methods routinely used in biology and paleobiology to construct phylogenetic hypotheses. Like evolutionary taxonomy, cladistics uses only homologous characters to determine phylogeny, but it goes one step further and focuses strictly on 'shared derived characters' – those held in common by two or more taxa and their immediate ancestor but no other taxon (Fig. 2). In contrast, 'shared ancestral characters' are homologous characters held in common by taxa that are related through more than a single ancestor. These are of less use because they do not allow us to order the taxa that have the characters. All we know is that the taxa are somehow related to each other (Fig. 2). For example, the presence of a highly complex structure such as a vertebral column is evidence that humans, birds, and literally thousands of other taxa are somehow related. This relatedness is part of the reason for the identification of the subphylum Vertebrata. But the vertebral column is a character that extends so far back in time as to be essentially useless in terms of helping us understand how the myriad backboned organisms of the last 400 million years are related phylogenetically.

To say that cladistics focuses strictly on homologous characters in order to determine phylogeny, and then on only a single kind of homologous character, begs the question of how one sorts homologous characters from analogous characters – those that two or more taxa acquire independently as opposed to through relatedness (Fig. 2). This is at least as

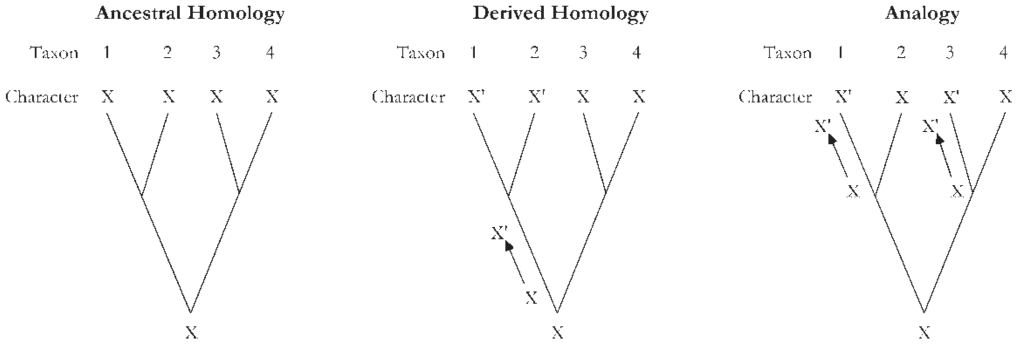

Figure 2 Differences between two kinds of homologous characters and analogous characters. Note that analogous characters originate in lines not united through an immediate ancestor (after O'Brien and Lyman 2003b).

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significant an issue in cultural phylogeny as it is in biological phylogeny, but, like their colleagues who work in the strictly organic world, cultural phylogenicists have developed methods for identifying and separating homologues and analogues (O'Brien and Lyman 2003b). Cultural phylogenetics, although difficult and often tedious, is not a hopeless enterprise, despite what a few uninformed nay-sayers have reported (e.g. Terrell 2004).

Although to date the major use of cladistics has been in the biological realm, the approach is identical in logic and similar in method to tracing historical patterns of descent in languages (Gray and Atkinson 2003; Rexová et al. 2003) and manuscripts (Platnick and Cameron 1977). Archaeologists have also begun to use cladistics to create phylogenetic histories of artifacts (Harmon et al. 2000; Jordan and Shennan 2003; Leonard et al. 2002; O'Brien et al. 2001, 2002; Tehrani and Collard 2002). The logical basis for extending cladistics into archaeology is the same as it is in biology: artifacts are complex systems, comprising any number of replicators, units analogous to genes (Hull 1988). The kinds of changes that occur over generations of tool production are constrained, meaning that new structures and functions almost always arise through modification of existing structures and functions as opposed to arising *de novo*. The history of these changes, which include additions, losses, and transformations, is recorded in the similarities and differences in the complex characteristics of related objects – that is, in objects that have common ancestors.

Harmon et al. (2000; see also Leonard et al. 2002) used phylogenetic methods to trace the development of intellectual traditions reflected in the ceramic iconography of the Medio-period Casas Grandes archaeological culture (AD 1200–1450) of north-western Mexico and the American Southwest (Fig. 1). Casas Grandes culture revolved around Paquimé (also known as Casas Grandes), a large, architecturally elaborate pueblo-like centre located in north-western Chihuahua, Mexico. The origin of the Casas Grandes cultural system has long been a source of speculation, with scenarios ranging from an indigenous, Mesoamerican-influenced development to an American Southwest–influenced development.

Instead of focusing specifically on the question of origin, Harmon et al. examined pottery traditions they identified from the Casas Grandes culture area and surrounding areas, using shared derived characters to create an ordering of the traditions. They found that the iconography reflects relatively close historical connections between people of the Medio-period Casas Grandes tradition and those of the Classic-period Mimbres culture of New Mexico (AD 1000–1150) and a more distant historical connection to the Comala-phase occupation of western Mexico (100 BC–AD 375) (Fig. 1). In addition, an intellectual break appeared between the Medio-period and earlier Viejo-period (AD 900–1200) Casas Grandes traditions. Numerous additional lines of evidence support not only the cultural connections among northern Mexico, New Mexico, and western Mexico but also connections between those regions and South America.

Another phylogenetic study, one I undertook with several colleagues (O'Brien et al. 2001, 2002), focused on the evolution of projectile points from the south-eastern United States that date *c.* 9250–8500 BC. Projectile-point form in the Southeast varied considerably during that period, but a lack of both stratigraphic evidence and radiocarbon-dated contexts has made it difficult to order traditional point types chronologically. There undoubtedly was considerable heritable continuity between point

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forms (Bradley 1997), but the nature of the relationships has been unclear. The phylogenetic trees we produced using character-state changes began to clear up some of those relationships. In addition, the relative position of various character states on the trees provided insights into early projectile-point engineering, as manufacturers constantly experimented with various hafting-element designs (Fig. 3).

Once one begins thinking in evolutionary terms, any number of interesting archaeological questions present themselves. To continue with the discussion of phylogeny and projectile-point technology, one question that comes to mind concerns the relationship between Folsom and Clovis points in the Southwest and Plains. Ever since the distinction was made in the 1930s between Clovis and Folsom points, archaeologists have proposed that Folsom points evolved out of Clovis points. This proposition is based on (1) formal similarities between the two point types (Fig. 4), (2) later radiocarbon dates for Folsom points (*c.* 8950–8500 BC) than for Clovis points (*c.* 9250–8950 BC), and (3) the stratigraphic position of Folsom points relative to Clovis points at Blackwater Draw, New Mexico, the Clovis type site (Cotter 1937).

Because two things are superposed does not imply they are connected in a hereditary sense, although this assumption is embedded in American archaeology. Maybe, though, what we are witnessing in the western United States is a case of non-related replacement of Clovis points by Folsom points. Bradley and Frison (1996) stated that in their opinion Folsom points evolved not out of Clovis points but out of a point type – Goshen (Fig. 4) –

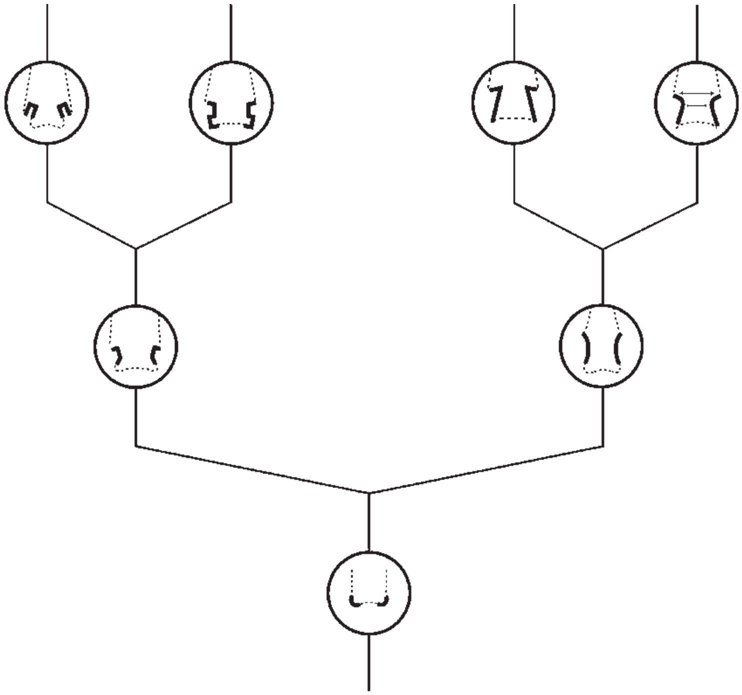

Figure 3 Hypothetical phylogeny of projectile-point taxa based on ordered changes in states of hafting-area characters

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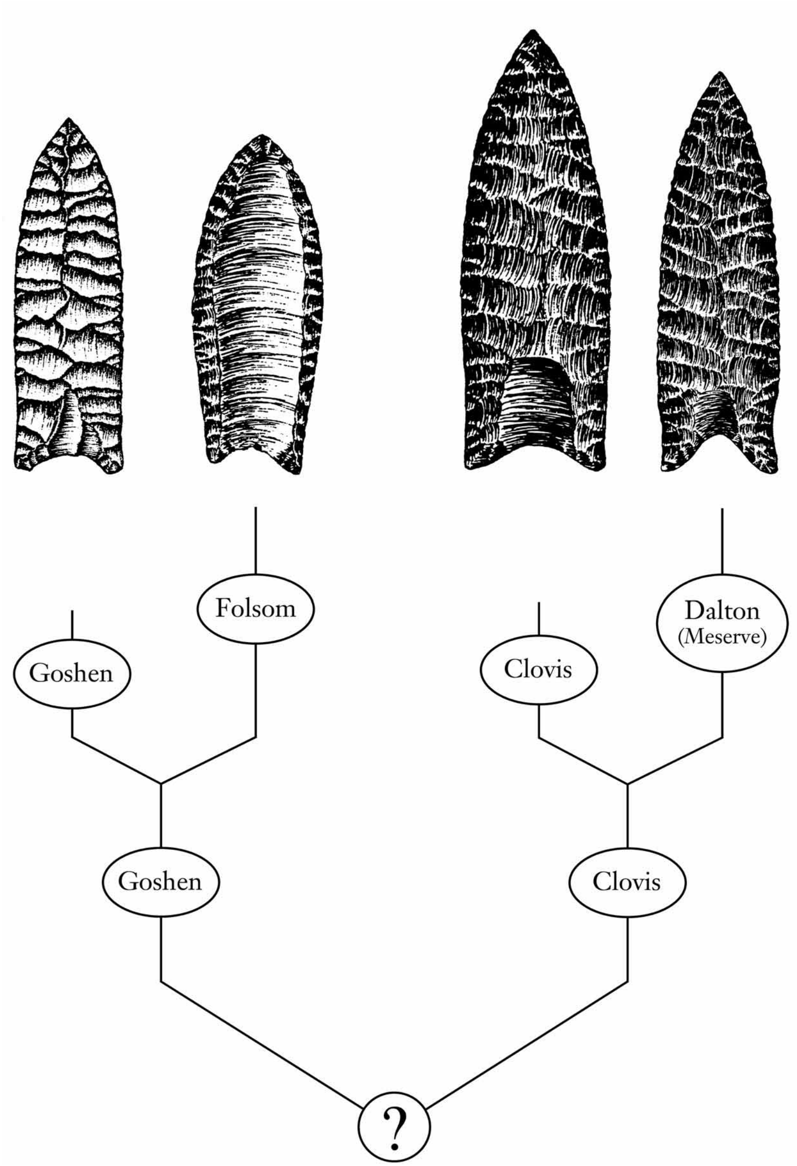

Figure 4 Suspected phylogeny of four projectile-point taxa from the western United States. Note that the ancestral histories of Goshen and Clovis are unknown.

that was a contemporary of Clovis. Of considerable interest is a statement by Taylor and his colleagues that the 'latest North American Clovis occupation predates the earliest occurrence of Folsom' (Taylor et al. 1996: 523). In other words, it does not appear that Clovis points and Folsom points overlapped, which one might expect to occur if one evolved out of the other. Unless sampling error is clouding the picture considerably, Bradley and Frison are correct: there was no natural evolution of Clovis into Folsom points. Rather, Clovis split, giving rise to Meserve/Dalton points (Bradley 1997).

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Lyman and I (O'Brien and Lyman 2000) suggested that the replacement of Clovis points by Folsom points was a classic case of punctuated equilibrium (Eldredge and Gould 1972), in which Folsom-point manufacturers moved into some of the same locales – Blackwater Draw, for example – that had been occupied by Clovis-point manufacturers. Work recently begun by archaeologists at the University of New Mexico (e.g. Hamilton et al. 2004) is geared toward examining these kinds of phylogenetic issues related to early hunters in the West.

Considerable recent debate in archaeology generally has focused on the significance of vertical (learning from one's cultural 'conspecifics') versus horizontal (induced by culture contact) processes of culture change. Some of the most interesting work in this area has been by personnel connected with the Centre for the Evolutionary Analysis of Cultural Behaviour, a joint unit of University College London and Southampton University funded by the UK Arts and Humanities Research Board (e.g. Collard and Shennan 2000; Holden 2002; Jordan and Shennan 2003; Steele and Hazelwood 2003; Tehrani and Collard 2002). Several projects have used North American materials. For example, Jordan and Shennan (2003) employed a long-term and regional framework to analyze the transmission of languages and craft traditions among Native Americans in California. Initial results suggested that basketry assemblages not unexpectedly exhibited a horizontal signal, arising from the transmission of cultural attributes across sharply defined linguistic boundaries. Their results also indicated that, despite broad similarities, local basketry traditions remained relatively distinct and therefore cannot be explained through horizontal transmission alone. Jordan and Shennan suggested that perhaps differential rates of cumulative innovation in language and craft traditions may have been present, leading to the erosion of phylogenetic signals for shared descent and the rapid emergence of distinct local basketry traditions.

Conclusion

The examples discussed above represent only a fraction of the work undertaken in North American archaeology by those with an interest in evolution. Even as such, the studies demonstrate the wide range of topics that can be incorporated under a Darwinian banner – a far wider range than is sometimes imagined if one pays attention only to labels such as 'selectionism', 'behavioral archaeology', or human behavioral ecology' (Shott 1997). One common current that runs through the studies is that, to borrow a shopworn phrase, 'history matters' (Gould 1986). Darwinism is a theory about history – why and how things that are genealogically connected change over time. History, of course, is not the exclusive purview of evolutionists, nor is it a recent interest in archaeology. Archaeologists of various intellectual persuasions have always been interested in history, and it would be difficult to imagine the discipline any other way. The real issue is not whether history is important but rather the kind of role history plays in archaeology (O'Brien and Lyman 2004). More specifically, is archaeology science or history? This question has roots deep in the earlier part of the twentieth century with respect to anthropology as well as archaeology (Lyman and O'Brien 2004).

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With respect to the latter, Trigger regarded history as being integral to a scientific archaeology: 'I wish to demonstrate that both idiographic, or particularizing (i.e., historical), and nomothetic, or generalizing, disciplines are vital components of a scientific study of human behaviour' (1973: 95). It is difficult to disagree with Trigger. Certainly from a Darwinian perspective, history cannot be divorced from science: 'Darwinian theory is both scientific and historical. The history of any evolving lineage or culture is a sequence of unique, contingent events' (Boyd and Richerson 1992: 179–80). Science without history, regardless of whether we are talking about the biological or social realm, 'leaves many interesting phenomena unexplained', whereas history without science 'cannot produce an explanatory account of the past, only a listing of disconnected facts' (Boyd and Richerson 1992: 201).

To evolutionists, archaeology is a historical science, in which writing and explaining the history of human phenotypes is the primary objective (Lyman and O'Brien 1998). From an evolutionary perspective, to explain means 'to identify a mechanism that causes evolution and to demonstrate the consequences of its operation' (Bell 1997: 1). Two of the more important mechanisms are selection and transmission. Both are historical, and both operate continuously, albeit sometimes more strongly or more rapidly than at other times. This varies the tempo of evolutionary change and produces the spectrum of consequences that attracted most of us to archaeology in the first place. And certainly North America exhibits a spectrum that is as rich and varied as that found anywhere.

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