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A historical perspective on environment and culture in Anasazi country

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Observations concerning the relationships between environment and human behavior are hardly a new arena of inquiry for archaeologists – or anyone else, for that matter. This volume, however, represents the culmination of an ambitious long-range attempt on the part of the contributors to bring to bear a tremendous amount of natural and cultural data on explanations for the development of Anasazi culture and perhaps the evolution of complex societies in general. It is an effort, called informally by us the Paleoenvironment Project, to come to grips in a realistic fashion with the universal problem of large-scale ecological studies – the testing of the fit between diverse voluminous data and cultural–ecological models. It is not the purpose of this volume to develop a universal model for the testing of all ecological–cultural linkages. Nor shall we detail the historical foundations of an ecological anthropology. Numerous summaries have documented the evolution of method and theory in ecological anthropology (i.e., Anderson 1973; Harris 1968; Jochim 1979; Vayda and McCay 1975). In order, however, to understand and evaluate the methods and the models that are developed for our purposes, it is necessary to set our study in an evolutionary perspective.

In many ways, the evolution of anthropologists' conceptual understanding of the coupling of environment and culture is an outstanding example of the general development of the entire discipline. Whether environment is ignored or given deterministic qualities, whether it is viewed in its grossest global terms or in single organismatic caloric units, the view anthropologists have of the culture–nature link is a fairly accurate reflection of both the sophistication of our general anthropological models and the precision of our methods. The American Southwest with its semiarid environment, generations of intensive field exploration, and prehistoric continuity provides an ideal subset of the ecological–anthropological sample, reflective of the evolution of anthropological method and theory.

In order to comprehend more clearly the development of understanding about climate and population in the prehistoric Southwest, it is profitable to examine how refinement in (1) techniques and methods, (2) conceptual frameworks, and (3) changes in the scale of observation and analysis have influenced our present perception of the problem.

Methods and techniques of course are the tools we use for describing and measuring the environment and human behavior. These involve not only anthropology but numerous other disciplines. The details of the strengths and weaknesses of the methods and techniques of those other disciplines as well as their underlying assumptions, which form the basis of the conceptual frameworks of these disciplines, are discussed in following chapters.

The conceptual models which ecological anthropologists employ determine, in large part, the interpretation of the data which have been accumulated by various techniques and methods. The conceptual model by which we are constrained or liberated structures our perception of the relationship between human beings and the environment. It is the construct which not only allows us to interpret the data, but determines how the data are interpreted.

The scale of observation and analysis is the breadth or focus of a specific unit of study. Scale here is used in the mundane sense referring to the relative size of something or the scope of activity. It is the narrowness or broadness of a scope of inquiry on any level of investigation. The scale of observation (whether determined by the limitations of methods and techniques or conscious selection, collection, and analysis strategies) often profoundly affects the interpretation of the data. Change or continuity may be masked or enhanced by the division of archaeological phases; the collection units or sampling intervals for pollen, soil samples, and artifacts; averaging of tree-ring width indices on a five-year, decadal, or century basis. Scale of observation and analysis is pertinent to and cross-cuts both techniques and conceptual models and affects the collection of data and their interpretation.

The very triteness of the observation that variation in the scale of observation and analysis affects our perception of what we are investigating has perhaps dulled our conscious sensitivities of its importance. In any case, scale is a convenient gauge with which to judge the effectiveness of cultural–ecological studies because it is a yardstick that can be applied to methods and techniques as well as conceptual models.

A BRIEF HISTORY OF ECOLOGICAL ANTHROPOLOGY IN THE SOUTHWEST

In the Southwest, one of the earlier calls for understanding the people in the context of their environment came from Lyndon Lane Hargrave, who, in a report on the Rainbow Bridge–Monument Valley Expedition (1935:24), declared archaeology inseparable from human ecology. It took no brilliant insight, of course, to establish that this semiarid, nearly barren land, raked as it is by incredible variations in precipitation and temperature, profoundly affected the behavior of its past and present human inhabitants. The Rainbow Bridge–Monument Valley Expedition exemplifies for the Southwest the difficulty of reconciling method with theory in ecological anthropology. Notwithstanding its lofty goals for studying past human ecology, the published reports on the project provided little analysis of human and natural environment (Beals, Brainerd, and Smith 1945).

Most early archaeological and anthropological studies used a broad scale of both observation and analysis in terms of the interpretation of the relationships between the natural environment and culture. Beyond general musings about population variabilities in the Southwest, most early efforts to explain demographic shifts were quite specific as to the locality of population movements and the possible causes of the movements. This early period of scientific exploration in Southwestern cultural ecology was characterized by *particularistic explanations*.

Beginning in the 1950s, improved methods and new techniques were developed for estimating populations and determining past environments. Conceptual models were devised that treated culture and environment as a holistic entity. Nevertheless, these schemes were usually static, with both the natural environment and culture viewed as relatively homogeneous entities in homeostasis. This period may be called one of *mechanistic cultural–ecological explanations*. Although culture and the natural environment were viewed in a quasi-systems sense, the variability between culture and environment as well as the number of variables impinging on the relationship was minimized. Furthermore, there was little in the way of testing conceptual models against the data during the period. What data existed tended to be interpreted in terms of gross scales of analysis.

By the late 1960s, anthropologists were using much finer scales of observation and analysis and viewing culture and environment as much more heterogeneous, often in a state of systemic disequilibrium. It was understood that in many habitats continual cultural adjustments had to be made to accommodate a perpetually fluctuating natural environment. The nuances of cultural buffering of environmental perturbations began to be more widely appreciated. In addition, concerns about the appropriate scale of observation and analysis began to take on added importance. This stage is characterized by much more *dynamic cultural–ecological explanations*.

While these three types of explanations tend to follow one another in historical progression, this is not always the case simply because in some instances investigators see "causes" for cultural change in a restricted area or are constrained by inadequate data. Most southwestern scholars, regardless of the type of explanation they employ, are at least peripherally interested in the kinds of population adjustments in space and time which characterized much of the Anasazi occupation of the Colorado Plateaus. As a result, changing views of population movement and abandonment provide an effective yardstick by which to measure the scale and sophistication of different explanations.

PARTICULARISTIC EXPLANATIONS

Conceptual models

Many of the earliest explanations for variations in population size or population movement were attempts to link specific populations to unique, usually catastrophic events, such as Frank Hamilton Cushing's heartfelt assertion in 1890 that earthquakes caused the abandonment of many of the large prehistoric towns in southern Arizona (Haury 1945).

Less fanciful was Harold S. Colton's (1932) hypothesis that the eruption of Sunset Crater in the mid-eleventh century was a major factor in population movements around the San Francisco volcanic field near Flagstaff, Arizona. Colton hypothesized that people were initially driven from the area of the erupting volcano, but later were attracted to the region because the cinders provided a suitable mulch for the agricultural fields. While Colton's hypothesis has recently been criticized (Pilles 1979), his formulation is remarkable for tying the abandonment of a restricted geographic area to a specific environmental event, and for linking the repopulation with environmental changes caused by the volcanic eruption and with the prehistoric farming technology. Furthermore, he was able to date the volcanic eruption by the newly discovered technique of dendrochronology because volcanic ash covered structures containing datable beams. Colton's scale of analysis was quite detailed over a limited region and for a narrow span of time.

This early era of particularistic environmental explanations for population movement and demographic change was not necessarily limited to climatic fluctuations, as the earthquake and volcanic theories demonstrate. Colton (1936: 337–43) felt that some apparent population declines resulted from the spread of epidemic diseases caused by crowded pueblos and unsanitary conditions. However, few, if any, archaeologists and epidemiologists now view disease as the sole cause of site abandonment on the Colorado Plateaus at any particular time, although they do agree that it may have been a contributing factor in some instances (Kunitz and Euler 1972).

More pervasive in the literature than disease as a reason for population decimation and movement is the spectre of "enemy peoples" arriving in the northern Southwest (Jett 1964, 1965). Population movements are viewed, not as the result of natural environmental factors, but as the consequence of cultures impinging on one another through increased competition for scarce resources. Warfare and feuding undoubtedly caused some displacement of populations in the Southwest, yet few archaeologists accept the view that large-scale population movements evidenced in the archaeological record are due to the incursion of enemy peoples or internecine warfare (Davis 1965). It makes more sense, as in the case of disease, to posit warfare as one of the results of a disequilibrium between population and resources than to see it as a cause for the disequilibrium.

Methods and techniques

The development of dendrochronologial and dendroclimatological techniques in the late 1920s and early 1930s by A. E. Douglass and archaeological colleagues eventually led to the development of more geographically widespread and more dynamic models of culture change linked to environmental events. The retrodiction of past climate, especially precipitation, as the result of dendro studies not only permitted an evaluation of each year's climate, but, because of the chronological aspect of the method, it permitted archaeologists to relate population movements over large areas to one another and to specific climatic trends. These first efforts in the 1930s, as might be expected, were searches for dramatic climatic shifts which were echoed in major population shifts with a very direct cause-and-effect linkage between environment and population movement. This culminated in delineating events such as the "Great Drought" between A.D. 1276 and 1299, which was supposed to account for a great deal of population movement.

In order to link population movements with environmental factors, there had to be some quantification of population size at specific times, but methods for determining prehistoric populations were in their formative stages. Since sites could be relatively dated by means of their ceramic assemblages and, later, by dendrochronology, early scholars were able to discern that sites of certain periods were much more numerous than sites of other periods. In addition, it was obvious that many localities with evidence of past human occupation were not presently occupied nor did they seem to have been during the Spanish *entradas*. But these observations were vague and imprecise.

Colton (1936) made the first efforts at quantifying population estimates. He estimated the number of sites for an area, the number of rooms for an average site, the number of families per room, and the number of individuals in a family. While he realized the inaccuracy of his figures, he felt that his method could at least demonstrate demographic trends. Colton's method, while crude, is still the basis for most demographic studies in the Southwest.

Although these first attempts to correlate environment with population shifts and site abandonment were characterized by simple particularistic models of the relationships between the two variables, the technique that was used remains unchanged. This method involves developing a population curve and a climate or precipitation curve, by whatever methods; dating the events; and noting correspondences, for example, between increasing population and wetter climatic regimes or between decreasing population and dryer climatic regimes.

MECHANISTIC CULTURAL–ECOLOGICAL EXPLANATIONS

Conceptual models

The term *mechanistic*, as applied to this type of model, is not meant to carry a pejorative connotation. The researchers who used these models saw culture and environment in a holistic, integrated manner, but were often constrained by methods which did not allow them to use very fine-grained scales of observation and analysis, by the use of general ecological principles which were not sufficiently developed for a sophisticated understanding of the natural environment, and by inadequate data. Furthermore, they perceived both culture and the environment as relatively homeostatic with only major change in one or the other causing disequilibrium.

It was Julian Steward who devised a conceptual model of cultural ecology by means of which it became possible to conduct a detailed study of the interplay between culture and environment. Steward was the first modern scholar to apply concrete examples in landmark early studies (1936, 1937) of cultural phenomena to the broader conceptual models of what he called "cultural ecology" (1955). Steward was one of those individuals who was capable of testing large-scale cultural ecological theory through a fine-scale analysis of data, a rare accomplishment even today. Steward's concept of the relationship between environment and culture, especially technology, was important because it assumed the systemic relationship between various aspects of culture. Among his contemporaries, only Leslie White had the same vision. Technology was conditioned by the natural environment, as were sociopolitical institutions and ideology. It was Steward's explorations of the relationship between environment and culture which introduced a new era into archaeological interpretation and has subsequently exerted a profound influence upon the modern generation of archaeologists.

The lure of Steward's, and to a lesser extent White's, concept for the archaeologist springs from several points. In the first place, the very idea

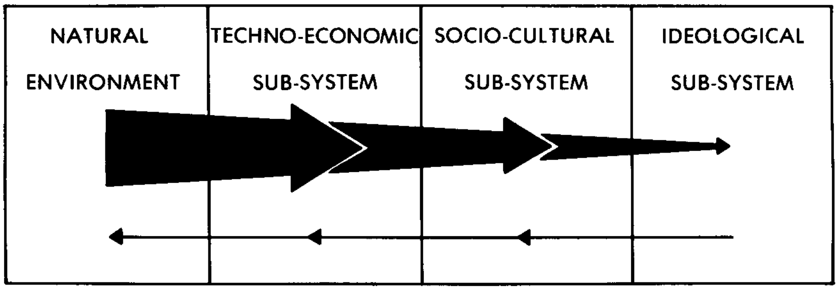

Figure 1.1 Mechanistic model of cultural–environmental relationships. While the subsystems of culture were seen as articulating with one another and with the natural environment, the strengths of the relationships were seen to vary, with the strongest relationships (wide arrows) being the environment and techno-economic subsystem and the weakest (narrow arrows) the natural environment and ideological subsystems. The cultural subsystems were generally seen to have no major influence on one another and on the natural environment (left-pointing arrows), especially the ideological subsystem.

of the interrelatedness of the various aspects of culture rekindled hope among archaeologists that the reconstruction of the nonmaterial aspects of culture could be accomplished. Following the reconstruction of the techno-economic system, according to this view, it should be possible to infer related aspects of a sociological and ideological nature. Secondly, archaeologists tended to feel that the material culture related to subsistence, which Steward stressed, was most plentiful in the archaeological record and also the easiest to interpret. Thirdly, both White and Steward's conceptual models are inextricably linked with cultural evolution. As many scholars have noted since then, evolution provides the theoretical basis for ecological studies (Jochim 1979:78; Kirch 1980). Hence, contemplating White's and Steward's ideas about the primacy of technology and environment, the presumed relative ease of extracting environmental and technological data from the ground, and the coupling of cultural ecology and evolution, archaeologists were having visions of whole extinct cultural systems dance in their heads (Binford 1965; Kushner 1970; Fritz 1972) (Figure 1.1).

Steward was followed by other ethnographers and theoreticians, such as Titiev (1944), Eggan (1950, 1966), Dozier (1970), and Ford (1972), who provided detailed descriptions of the interaction between Puebloan peoples and their environment, as well as models for archaeologists to test.

Demographic conceptual models during this period were usually based on relatively simple schemes, mostly Malthusian in nature, or more recently, based on the schemes promulgated by Boserup (1965; see Zubrow 1975, for a review of anthropological, demographic, and economic models). The number of conflicting hypotheses concerning demographic processes, as well as misinterpretations of these hypotheses, have resulted in confusion rather than clarity. Suffice it to say that the view has prevailed since the 1950s and 1960s that increases in population are a source of culture change and only a small number of archaeologists continue to see culture change as a cause of demographic change.

The single overriding commonality among demographic studies of the mechanistic cultural–ecological model is that they view population and resources as normally being in a state of static equilibrium with only occasional states of disequilibrium. Dean (Chapter 2 below) provides a fuller statement on the role of demography in culture change.

Methods and techniques

Concomitant with the development of conceptual models for formulating an ecological anthropology in the Southwest was the refinement and discovery of techniques for reconstructing paleoclimate, estimating extinct populations, and dating both. Techniques such as radiocarbon dating, palynology, and surficial geology were initially largely divorced from the development of conceptual models. Instead they were most often used to develop local sequences and to sketch in general ways local climate variations. Established variations in climate were used as explanations for culture change when both cultural and climatic changes appeared to be coincident.

Tree-ring studies over the years continued to refine the relationship between ring growth and climate (Fritts 1976), so that many local dating and climate sequences were constructed. Radiocarbon dating complemented dendrochronology, especially for early sites and depositional units which contained no datable artifacts or beams. Palynology became a very important technique for paleoclimate reconstruction, especially when studies were done on a regional basis (Hevly 1964a; Martin 1963;

Schoenwetter and Dittert 1968). Schoenwetter and Dittert's landmark study was a vital step in understanding the linkages between climate and culture, because they made interpretations about culture change not only on the basis of climate and more specifically rainfall, but on the seasonability of the precipitation.

Hack's (1942) study of the surficial geology and hydrology of the Hopi country built on the early pioneering work of Bryan (1925; 1928; 1954) and contemporary work of Bryan (1954) and Antevs (1952; 1955) provided the baseline study in the northern Southwest for using the very recent geology for reconstructing climate. Hack's work also permitted the relative dating of sites found in similar depositional units. In addition, Hack, a geologist, produced in the same volume an excellent exposition of the relationship between environment, technology, and social organization. The Hopi, Hack showed, were able to adapt to a high-risk environment by planting in a great diversity of environmental niches, usually ensuring the successful maturation of crops in at least several of the niches. The strength of Hack's study lies in its use of a relatively fine scale of observation and analysis to address larger questions of adaptation, combined with the use of precise analytical techniques, in this case surficial geology, to test concepts of cultural adaptation.

Each of these techniques, as with dendro studies, was first applied to gross problems, with little knowledge of limitations in methodological applications and interpretations. Later, increasing refinement of the various techniques, coupled with better understanding of their strengths and weaknesses, permitted a more realistic appraisal of the relative value in reconstructing paleoenvironments.

Parallel to the development of these various techniques was the evolution of increasingly refined archaeological techniques, such as finer provenience control, and improved screening and flotation in order to recover proxy data for paleoclimate and demographic trends.

Until the mid-1970s archaeological methods for estimating population were mechanistic and, as I said earlier, assumed that static equilibrium was the normal condition. Estimations of population size from this period were based on cemetery body counts, room and site counts, room size, size of cooking vessels, and amounts of food refuse, among other things. But few archaeologists gave actual population figures for an area; instead, relative figures for different periods were the rule, and for most purposes that sufficed. But mechanistic models also