Part I
Thinking About Archaeology

1

Analytical Archaeology

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The mere recognition and definition of an activity by the production of a concomitant set of artefacts constitutes the transmission of information or a message . . . A child brought up amongst motor-cars and skyscrapers is differently informed to another child born amongst stone axes and pig-hunts.

Clarke (1968: 86)

Introduction

Archaeology today is subject to the tyranny of the present. Its ideas are reduced to their sources in contemporary or recent society and subject to retrospective disapproval. That the origins of culture history go back to dubiously motivated nationalism, or that "New Archaeology" can be seen as an aspect of 1960s American imperialism, encourages the assumption that the approaches have no intrinsic value, rather as if the origin of some of Darwin's ideas in nineteenth-century capitalist economics should justify discarding the theory of evolution by natural selection (cf. Klejn 1998). With the rise of the cultural heritage movement more interest is devoted to the ownership of archaeological material and its political and economic implications, than what the material tells us about the past. Furthermore, the focus of interpretation now places archaeologists in the role of ethnographers of a lost "ethnographic present," struggling hopelessly against the fact that the people we need to talk to are long dead and most of the residues of their lives long decayed. One example is the current preoccupation with how prehistoric people perceived past landscapes, where studies leave it willfully unclear whether the perceptions proposed are those of the investigator or of the past people being studied. Finally, our desire to see people in the past as the active, knowledgeable agents we believe ourselves to be, means requiring all material culture variation to result from self-conscious identity signaling and all change to be the outcome of the conscious choices of individuals with existentialist mentalities who walk clear-sightedly into the future.

In contrast, this chapter assumes that the aim of archaeology is to obtain valid knowledge about the past. It tries to show that archaeologists do not need to be failed ethnographers. It argues that there are diachronic patterns in the past which we can discern retrospectively but of which people at the time would have been totally unaware,

or only perceived from a limited perspective, and which can only be explained from the point of view of the present-day archaeologist. This does not mean that we are condemned to producing teleological accounts of "progress" leading to the present, but that we should investigate the past in a way that plays to archaeologists' strengths, which undoubtedly lie in the characterization of long-term patterning in past societies. Furthermore, such investigations should provide a basis for supporting their claims, which goes beyond mere assertions on the part of the investigator appealing to some undefined notion of plausibility. Accordingly, this chapter is an argument for *Analytical Archaeology* in both the senses intended by Clarke: the characterization of diachronic patterns and processes through the application of analytical methodologies.

Diachronic Patterns and Culture History

Within the American or European traditions, the only archaeological approach which has ever studied diachronic patterning in the archaeological record seriously is culture history, originating with Kossinna and Childe in Europe and with Kroeber and Kidder in North America. Its aims involved the characterization of cultural traditions, including spatial extent and changes through time. These two versions differed significantly.

In Europe "cultures" were characterized by distinctive artefact types associated chronologically, geographically, and contextually. They were represented by static distribution maps of particular periods, leading to change being seen as the comparison of successive "snapshot" maps. Partly this was because European cultural descriptions were qualitative rather than quantitative; for example, cultures might be defined by the presence of a particular kind of painted pottery.

In North America, in contrast, the approach developed by culture history was quantitative, with the construction of so-

called "battleship curves": chronologically ordered sequences showing the frequency of different stylistically defined ceramic types in successive assemblages (see Lyman et al. 1997). Through time these types showed a characteristic pattern of origin, followed by increasing popularity to a peak, in turn succeeded by decline and disappearance. The resulting double-lenticular curve had the shape of a battleship hull. By looking at patterns in these curves for particular sites or regions it was possible to see that at certain points in time there were major breaks in such sequences, where several types came to an end and others started; more commonly, there was a more gradual pattern of different types coming into fashion and going out again.

What both European and American versions of culture history shared, was an interest in explaining cultural change and a set of assumptions making this possible. The central assumption was that the spatial or chronological entities identified represented human group traditions. It followed from this that major changes occurred through the replacement of one tradition by another and therefore of one people by another, at least where material culture production was domestic rather than in the hands of specialists. Within the European tradition, this idea suited the relatively short timescales available for change, and the nationalistic view of peoples as historical actors having pasts and destinies. Lesser changes were seen as resulting from diffusion. Both migration and diffusion were considered unproblematic concepts.

When the New Archaeology emerged in the 1960s, there was some interest in developing the culture historical ideas (e.g., Deetz 1965), but the dominant Binfordian strand rejected norms and traditions. It took the view that the key to understanding culture change was to see the artefacts produced by human communities as a means of adaptation, rather than as reflections of population replacement or cultural influence. In detail though, its protagonists

appreciated that material culture was multi-dimensional, affected by a variety of factors, and explored the implications of this. For example, changes in the size of ceramic serving vessels might signal changing sizes of the groups which ate together, rather than an incursion of a new population which preferred vessels of a different size, while new vessel forms might indicate new food consumption practices, perhaps associated with the emergence of new patterns of social interaction or differentiation.

Lyman et al. (1997: 224) suggest that North American culture history failed because it used the *archaeological* units it had created, which were largely stylistic and defined by the archaeologist, as *anthropologically meaningful*, supposing them to correspond to the cultural classifications of the people who used the artefacts, or to produce useful information about function and adaptation. Indeed, a key argument of the New Archaeology was that classifications of the data could not be taken as somehow natural. Rather, classifications are developed for specific purposes and, depending on the purpose, one might use completely different sets of attributes of a group of artefacts as the basis of a classification.

The implication of this perspective was that cultural complexes defined by culture historians either didn't exist or didn't matter. What was left of the issues which they raised was subsumed under "style," which was regarded as a residue, that variation in artefacts which didn't seem to have any obvious functional explanation (cf. Binford 1962).

Analytical Archaeology

The only large-scale systematic attempt to transform this culture historical tradition in the light of the early stirrings of the New Archaeology and parallel developments in other disciplines, such as geography, was David Clarke's *Analytical Archaeology* (strongly criticized by Binford 1972).

Clarke (1968: 20) presented archaeology as a discipline in its own right, arguing that the data it studies are so unlike those of other disciplines that archaeology has to develop its own systematic approach. This involved three main objectives: the definition of fundamental entities, a search for repeated regularities within and between them, and what he called "the development of higher category knowledge" (Clarke 1968: 21). He defined a hierarchical set of fundamental entities, from the *attribute* (the "atomic" level), through *artefact*, *assemblage*, and *culture*, up to what he called a *technocomplex*, a broad response to specific environmental and/or technological conditions. A single set of processes operated on these different entities, albeit differently at different levels of the hierarchy, including invention, diffusion, and cultural selection. In specific circumstances, the combined operation of these processes, in varying combinations, could lead to other processes, such as cultural growth, decay, and disintegration (Clarke 1968: 22). In contrast to the culture historians, these differing levels of cultural entities were conceived not as lists of traits but as dynamic systems characterized by such systemic processes as negative and positive feedback.

At all levels beyond the "atomic" one of the attribute itself, *key attributes* could be identified whose continued joint covariation expressed the survival of a particular inner pattern or structure (Clarke 1968: 71). These covarying sets were characterized by strong negative feedback processes, which ensured that they stayed in the same relation to one another over time. Cultural entities, whether artefact types or cultures, ceased to exist when a specific set of through-time correlations between attributes disintegrated, and new cultural entities came into existence when new relatively fixed constellations of attributes emerged. Outside the core set of attributes others were more free to vary. Because cultural entities are not capable of immediate and complete transformation they can be regarded as (semi-) Markovian

systems: systems in which the transition probabilities from one state to the next depend on previous system states (Clarke 1968: 63).

In fact, cultural systems are essentially systems for transmitting acquired information; even the recognition and definition of an activity by a concomitant set of artefacts constitutes information transmission (Clarke 1968: 86). New information will not be accepted if the dislocation introduced cannot be reduced to vanishing point (Clarke 1968: 97). Nevertheless, since the pooled innovation rate of groups of cultures is correspondingly greater than the innovation rate of a single culture, it follows that the integration and modification of innovations derived from diffusion will provide most of the variety within a given system (Clarke 1968: 122; cf. Neiman 1995).

For Clarke then, it was diachronic trajectories that were central – the patterns of correlation between different attributes through time at any given level of the hierarchy. It follows that the primary aim in classifying data is to identify different vertical traditions (Clarke 1968: 148), and only secondarily to ascribe things to phases, which are more artificial entities than vertical traditions, given the problematical nature of contemporaneity in most archaeological situations. Within this framework an artefact type is not simply something arbitrarily defined by a specific analyst's artefact classification system, but has a reality as a highly correlated core of attributes accompanied by an outer cloud of attributes which have decreasing levels of correlation with the core (Clarke 1968: 196). The resultant types are real but fuzzy.

Through time such types change and new types emerge which are *transform types*, linked by descent to earlier types, and distinct from *independent types*, "not connected or derived from one another although they may be used within a single cultural assemblage" (Clarke 1968: 211). Change represented by transform types linked by descent is very different from change characterized by replacement of a set of types by new independent types.

At the level of the cultural assemblage, change works in a similar way. Diachronic cultural entities have formative phases in which much variety is generated from multiple sources and gradually integrated into a pattern, which then remains relatively stable (Clarke 1968: 279). One way in which this often occurs is through the occupation of new ecological and/or social environments, resulting in rapid rates of change: "As this cumulative change progresses, the possible developmental trajectories or formats become increasingly restricted as the traits are highly integrated within a functional whole" (Clarke 1968: 253). However, at levels of the hierarchy higher than the society or culture – the culture group or technocomplex – the entities are less tightly integrated (Clarke 1968: 287).

Clarke summarized his approach by suggesting that archaeology has a small number of regularities useful in archaeological interpretation (Clarke 1968: 435–6).

- *The inherent space-time population regularities of archaeological entities*. These include the battleship curve pattern in which attribute and type states increase then decrease in popularity through time, and the patterned intercorrelation through time of attributes forming particular types at low levels of the hierarchy of entities, or of types forming particular cultural assemblages at a higher level.
- *The inherent system regularities of archaeological entities as related kinds of special system*. These include his general model of archaeological systems as semi-Markovian systems linked to contextual systems, with historically generated transition probabilities from one state to another, and a capacity for dramatic system changes when the introduction of new features reaches a particular threshold.
- *The inherent system regularities of archaeological entities as parts of sociocul-*

tural information systems, in particular the "continuity hypothesis," the idea that sociocultural systems change so as to minimize short-term disruption of the system.

- *The inherent distribution and diffusion regularities of archaeological entities as parts of sociocultural population networks*. For example, since the internal integration defining a culture depends on a set of key artefact types, any area which is claimed as the origin of such a cultural entity must show a set of sources from which these key elements developed and then became integrated with one another.

This final systematization of the culture historical tradition by Clarke was never followed up; it remained moribund for over twenty years in Anglo-American archaeology (cf. Shennan 1989a) and indeed has no descendants. As noted already, processual archaeology was dominated by synchronic studies of function and adaptation, while postprocessual archaeology has been concerned with political critique and studies of past meaning. Clarke's scheme sketched out in abstract terms a way in which Binford's devastating critique of culture history could be transcended and the study of culture change addressed, but no one was interested and indeed it is perhaps difficult to see how the approach could have been carried forward at the time, despite Clarke's presentation of an array of modern analytical techniques in the second part of his book.

Darwinian Archaeologies

Since the end of the 1980s, however, the issues raised by culture history have attracted renewed interest from a source with very different theoretical antecedents, through the emergence of various "evolutionary" or "Darwinian" archaeologies. Like most such labels, this one covers an enormous range of often mutually antagonistic views (see Boone and Smith 1998; Lyman and O'Brien 1998).

The unifying element is that all of them draw on aspects of the modern neo-Darwinian evolutionary synthesis in biology in attempting to explain culture change (examples may be found in Teltser 1995; Maschner 1996; Steele and Shennan 1996; O'Brien 1996; Shennan 2002). It is impossible here to describe the different strands in any detail, but we may distinguish two poles of the approach.

One of them derives from the assumption that in evolutionary terms humans are like any other animal. Accordingly, as a result of natural selection, humans have a propensity to take decisions, consciously or otherwise, in the light of the costs and benefits of the consequences for their reproductive success or inclusive fitness. Culture makes little difference to this process because cultural behavior which leads to deviation from this cost-benefit calculus will not last very long. The best-known substantive approach based on these assumptions is optimal foraging theory (e.g., Kaplan and Hill 1992), which generates predictions about the subsistence strategies which will best meet these criteria in a given set of circumstances and compares them with actual subsistence strategies or their material residues (e.g., Mithen 1990; Broughton 1997). Although this end of the spectrum of evolutionary approaches is interesting and important, it is the cultural end of the continuum, and its relevance to the *Analytical Archaeology* agenda, which will be explored further here.

This argues that cultural variation cannot be explained solely in terms of criteria linked to the reproductive success of humans as "culture bearers," but that culture can be considered as a distinct kind of inheritance system, since cultural traditions are handed down from one generation, and indeed from one day, to the next, by specifically cultural mechanisms. Accordingly, we can explore the analogies between the operation of the cultural inheritance system and the biological inheritance system of the genes. The attraction is that the processes of biological evolution and genetic transmission, and the factors affecting them from one generation

to the next, are much better understood than cultural transmission, so we can learn from exploring both positive and negative analogies between the two systems and the way they operate. This process may lead to the development of useful theory helping us to understand particular cases of cultural stability and change.

The best-known version of the analogy between cultural and genetic transmission is Richard Dawkins' concept of the meme (Dawkins 1976; 1982: 109–12; see also Blackmore 1999 for a more extended analysis):

> A unit of particulate inheritance, hypothesized as analogous to the particulate gene, and as naturally selected by virtue of its "phenotypic" consequences on its own survival and replication in the cultural environment.

Despite the fact that there are serious problems with the meme concept (for a summary, see Shennan, 2002), and that an adequate understanding of the manner in which culture operates as an inheritance system is far from achieved, there is considerable evidence that it does operate in this way.

Boyd and Richerson (1985: 46–55) reviewed extensive psychometric and sociological evidence supporting the view that social learning acts as an inheritance mechanism by producing significant similarities between learners and those they learn from, which cannot be accounted for by genetic transmission or correlated environments. They concluded: "The calculated heritabilities for human behavioral traits are as high as or higher than measurements for behavioral and other phenotypic characters in natural populations of non-cultural organisms . . . Thus it may be that [social learning] is as accurate and stable a mechanism of inheritance as genes" (Boyd and Richerson 1985: 55).

Ethnographic studies suggest that the ways of carrying out many human practices exhibit a strong element of social learning, including many practices which create social institutions (e.g., Toren 1990) and those involved in craft production (Shennan and Steele 1999). In other words, they are phenomena subject to inheritance. Archaeological evidence adds support. Some specific practices acquired by social learning show considerable similarity over time even in the absence of strong functional constraints; ceramic decoration practices defining regional traditions provide one obvious example.

This returns us to the agenda of culture history, at least in descriptive terms: we need to reconstruct cultural phylogenies, histories of specific traditions, because we cannot understand cultural variation in time or space without them, just as we cannot understand organic evolution without reconstructing biological phylogenies. Whether such phylogenies will have the relatively straightforward branching structure of most biological trees or whether the branches will be completely intertwined with one another is something still to be resolved (cf. Moore 1994; Mace and Pagel 1994; Collard and Shennan 2000).

Acknowledging cultural inheritance then has important consequences for the kinds of archaeology we should be carrying out, since we have to revisit the concerns of culture history. But this is not the only such consequence. It also follows that we cannot define a set of functional attributes or types resulting from adaptive processes and a different set of stylistic features which simply reflect learning and interaction histories. Every practice which is socially learned, whether it is a way to hunt or a way to decorate a pot, in other words whether obviously functional or not, will have a history of descent. Furthermore, in any given case we cannot establish whether or not the presence of a particular feature in several different nearby cultural contexts arises from a common convergent adaptation without first carrying out a phylogenetic analysis: adaptation can only be understood through a diachronic approach which recognizes descent. Equally, style is more than a residue

after the function has been taken out. Style is simply a "way of doing." Some "ways of doing" are designed with immediate practical consequences, but they can possess a historical signature as well.

The Coherence of Cultural Traditions

As Clarke pointed out (see above), the through-time reality of cultural traditions, whether at the level of individual artefacts and artefact types, or at the level of "cultures," depends on continued patterns of correlation between the elements of the entity concerned. Clearly, there will be different factors leading to the maintenance or disintegration of these diachronic patterns of correlation between sets of attributes characterizing a particular artefact type, or between practices in different areas of life. There will be external limiting constraints, such as functional requirements; there will be the mutual compatibilities required in different aspects of a single process, such as pottery-making, or of different processes which are carried out together, for example, the embedding of lithic procurement in a mobility pattern conditioned by the requirements of hunting expeditions; and there will be the extent to which the different activities or elements are transmitted from one person to another in similar ways, not to mention variations in the pattern and strength of social sanctions concerning appropriate ways of doing things.

The nature of archaeological cultures is much better addressed from this vertical diachronic perspective than by looking at synchronic cultural distributions, as is usually done, since, by focusing on the latter, we get little further than pointing out that distributions of particular features never coincide with one another, so that it is implausible to think of cultures as real entities in any sense (Shennan 1978, 1989b).

In descent and diachronic continuity terms we can think of a continuum of possibilities

as regards cultural coherence (Boyd et al. 1997). At one extreme, whole cultures may be transmitted between generations, hermetically sealed from others, each characterized by its own worldview. This possibility, favored by ethnic nationalists and others who regard cultures as unique constellations of meaning, understandable solely in their own terms, seems unlikely given that diffusion certainly occurs, and that in synchronic distributional terms it is impossible to identify such perfectly coherent blocks, as we have seen. At the other end of the spectrum we have a situation where there is no spatial or temporal coherence: people always make their own decisions about how to carry out any specific activity on the basis of their own trial and error experience and the alternatives to which they are exposed. The temporal coherence we see in the archaeological record, together with the importance of social learning, suggests that this extreme is as unlikely as the first.

A more likely possibility than either of the two extremes is that there are core traditions (cf. Clarke's "key attributes") whose components stick together over time and provide a basic cultural framework, which has a major influence on social life but does not organize everything, so that there also exist "peripheral" cultural elements not closely tied to the core (Boyd et al. 1997: 371). The latter authors cite a number of anthropological cases where such core traditions are maintained over long periods. One example is a study by Rushforth and Chisholm (1991) on linguistic groups of the Athabaskan language family, whose social behavior was linked to the language spoken because they were related historically by culture birth. They concluded that the cultural values of these groups were "genetically related" to one another, since they "originated in and developed from a common ancestral cultural tradition that existed among Proto-Athabaskan . . . peoples . . . this cultural framework originated once . . . and has persisted (perhaps with some modifications) in different groups after migrations separated them

from one another" (Rushforth and Chisholm 1991: 78; quoted in Boyd et al. 1997: 374). Similar conclusions are reached by Vansina (1990; quoted in Boyd et al. 1997: 375) in his study of African political traditions: despite extensive outside influence, internal factors determined development and meant that traditions remained recognizably continuous even though they changed and branched in different directions. As we have seen already, the key to understanding in such cases is the identification of cultural homologies (similarities arising from common descent).

Similar ideas are discussed by Rosenberg (1994), who also favors the idea that cultural cores exist; what he calls, following Gould and Lewontin (1979), the cultural *Bauplan*, "the central ideational component of its superstructure system" (Rosenberg 1994: 320). A culture remains itself, "as long as the systemic integrity of its *Bauplan* is maintained" (Rosenberg 1994: 320). On this view though, in contrast to that of processual archaeology, a culture is not an adaptive system but a self-replicating reservoir of information which is differentially used by real actors in the world, whether individuals, families, or larger entities such as communities. Because the elements of the *Bauplan* are tightly linked, not only are they not easily changed, but also they can themselves constrain innovation and lead to cultural stasis.

Such a view can accommodate the well-rehearsed argument from structuration and *habitus* theory (Giddens 1984; Bourdieu 1977) that individuals are not robots mechanically reproducing their culture, but are constantly using and modifying cultural resources to achieve their own ends. However, mere agency is insufficient as an account of the process of change because we have quite clear archaeological evidence of periods of stasis and of others when change occurs rapidly. In other words, saying that in one period the outcome of myriad actions based on individual agency is that people continue doing the same thing, while in another it leads to people engaging in new forms of action, only pushes the problem back a step.

Rosenberg (1994: 326) suggests that innovations/novelty which have the potential to break up an existing *Bauplan* are most likely to be extensively adopted when they are essential to individual/family survival; more often than not in the context of "infrastructural stress" or new economic/ecological challenges. In particular, such processes of cultural disintegration and the formation of new cultural *Baupläne* are likely to occur in new circumstances which will produce an increase in the rate of innovative behavior, in small groups physically separated from their larger parent population, because the social sanctions maintaining the existing *Bauplan* are likely to be weaker (Rosenberg 1994: 330). The new core which emerges will have a strong stochastic element: founder effects, in terms of those elements of the cultural repertoire which exist within the small sub-population; chance effects of transmission in the small population, relating for example to the number of children particular families have; and the compatibility of specific elements of the old cultural *Bauplan* with the new practices. Such situations arise particularly in the context of migration processes, which have consistently produced punctuated change.

But the cultural core or *Bauplan* phenomenon is not the only plausible point on the continuum of cultural coherence outlined above. Towards the other extreme we have the case where there is no cultural core but rather a series of distinct groups of elements, each with its own distinct pattern of descent. Boyd et al. (1997: 377) suggest that in general smaller coherent units are more likely than large ones in the case of cultural attributes, because different elements of people's cultural repertoire will be acquired at different times from different people for different reasons. Furthermore, the rates of change in different areas of cultural practice may be very different. In some cases, such as the rituals of the Mountain Ok of New Guinea, famously described by Barth (1987), they change extremely quickly, so similarities due to common descent rapidly become dis-

sipated. However, we need not consider that either the "cultural core" view or the "multiple packages" view is right or wrong. It seems plausible to suggest that in some cases there are genuine, powerful, "cultural cores" and in others there are not. The point is not to decide the issue *a priori* in principle, but to find out which is relevant in any particular case and then try to explain why.

There is every reason to assume that these issues can be approached archaeologically; for example, by looking at patterns of correlation between different types through time in different assemblages, or by comparing the descent relationships between sites with regard to different types of material. The pattern of cultural descent relationships between sites for pottery decoration, for example, may be very different from that for house form.

These diachronic material culture patterns are real and are not an epiphenomenon of anything else. They have their own internal logic, since the way they change depends on their own state at a given time: this is the essence of an evolutionary process. Change can only operate on the forms or practices inherited from previous generations. New social conditions, for example, may lead to changes in pottery-making, but those changes will be responses to the existing practices and organization of pottery-making. Moreover, the sort of knowledge we acquire from describing and explaining these patterns is in no sense an inferior kind of knowledge to that obtained by talking to people or reading written sources. As Clarke (1968: 86) says, people's activities and the material environment around them play a key role in creating their consciousness.

This diachronic approach clearly represents a move away from "presentist" archaeological ethnography. It is not trying to provide an inevitably inadequate account of what it felt like to be living, for example, in the region of Stonehenge in the late Neolithic. The patterns it deals with are only recognizable to the global retrospective view of the archaeologist and are only com-

prehensible through archaeological analysis. Not only would the perspectives of the social actors concerned have been almost entirely limited to the specific time and place in which they were living (cf. again the Mountain Ok, Barth 1987, for a discussion of this issue), but also the kinds of practices whose outcome we study would not most of the time have been the object of conscious thought. Accordingly, while we can happily accord people their capacity for conscious agency, doubtless submerged most of the time in their daily routines, and while the explanations we come up with must not contradict what we know about people and the way they act, a desire to write an intuitively accessible "people's prehistory" – a tabloid human interest story – should not blind us to the fact that many important patterns and processes would not have been immediately visible. This may even be the case in the present-day context of global scientific research; for example, despite the spending of enormous amounts of money and a global perspective, it is still not clear how much impact human activity has been having on climatic patterns and it is likely to become so only in retrospect.

Explaining Stability and Change

So far I have been arguing for the importance of describing diachronic patterns as an archaeological enterprise. In some respects, the culture historians achieved this with considerable success. Their failure lay in assuming that "cultures" were always real entities at the high coherence end of the spectrum, which has just been described. The degree of coherence has to be established, not assumed, and the multidimensionality of the variation in the archaeological record which the New Archaeologists established suggests that high coherence is less likely rather than more.

Under a different guise, this issue of coherence has also been an implicit concern in some structuralist approaches. The premise

behind these studies is that there are symbolic structures generating social action which lead to similar patterns and symbolic relationships in different spheres of activity; for example, the organization of burial space and domestic space (e.g., Hodder 1982). Most such studies are purely synchronic, of course, examining symbolic relationships in a notional present, but essentially they are based on a claimed pattern of coherent correlation between different material culture phenomena. Whether such patterns of coherent correlation really are based on some generative structure which, for example, leads to common patterning in domestic and burial space, or whether they simply represent our rationalizations and explanations of the observed correlations, is another matter. Of course, such synchronic studies never have to face up to the question of the mechanisms which create or maintain the patterns. In fact, failure to do this is one of the most important weaknesses in one of the few such studies which have attempted to take a diachronic view, Hodder's (1990) study of symbolic structures in the European Neolithic. As Sperber (1985) has pointed out, "structures" are abstractions which do not as such have causal power. Ideas and practices can only spread through time and space by taking some public form which is passed on from one person to another.

At this point then we need to outline a framework for understanding the processes responsible for the patterns of stability and change we observe. Our object of study is not past people but the traditions they were involved in perpetuating and changing. Archaeologically, as we have seen, it is the history of these practices, as represented in their residues, that we observe in the record from our privileged position. However, this is not the most important reason for adopting such a perspective, which is simply that traditions and social institutions are always prior to any individual: norms and social contracts are not invented anew each day but depend on those prevailing the day before. Individuals are born into this flow of traditions and with propensities derived from a long biological heritage. Accordingly, our aim must be to understand how people's actions, consciously and unconsciously, alter those traditions and practices. The ways in which it can occur are many and various.

One of them is copying error. People can alter the way they do things quite unwittingly. In many circumstances this will not matter. If one person unwittingly decorates a pot in a slightly different way from the norm, this will not make any difference at all if there are many potters, unless some at least begin to deliberately copy the innovation. In other circumstances though, copying error can make a difference. For example, if a small number of elders carry out an initiation ceremony at relatively rare intervals then, as their memories fade, with relatively few people to check against, change can be quite rapid through this process alone. This seems to be the process responsible for the rapid divergent evolution of ritual reported by Barth (1987) for the Mountain Ok. The result over time is a cultural drift process which has no other cause than successive erroneous copying among small numbers of people who are not in a position to keep it in check.

Other processes can also produce such drift. For example, if pottery-making is transmitted from mothers to daughters and a particular mother has more surviving daughters than others, who in turn have more reproductively successful daughters themselves, then the result will be that the variations in pottery-making which characterized the mother who started the sequence will become more prevalent in the population. This latter sort of founder effect is of particular significance in small, often pioneer colonizing, populations. The initial members of a small group separating from a larger population are most unlikely to be culturally representative. If the pioneering group is successful in expanding and producing its own increasingly large group of descendants, their cultural repertoire will be based on the particular variants which

characterized the founders, and it may well look very different culturally from the descendants of the main population from which its founders initially separated (cf. the discussion of *Baupläne*, above).

In fact, such demographic issues are more widely relevant. If a particular population is expanding, then much of its cultural repertoire will expand with it because of the importance of parent–offspring cultural transmission, even if that repertoire has nothing to do with the reasons why the population is expanding. Similarly, if it goes extinct, then those aspects of its cultural repertoire which have a strong element of vertical transmission will go extinct too, even if they were not the reason for the decline. If past demographic patterns had been relatively unchanged, representing a slowly rising growth trend as often assumed, these demographic phenomena would not make much difference. However, it has become increasingly clear that past populations have been much more dynamic than we appreciated until the advent of modern genetic studies, which have enabled the identification of bottlenecks and expansions.

Other processes of potential change to cultural trajectories may be more conscious. Just because someone has learned from their parents a particular way to make an arrowhead, for example, or the best time to plant a crop, it does not mean they will always follow it. They may experiment with alternatives, especially if their current way of doing things does not seem very successful. If they permanently adopt their new variation, it is likely to be copied by their children. If it appears to be more successful than what other people are doing, it may be copied by them as well. From the "tradition-centered" perspective which is being advocated here, we may imagine some sort of competitive process between different practices, where the selective environment for that competition is the human population, or certain elements of it. To give a slightly more extended example, we can imagine two different ways of hafting an ax blade present within a human population (cf. Pétrequin 1993), one of long standing and widely prevalent, the other relatively novel and little used. These methods of ax hafting can themselves be considered in population terms and their population trajectories traced through time as the two types compete with one another. The selective environment in which the competition takes place is the human population of ax makers and users. Decisions will be made about which form of ax haft to make in the light of a number of factors; for example, the size of trees to be cut down (which may change as clearance proceeds and primary gives way to secondary forest); the raw material sources available (which may affect the form and the size of the ax blade); the ways in which axes are held and used; within a broad least-effort framework which assumes that, other things being equal, people would rather spend less effort cutting down a tree, rather than more.

This sort of relatively conscious selection process need not just operate in very practical domains. Another case might be competition between existing and novel methods of enhancing sexual attractiveness. Furthermore, if people decide to switch to new modes of enhancing perceived sexual attractiveness, they may also go a step further and start copying attributes of a sexually attractive or prestigious person which are not actually anything to do with the reasons why they are sexually attractive or prestigious, perhaps their style of speech. Finally, people may change what they do or the way that they do it simply to conform to the majority; for example, if what they have learned from their parents is ridiculed by their peers (Boyd and Richerson 1985).

Of course, in some areas of life, whether the consequences of a particular action are good or bad may not be at all obvious until long after the event, which adds a considerable element of uncertainty to the generation of novelty and argues in favor of adopting existing modes of behavior whose consequences in older individuals can be observed, or simply accepting what one first learned

from a member of the older generation. The result is that such practices may be largely insulated from competition and continue undisturbed.

In fact, it seems likely that what people learn as children in their natal household, in addition to their evolved psychological propensities, provides a foundation which considerably affects their susceptibility to novelty to which they are subsequently exposed, especially if this cannot be judged against obvious standards of instrumental rationality. The fact that initial learning from close relatives of the older generation creates an important filter against the subsequent acquisition of incompatible cultural practices is a main reason for the existence of specific "cultural logics," and for some of the regularities in the patterns of change in cultural systems which Clarke discussed. Moreover, such filters are often enhanced by the existence of sanctions against behavior not corresponding to traditional practices, where the severity of sanctions and the strictness of adherence required are themselves norms which can vary through time in response to selective pressures, such as those relating to "grid" and "group" in Douglas' (1978) well-known scheme.

One more aspect of the relatively conscious decision-making processes which have a selective effect on continuity and change in cultural practices must be mentioned: the fact that decision-making powers are not evenly distributed through populations. Some people, such as political leaders, may be in a position to make decisions in certain areas of life on behalf of a large number of others who have much less autonomy. This has important consequences. First, even if the overall population is very large, if the population of decision-makers is very small then major changes can potentially occur as a result of the sort of chance processes discussed above in relation to copying error. Second, selection of such practices will be in terms of criteria which benefit the decision-makers. It seems possible that the Japanese rejection of guns and the eventual

Chinese rejection of ocean-going navigation should be seen in this light (cf. Diamond 1998).

It remains to mention briefly two more or less conscious processes which have a bearing on issues of cultural stability, or at least processes where conscious actions have unintended dynamic outcomes of which people are likely to be unaware. The first concerns game theory.

When people interact to achieve some end which each has in mind, the strategy to adopt cannot be decided in advance and then applied to obtain the end in view, because the best approach to adopt will depend on what the other person does. Moreover, it is quite easy for the outcome to be sub-optimal for both of them even though both could have done better if they had adopted different strategies. Game theorists have explored a variety of different theoretical games and examined the payoffs to the individuals concerned when different strategies interact repeatedly. In some cases one strategy takes over, since this always gives the best return to both players. In other cases the equilibrium best outcome may involve a mix of two different strategies within the population, at a specific proportion. Such optimal equilibrium outcomes can be established by mathematical modeling or computer simulation. In some cases it turns out that when different strategies are played against each other in this way an equilibrium can emerge in which strategies continue to be maintained in the population even though they do not show *modular rationality* – they are not a rational choice in terms of the payoffs obtained in specific situations (Skyrms 1996: ch. 2).

The significance of game theory from our point of view is that, as with all the other practices we have been discussing, we can imagine populations of social strategies evolving over time and changing in relative frequency as they compete with one another in terms of the payoffs that they give to the individuals using them. Given enough time an equilibrium will emerge, but the precise

equilibrium reached may be dependent on the specific history of the interactions. As an example, we might imagine a hypothetical case where one strategy to obtain social advantage is to hold a major funeral feast when a group member dies, involving the deposition of large amounts of grave goods, while an alternative is to pass on the wealth to the next generation to use as "capital" to build up a social position. It is hard to imagine having the information to explore the payoffs and dynamics in a real past situation, at least in prehistory. Nevertheless, it may still be useful to think in game theory terms and it brings social strategies into the same diachronic framework of looking at the trajectories of past populations of cultural practices that we have seen in the other areas discussed.

In a similar vein are models derived from complexity theory involving "self-organized criticality" (e.g., Bentley and Maschner 2000). These have been used to explain the distributions of species lifespans and extinctions in the fossil record. They hypothesize that patterns in such events – for example, the scale of extinction events in terms of the number of species that go extinct at the same time – result from the interactions between "agents" which are competing to survive within a limited space. Such interconnected agents, whose success depends on one another, could include artefact styles (Bentley and Maschner 2000). In other words, complex interactions produce specific types of dynamics simply as a result of their interconnectedness and complexity. It remains to be seen how the consequences of such ideas will be worked out in archaeology (see, for example, Bentley and Maschner 2001), but the existence of the phenomenon of self-organized criticality makes the important point that, even though the starting point for the processes may be patterns of decision-making, the resulting dynamics of change through time can be both complex and counter-intuitive.

Given the complexity and abstraction of the ideas which have been presented in this chapter, it seems appropriate to finish by looking briefly at two examples which attempt to understand precisely the kind of Markovian diachronic patterns which Clarke argued were the concern of analytical archaeology and which are also at the heart of evolutionary approaches to culture.

Stylistic change in the Woodland period of Illinois

Neiman's (1995) analysis of Illinois Woodland ceramic assemblage variation focused on diachronic variation in exterior rim decoration, and explored the implications of assuming that the decoration system represented a tradition maintained by social learning, in which the only relevant evolutionary forces accounting for change through time in the form and frequency of decorative attributes in a given ceramic assemblage are mutation and drift, because stylistic variation is regarded as adaptively neutral and therefore not subject to selection. As we have seen above, drift represents the chance element affecting the prevalence of practices: even if we assume that all potters and/or all decorative motifs are equally likely to be taken as models in an episode of social learning and subsequent ceramic production, in any finite population not all potters or motifs will be copied the same number of times. For smaller populations, the chances of such random variation are particularly great. By the time a few "generations" of ceramic decoration copying/production have gone by, some of the motifs will have disappeared altogether, while others will be present at high frequency. Eventually, only one will prevail and the time taken for this to happen will depend on the population size.

Mutation refers to the introduction of novelty into the decorative repertoire of a particular group. This can come from local innovation or from the adoption of new motifs from other groups. To the extent that groups are in contact with one another, the drift-driven changes in the different groups should go in step with one another.

Neiman (1995) carried out a simulation to demonstrate that, for a given population size, higher levels of intergroup transmission produce lower equilibrium values of inter-group divergence. It follows from the theory and its mathematical specification that when drift and neutral innovation are the only forces operating, then, if we examine the relationship between the variation within an assemblage and the differences between different assemblages, as one decreases the other will increase (Neiman 1995: 27).

An analysis of the differences between a number of Woodland ceramic assemblages from different sites, for a series of seven successive phases, showed a trend of decreasing then increasing difference between them. It also showed the pattern of inverse correlation between intra- and intergroup variation just mentioned: as inter-assemblage differences went down, the variation within assemblages increased. Neiman (1995: 27) therefore concluded that the trends through time in inter-assemblage distance were indeed a function of changing levels of inter-group transmission, which started low, reached their highest level in Middle Woodland times, and sank to new low levels in the Late Woodland period. The Middle Woodland was also the time of the "Hopewell Interaction Sphere," evidenced by the wide-spread appearance of exotic trade goods.

Neiman went on to suggest that since the attribute being studied was decoration on cooking pots, and since ethnoarchaeological work suggests that successful transmission of ceramic traditions requires a long-lasting relationship between teacher and learner (cf. Shennan and Steele 1999), then the changes in level of intergroup transmission must relate to changes in the level of long-term residential movement of potters between groups. He also pointed out that his conclusions about the patterns of interaction through time in this period and area correspond to those of the culture historians who had studied the phenomenon, rather than with those of subsequent analyses undertaken within a New Archaeology frame-work. These had suggested that the end of the Middle Woodland and the cessation of exotic goods exchange represented the replacement of gift exchange relations by more frequent, routine, everyday forms of contact. This does not appear to be the case.

Diachronic variation in LBK ceramic decoration patterns in the Merzbachtal, Germany

The second example is very similar to the first, in that it involves accounting for changing patterns in the frequency of ceramic decorative patterns; in this case decorative bands on the bodies of ceramic vessels from two settlements of the early Neolithic *Linienbandkeramik* in western Germany. However, the conclusions reached in this case are different from those of Neiman (Shennan and Wilkinson 2001).

The two settlements are located within a small early Neolithic settlement cluster along the shallow valley of a stream, the Merzbach, which was totally excavated in advance of mining. A quantitative analysis of the decorative motif frequency data was undertaken in the same way as Neiman had done. In this case the analysis of the changing diversity of the decorative assemblage through time, established that the diversity values derived from the neutral model of stylistic change and those based on the band type frequencies in the LBK data were completely different from one another. More specifically, it appeared that in the early phases the diversity of the ceramic assemblage in terms of its decoration was less than would be expected under the neutral model, while in the later phases it was greater. This indicated the existence of some directional selective forces acting on ceramic production decision-making, thus leading to the departure from neutrality: to the rejection of novelty (or conformist transmission) in the early phases and a much more positive attitude towards it in the later ones.

In fact, the increased decorative diversity within each of the two sites analyzed is

chronologically associated with the founding of separate but adjacent settlements within the Merzbach valley. There appear to have been strict norms regarding band type choice in the early phases, followed by an assertion of distinctiveness at both the intra- and inter-site level in the later ones. This argument is supported by a recent cladistic analysis of the ceramic assemblages from all the Merzbach settlements (Collard and Shennan 2000), which suggested that the ceramic assemblages from the newly founded settlements arose as a result of processes of branching differentiation from ancestral assemblages, despite the fact that all the sites concerned are extremely close together.

Conclusion

Analytical Archaeology argued for the centrality of describing and explaining diachronic patterns in the archaeological record at a series of different hierarchical levels and suggested that there were general processes operating which produced regularities in how such patterns developed over time. As the quotation at the head of this chapter indicates, it also insisted on the importance of people's interactions with the humanly constructed material world around them in creating their identities. Nevertheless, although that world has an enormous influence on creating the sorts of people who grow up and lead their lives within it, its simple presence does not provide sufficient information to reproduce it for the future, in just the same way that looking at and tasting a cake does not provide sufficient information to make one. For that you need the passing on of instructions from someone who knows how to do it.

This point has become particularly central for those archaeologists who have suggested that the cultural lineages created by social learning can be regarded as analogous in certain respects to genetic lineages, and who have begun to explore the implications of this in terms of the impact of analogues of

mutation, selection, and drift on diachronic patterns in cultural practices.

A key area of concern to both Clarke's agenda and that of the evolutionary archaeologists (*sensu lato*) is the identification and characterization of coherent patterns of diachronic correlation at the different levels of the hierarchy identified by Clarke, between attributes characterizing types or between elements of assemblages relating to different cultural practices. The extent of cultural coherence is likely to be very variable and must be an object of investigation rather than being assumed at the outset. Nettle (1999) has recently made a similar point in relation to language, pointing out that it is mistaken to talk of the history of "a language," but that we need to look at the separate histories of its various elements. In an archaeological context differential patterns of correlation among the attributes characterizing arrowheads have been used to infer different processes in the introduction of arrowheads in different regions (Bettinger and Eerkens 1999).

This approach puts the diachronic patterns in material culture (in the widest possible sense) and the cultural practices associated with them at the center of archaeological investigation, not people. Moreover, these are patterns recognized by the archaeologist after the event. Nevertheless, human action isn't written out of the picture. In the various complex ways outlined above, it modifies the diachronic patterns. Much of that modification occurs as a result of processes which people are unaware of or don't intend; for example, some of the drift processes described or the interactions whose implications are being explored by complexity theory. Some of it appears to be more deliberate, such as the switch from suppressing novelty to embracing it in LBK pottery decoration. But it is important to note that this inference is a conclusion, based on the rejection of a null hypothesis of stylistic neutrality, not an untested starting assumption about the ubiquitous centrality of self-conscious identity signaling. Indeed,

Neiman's Illinois Woodland results show that the latter is not always the case.

Paradoxically, however, given what was said at the beginning of this chapter, the focus on documenting diachronic lineages of cultural practices and the factors affecting them may also ultimately tell us a lot more about the links between the past and the present.

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