Explaining Organizational Change:
Anasazi Community Patterns

by

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EXPLAINING ORGANIZATIONAL CHANGE:
ANASAZI COMMUNITY PATTERNS

by Charlotte Louise Benson

To explain organizational change on the northern edge of prehistoric Anasazi occupation, a large block was archaeologically surveyed in southeast Utah. Resulting site distributions are used to interpret community patterns, and explain temporal change. Pueblo sites are grouped into temporal sets based on ceramic variation. Sites are functionally classified, and their activity ranges measured. Relative sedentariness and permanence of settlements is assessed, and the use of the study area found to become increasingly temporary and impermanent after AD 1200. This pattern shift is interpreted not as evidence for social structural change, but of organizational variation and the maintenance of mobility as an adaptive strategy in a fluctuating environment. Social organization and structure are differentiated through a review of work on social complexity in the northern Southwest. An archaeological method for explaining social change is advanced.
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CHAPTER I
INTRODUCTION

Community Patterns and Organizational Change

Interpretations of social organization have played an important role in explaining prehistoric change in the Southwestern United States. The dramatic demographic fluctuations characterizing Anasazi occupation of the Colorado Plateaus can be understood in terms of organizational flexibility. This dissertation attempts to generate such an understanding.

The importance of early efforts in explaining organizational change in the Southwest (e.g., Hill 1970; Longacre 1970) has been obscured by arguments about method, but the theoretical contribution of such workers is even more important today. Social organizational change plays a critical role in the evolution of complex societies, a primary research interest in current archaeology.

Prehistoric Social Organization and Social Structure

Aspects of social organization are reflected in patterns of distribution in the archaeological record. In this study I define social organization as the size, scale, and nature of corporate groups; social structure comprises the relations between groups.
These definitions render social structure and organization intelligible in the archaeological record. Sets of functionally redundant or equivalent groups are considered "egalitarian"; nonredundant or nonequivalent groups are interpreted as nonegalitarian, with equivalence established variously (e.g., Smith 1983:42-43).

Using distributional data generated from fieldwork in southeast Utah, I apply this approach to the analysis of Anasazi community patterns in describing social organization. Inferred aspects of community dynamics are used to explain pattern changes through time.

Contrary to some of the earlier studies of organizational change, social organization as determined by the scale of functional redundancy and group boundaries is a method robust enough to provide descriptions of peripheral and marginal Anasazi adaptations in the same terms as those of the "heartland" areas. The organizational descriptions so generated are used to address questions of social complexity (e.g., hierarchical or nonhierarchical structure), and level of integration, through a procedure grounded in the archaeological record.

Aspects of community dynamics important in explaining organizational change include the degree of population mobility; scale of production unit, consumption unit, and migration unit; population nucleation and dispersion; site permanence; and sedentariness. In this study, the distributions of these variables are related to selective pressures of the Colorado Plateau environment to isolate
the adaptational component of organizational variation.

**Explaining Organizational Change in the Southwestern United States.**

Interpretation of developments in Southwestern prehistory such as the population aggregation of the thirteenth and fourteenth centuries (Martin and Plog 1973), abandonment of the Colorado Plateaus in the twelfth to fifteenth centuries (Lipe 1978; Cordell and Plog 1979), "urbanization" (Martin and Plog 1973), and social organizational variation (Plog 1979), relies on community pattern description.

**Community Patterns**

A distinction between nucleated and dispersed community patterns is a critical component in interpretations of Southwestern culture history. Nucleated communities are those in which all members reside in one settlement. Dispersed communities consist of more than one settlement; they are "multisite" communities (Lightfoot 1979) with scattered distributions (Rice 1975). Both patterns may be sedentary, but they indicate different land use and organizational strategies. Sedentary means the year-round occupation of a settlement, and contrasts with seasonal use. Permanence is a measure of the total duration of site use.
Social Group Boundaries

Like previous workers, I assume that nonrandom distributions of sites reflect organizational behavior. Intersite patterning may have underlying generative processes of an economic, political, religious, or other character, but all contemporaneous patterns represent social interaction with boundaries that are variously accessible in the archaeological record. Community patterns thus reflect social group boundaries at some scale.

Archaeologists have most commonly recognized social group boundaries at the scale of the household (e.g., Wilk and Rathje 1982), domestic unit (Fuller 1981), socioeconomic unit (Rohn 1965), habitation unit (Steward 1955; Aikens 1966), or coresidence group (Lipe, 1970). This appears to be the minimal group that can be isolated in material remains. More inclusive social groupings, such as the courtyard unit (Flannery and Winter 1976), corporate group (Haas and Cannon 1982), and courtyard complex (Dean 1969) are predicated on these minimal units.

Methods for Determining Social Group Boundaries

Determining social group boundaries has a long history in the Southwest, and numerous methods and techniques have been used, including architectural analysis (Prudden 1903, 1914; Brew 1946; Rohn 1965; Wilcox 1975, 1982; Hayes and

**Contemporaneity and Redundancy**

Determinations of the boundaries of social groups use different lines of evidence in varying combinations. However, they share the strategy of first establishing contemporaneity (to various degrees of resolution), and then establishing functional redundancy (usually through the interpretation of pueblo room use, or other morphological characteristics). Such studies share certain limitations. Most are intrasite analyses restricted to single-settlement communities, and reflect nucleated patterns or parts of dispersed multisite patterns. The architectural studies require standing walls, preferably with preserved construction wood. These conditions are usually satisfied only in sheltered locations, or through excavation (Dean 1970:170). Adams' (1983) method, for example, does not require new excavation, but does require a large multi-story pueblo with good documentation of its initial investigation.
The Owl Creek Community Pattern Study

Sites that meet the requirements outlined above represent only a fragment of the archaeological record of the northern Southwest. An unquantifiably biased picture of community pattern change is derived when such studies are used as the basis for generalization. Can the scale of redundant units and social group boundaries be defined in the absence of these conditions? The Owl Creek study reported here was designed to describe community patterns and explain organizational change on the basis of the surface remains of small sites without standing architecture or datable beams. The strategy used is similar to that applied in other circumstances, but methods necessarily differ. Contemporaneity of sites was established on the basis of dated ceramic types, and functional redundancy based on site classification. Contemporaneous patterns of site distributions were compared, and pattern changes interpreted in organizational terms.

Of previous community pattern analyses, the settlement plan studies (Chang 1958; Vivian 1970; Grebinger 1973; Upham 1982), Tuggle's Grasshopper survey (1970), and Lipe's (1967, 1970) delineation of site clusters representing dispersed communities, address intersite patterning with organizational referents. The Owl Creek project thus shares the goals and interpretive structure of those studies, although the methods and techniques employed differ.
An Evolutionary Archaeological View of Organizational Change

Anasazi Culture History

The Owl Creek study area is located on Cedar Mesa in southeast Utah, an area occupied prehistorically by the Anasazi (Figure 1). Anasazi culture history has recently been thoroughly summarized by Plog (1979) for the western Anasazi, and by Cordell (1979) for the eastern Anasazi (Figure 2). Anasazi history reflects widespread similarities early in the sequence, with later emergence of regional traditions (e.g., Mesa Verde, Chaco, Kayenta). In spite of problems in the application of the Pecos classification (Hill 1970:53), the terminology is useful in providing a synoptic view of the northern Southwest.

Basketmaker II (approximately AD 1-400) is followed by Basketmaker III (approximately AD 400-700). Pueblo I, Pueblo II, and Pueblo III cover the eighth through the thirteenth centuries. The Pueblo period sites located in the Owl Creek study area (Figure 3) provide the data for the community pattern analysis described below.

The breaks between stages in this chronology do not represent historical discontinuity; in fact, the variation within periods sometimes exceeds that between periods. For example, Basketmaker III is more similar to Pueblo I in many respects than it is to Basketmaker II. There are more distinct differences between Early
Figure 1. Location of the Owl Creek study area on Cedar Mesa, southeast Utah.
Figure 2. Four Corners area showing maximum distribution of Anasazi sites, and locations discussed in the text.
Pueblo II and Late Pueblo II than between Late Pueblo II and Pueblo III. And, of course, change did not proceed at a uniform rate across the Anasazi area. Nor was it uniform between the variables describing each period. Although this periodization thus reflects more about the history of archaeology than about the character of prehistoric change, the Basketmaker-Pueblo sequence is useful at the grossest level of analysis (Chapter 3).

The Nature of Change

A chronology of static units like the Pecos sequence reflects a transformational view of change. Constellations of traits are seen as changing as a unit. Such a conception is useful at early stages in a field of inquiry, when the range of variation is not known. Archaeologists, however, are now aware of the range of variation in their data, and able to (empirically) to employ a more productive view of change.

In addition to the problems with a transformational view that Plog (1974) has pointed out (e.g., all the change that archaeologists want to observe is compressed into the lines between phases), there is a fundamental conceptual change required. Recognizing a wide range of variation within "Anasazi" requires that we view change as attribute varying (not necessarily in concert) through time, each with frequency distributions that can be charted from the archaeological record. Change inheres in the monitored frequencies, unlike changes that archaeologists create by making phases.
A selectionist view of change shows promise in explaining the development of social complexity, an enterprise in which the transformational view of change is bankrupt. Cultural evolutionary stage schemes are inappropriate when the range of variation is known, and social change remains to be explained. The analysis of organizational change based on community patterns described here demonstrates the utility of evolutionary explanation in archaeology.

**Owl Creek Analysis**

I conducted the survey of a large contiguous area in the Owl Creek uplands of northeastern Cedar Mesa, to describe community patterns and interpret the organizational change assumed to be reflected in community patterning.

In the following chapter, the Cedar Mesa environment is described, and a model of adaptation based on probable selective factors is generated. The agricultural potential of the mesa is assessed, and Anasazi settlement patterns are described on the basis of Lipe and Matson's (1970-1975) survey. The relative success of the Anasazi adaptation, as reconstructed from the Cedar Mesa study and from archaeological work in adjacent areas, is evaluated.

In Chapter 3, regional-scale surveys in the Anasazi area are discussed, and that of Cedar Mesa (Matson and Lipe 1978) is reviewed.
Figure 3. Distribution of Pueblo sites in the Owl Creek study area.
in detail. The goals and methods of the Owl Creek study, and its development from the Cedar Mesa Project, are described. A distinction is made between locational and distributional data. Owl Creek site distributions (Basketmaker II, Basketmaker III, Pueblo) are described, and their differences related to varying adaptations.

In Chapter 4, the Pueblo period site distribution is divided into contemporaneous sets, using tree-ring dated ceramic types and seriation. Nine temporal sets were isolated by these methods.

Chapter 5 presents a functional classification of Owl Creek sites, and the rationale for the classification. The utility of the four types is assessed through the application of a Range Activities Measure. Different activity ranges are shown to characterize the different site types. These data are used in interpreting the relative sedentariness of sites. Ceramic/lithic ratios and painted/utilitarian ware ratios reflect temporal variability. Site size is analyzed to aid in community pattern interpretation.

Chapter 6 discusses mobility in Owl Creek populations. Relative sedentariness is assessed. Sedentary/temporary site ratios demonstrate increasingly temporary use of the Owl Creek upland through time. Permanence of sites is assessed, and ceramic repair incidence analyzed. The maintenance activity reflected in ceramic repair is discontinued after AD 1200, perhaps reflecting shorter site occupations.

In Chapter 7, the distributions of types of sites are
presented in temporal sets. Owl Creek sites are interpreted in functional terms, and community patterns are described. The abandonment sequence of the Owl Creek upland is presented. A decrease in sedentary use of the study area after AD 1200 is demonstrated by changes in community patterns. The nature of the change, and the importance of mobility in Anasazi adaptations, are explored. Implications of mobility for social organization are derived.

In Chapter 8 a distinction is drawn between social organization and social structure in order to explain Anasazi community pattern change. Interpretations of social structure and social complexity by other investigators in the northern Southwest are reviewed, and their explanatory potential evaluated. This analysis demonstrates how the interpretation of social organization is logically prior to the reconstruction of social structure, and how organizational change can be inferred from community patterns. I find that the analysis of local sequences like the Owl Creek record is critical to the evolutionary explanation of cultural change.

Chapter 9 contains a theoretical, and partly speculative, account of the development of social complexity from the perspective of organizational change. In specifying the conditions under which functional differentiation arises, I show why such development did not occur among the Anasazi.
CHAPTER II
THE ADAPTATIONAL COMPONENT OF ORGANIZATIONAL CHANGE

Introduction

Given the low annual rainfall, its unpredictability, and the particular topographic and edaphic conditions that obtain on the Colorado Plateau, the combinations of circumstances favorable to agriculture are local and transitory. There is no reason to suppose this was qualitatively different in the recent past. Therefore, to the extent the Anasazi depended on agriculture, these conditions must have played an important role in population distributions. Anasazi occupation of the Colorado Plateau implies the existence of strategies that accommodated the local and fluctuating character of plateau agricultural conditions.

In this study, environmental characteristics of the Colorado Plateau in general and Cedar Mesa in particular are viewed as possible selective pressures acting on behavioral variability to produce the adaptations of Anasazi groups represented in the archaeological record.

Analysis of the Owl Creek environment leads to the conclusion that mobility was an important component of Anasazi adaptation. The spotty rainfall distribution contributes to population dispersion. The susceptibility of soils to accelerated erosion leads to short-term land use, and consequent high logistic as well as residential mobility. Slow recovery rates of the mesa soils limit reoccupation. Organizational variation reflects the constraints imposed by these and other plateau environmental conditions.
Environment

Climate

The climate of the Colorado Plateau is characterized as semiarid, with 250-500 mm (10-20 inches) average annual precipitation. A bimodal rainfall pattern results from Pacific cyclonic fronts in winter, and Gulf of Mexico convective storms in summer. Evapotranspiration generally exceeds annual precipitation (Gregory 1938).

The southern Utah low pressure system, which follows the winter fronts, produces widespread rain with less topographic variability (Gifford et al. 1967). The low is usually followed by a spring drought which magnifies the importance of residual winter soil moisture. While 30 to 40% of the average annual precipitation may fall during the May to September growing season, most of the year's rain falls in late summer, high energy storms. Such storms result in rapid runoff and high evaporation with little potential for water retention. These localized rains with variable intensity, frequency, and extent are modified by individual catchment characteristics, and contribute to accelerated erosion on disturbed surfaces (Thornthwaite et al. 1942; Price 1956).

The dissected peneplain of the Colorado Plateau provides evidence of water and wind erosion. The angular landscape is the
product of cliff-forming sandstones; structural deformation is a minor component.

Physiography

Cedar Mesa is a remnant of permeable Permian sandstone, tilting southwest from Elk Ridge toward the San Juan River (Figure 4). Its elevation varies from 2119 meters (6950 feet) at the north end to 1902 m. (6240 feet) in the south. The mesa's eastern and western edges are defined by the 1707 m. (5600 feet) contour, and the south edge by an 800 foot escarpment, below which lie the deeply incised meanders of the San Juan River known as the Goosenecks.

The axis of the Monument Upwarp provides the mesa's north-south central divide, approximated by Utah highway 162 (Figure 4). Rolling eolian ridges cover the mesa's top, and are deepest on the divide. Canyons draining the east side of Cedar Mesa flow into the San Juan River through Comb Wash, and the more deeply entrenched western canyons drain directly into the San Juan. Grand Gulch is the master canyon on the west.

Water

Springs and seeps are found in the canyons at the contact between the Cedar Mesa sandstone of the Cutler formation and the Halgaito shale. There is no permanent water on the mesa top, although bedrock depressions sometimes hold water for days or weeks.
after a rain. The San Juan River is the nearest "permanent" stream, but is not accessible from the mesa. Precipitation averages 254 mm on the south end of the mesa and 300-325 mm on the north, with departures from the means of 30-40% (Trewartha 1954).

Soils

Like Colorado Plateau soils in general, Cedar Mesa soils are the brown and red-brown pedocals of semiarid regions. Cedar Mesa soils belong to the Monticello and Blanding series, and are uniformly low in organic content (Olsen et al. 1966). The eolian upland loams are well-drained and moderately retentive of soil moisture. While the calcium carbonate content of the soils varies, a caliche zone 30 to 46 cm. below the surface is characteristic. This deposit inhibits infiltration and root development (Olsen et al. 1966). The soils become blocky when dry. The residual soils of the mesa top (red-brown loams) reach a depth of 3 meters on the divide, and thin to exposed bedrock toward the east and west mesa edges.

Alluvium has been deposited in some drainage heads, and in canyon bottoms. There are distinct terraces in Kane Gulch and in Grand Gulch, where episodes of aggradation and cutting are evident (Agenbroad 1975). Basketmaker III through Pueblo III materials are found on and in the upper levels of T2, the upper terrace, which apparently was stable or aggrading during the entire time of span of Anasazi occupation. No archaeological
materials are found on the more recent T1 and T0. The T2 terrace was cut near the end of Pueblo III occupation, and the T1 and T0 terraces post-date Anasazi times and reflect the recent erosional episode that probably began in the 1880s (Agenbroad 1975).

Vegetation

Like similar elevations in the plateau region, much of the mesa top supports a pinyon-juniper woodland of varying density with interspersed sagebrush and grasses. The soil surface between trees is covered by a cryptogamic crust (mostly lichens) which slows runoff and aids infiltration (Loope and Gifford 1972). A delicate balance is maintained between soil, vegetative cover, and precipitation (Henderson, 1979). Cedar Mesa's pinyon-juniper woodland (Pinus edulis and Juniperus osteosperma) varies in composition and density with elevation, ranging from 128 trees per hectare in the southwest to 485 trees/hectare in the north (West 1978:33). Density in the Owl Creek study area averages 400-450 trees/hectare with an understory of silver buffaloberry (Shepherdia rotundifolia). Pinyon numbers increase at higher elevations, and junipers are more numerous at lower ones. Both are denser on deeper soils. Sagebrush parks (Artemesia tridentata) are found at drainage heads and in areas of the deep soil divide without a well-developed calcrete layer. The latter has encouraged speculation about farming use of these areas by the
Anasazi; sage flats are thought by some to indicate prehistoric field locations. It does appear that sagebrush rapidly colonizes cleared areas, followed by pinyon-juniper encroachment onto the sageflats (West 1978:39). The occurrence of sagebrush in more mesic pockets has been demonstrated for the eastern Grand Canyon (Cole 1982). Mesa top sage flats may thus have been important to farmers dependent on limited local water.

Historically, fire has maintained park openings in the pinyon-juniper woodland. The grasses associated with sage parks on Cedar Mesa include Oryzopsis (Indian ricegrass), Poa, Hilaria, and Agropyron. The long-term pattern of pinyon-juniper succession described by West (1978) suggests that cleared areas could have been reused with less energy expenditure than that required in initial clearing. This implies slow removal of the woodland by groups practicing agriculture, although firewood and construction needs would also contribute to increase the rate of tree cutting.

Growing Season

The number of days between last and first frosts averages 129 on the north end of Cedar Mesa and 144 at the south end (West 1978:20). There is considerable variability from year to year, and spring and fall frosts are common. The balance between adequate soil moisture for germination and susceptibility of plants to soil frost is delicate. Planting and harvesting times must be carefully fit
between last and first frosts. The maturation time for Hopi maze has been calculated at 120 days (Hack 1942) and 115-130 days (Bradfield 1971).

Climate records from the weather station nearest the study area, Natural Bridges National Monument, document the frequency of adequate growing seasons. Natural Bridges is located on northwest Cedar Mesa at an elevation of 1981 m (6500 feet), the same elevation as the Owl Creek block. The growing season ranged from 110 days in 1974, when total precipitation was 219 mm (8.63 inches), to 163 days in 1976, when rainfall was 208 mm (8.17 inches). In spite of the long 1976 growing season, precipitation was probably inadequate for corn growth. An anomalously high rainfall in 1969, 502 mm (19.8 inches), coincided with a long growing season (160 days), but in general the length of the growing season and amount of precipitation are not strongly correlated (West 1978:20).

Past Environment

The vegetational history of Cedar Mesa and the model of pinyon-juniper succession advanced by West (1978) indicate no significant climatic change and no greater variation over the last 2000 years than the present. Botanists who have investigated Colorado Plateau pollen records are generally in agreement with this interpretation (West 1978:89). Dendroclimatological evidence from Mesa Verde shows no major climatic changes, although numerous droughts are recorded
from the time of Anasazi occupation (Fritts et al. 1965). The weight of the evidence on plateau climate suggests an irregular oscillating pattern with wide variation around the mean, but no short-term periodicity and no long-term trend.

West pointed out that the pinyon-juniper succession could be forestalled by such processes as burning, clearing, or continuous occupational disturbance, and that the annual stage would be maintained as long as the altered soil composition favoring particular species continued (see also Yarnell 1965:668-669). He concluded that

Although climatic shifts and edaphic variables require consideration, the importance of the overall successional pattern is greater, in the time period covered, than the influence of either of these factors. (West 1978:92)

Pollen profiles from archaeological contexts on Cedar Mesa indicate vegetational disturbances followed by succession and are interpreted as evidence for agricultural clearing and wood gathering. Adding this to the fact that woodland recovery takes 250-300 years (Wyckoff 1977), West concluded that even small Anasazi groups had a significant impact on mesa vegetation, and that these effects were probably much greater than any caused by climatic variation (West 1978:124-125). West identified pollen of *Zea*, cucurbits, Cactaceae (opuntia), *Cleome*, graminae, ephedra, and cheno-ams in archaeological contexts. He related high cheno-am and grass pollen to deforestation associated with farm clearance, and high low-spine Compositae with various kinds of anthropogenic disturbance (West 1978). Recent
vegetational changes can be accounted for by historic use of the mesa top. Pollen analyses in other areas of the Colorado plateau have been interpreted as evidence for shifts in rainfall patterns (Schoenwetter 1962, 1970; Hevly 1968).

**Adaptation**

In considering northern Anasazi adaptations no assumption of agricultural dependence is made, but the environmental characteristics relevant to subsistence systems in general are examined. A model of Anasazi adaptation is generated based on the Colorado Plateau environment and probable selective factors.

**Agricultural Potential**

Rainfall biseasonality is important to plateau agricultural potential. Winter rains infiltrate and replenish the soil moisture necessary for germination in the spring. The summer rainfall required for maturation falls in torrential local showers which result primarily in runoff. Rose and others (1981) have shown dendroclimatologically that most of the annual rainfall variability (in the Santa Fe area) can be attributed to the variation in spring precipitation.
The high amplitude, high frequency fluctuations of the plateau environment suggest that risk minimization strategies would be more effective than "optimizing" ones (cf. Christenson 1982). Anasazi adaptations have been interpreted as strategies for damping oscillations through storage (Jorde 1977), maintenance of ties for exchange or migration outlets (Braun and S. Plog 1982), and population redistribution (Jochim 1981). Implications of these strategies are considered below.

Given the relationships between elevation, precipitation, and temperature, local physiography becomes critical to agricultural potential. Floodwater farming requires wide undissected valleys and/or sandy soil for groundwater storage. Diversion irrigation requires permanent surface water. These conditions are not met on Cedar Mesa. Crops other than pinto beans (*Phaseolus* spp.) have not been grown on the mesa in historic times. The mesa top is unsuitable for farming today (Olsen et al. 1962). Lipe's (Lipe and Matson 1971, 1974) maize growing experiments resulted in poor yields, but convinced him that with more expertise (or luck) a subsistence yield would be possible. One feature of Lipe's experiments was a demonstration of the necessity for human presence at fields during the growing season to discourage rabbit and other animal depredation.

Dry farming subjects the mesa top to accelerated erosion and soil loss with removal of the natural vegetational cover (e.g., Branson et al. 1981; Butzer 1974; Cannell and Weeks 1979; Cooley
1962; Lawton and Wilke 1979). These effects are compounded by planting on slopes (Kirkby 1969), and little of the mesa top is flat. Floodwater and akchin farming are subject to erosion, arroyo-cutting, and downstream sedimentation (e.g., Bryan 1929; Cooke and Reeves 1976; Bailey 1935; Goudie 1981). Runoff farming is subject to channelization and slope wash (Gifford 1973; Evenari et al. 1968). The duration of agricultural use of this landscape is limited by natural processes, and varies with the strategy and technology used. To the extent that prehistoric farmers could minimize these problems, a farming strategy in a particular local might have short-term success. The potential for long-term success is low due to the irreversible nature of the geomorphic and hydrologic changes accompanying ground disturbance. Techniques such as terracing, known to the Anasazi, might be effective in controlling slope wash for a time, and checkdams could make use of channelized runoff, but these are only temporarily effective short-term solutions (see Woosley 1980).

The mesa top eolian ridges are susceptible to wind and water erosion with removal of vegetation cover and/or the microfloral surface crust. Soil formation is so slow that soil loss is considered irreversible (Olsen et al. 1962; Witkamp 1971); infiltration so affected by disturbance of the cryptogams that the soil must be considered a fragile non-renewable resource (Gifford and
Shaw 1973; Henderson 1979). An additional factor in the low recovery rate of plateau soils is that juniper, the most opportunistic plant in the native vegetational spectrum, rapidly produces a needle litter which excludes vegetation that might contribute to soil productivity (Branson et al. 1981).

The lichens in the microfloral surface crust are often the only nitrogen-fixing plants available to plateau soils. Their removal, in addition to the nitrogen-using properties of maize, would result in rapid nitrogen depletion. With no means of restoring nitrogen to the soil, fields will have a short use-life.

We can also predict that high labor requirements and associated trampling would contribute to erosion. Rapid chemical depletion of the soil combined with increased susceptibility to wind and water erosion would require frequent change in field locations, with obvious implications for settlement pattern changes and population mobility. The changing potentials of specific field locations are irregular and unpredictable, leading often to unanticipated shortages. In this context, the value of mobility and migration options are readily appreciated.

Environmental analysis leads to the conclusion that short-term oscillations are more important to Anasazi adaptations than any long-term environmental changes (see Cordell 1980). In addition, based on the foregoing, reliance on agriculture is not an effective risk minimizing strategy on the plateau. We would expect a more
generalized subsistence system to be selected for, e.g., horticulture-hunting-gathering (Powell 1983). We certainly would not expect intensification of agriculture based on maximizing yield or other variables. Additionally, there is no practical means of intensifying agriculture on Cedar Mesa. Since no fertilization or renewal measures were available, the only alternatives available to the Anasazi included abandonment of depauperate soils and clearing of new fields. Fallow of varying lengths could be practiced, but it is doubtful that field sites would become productive again during Anasazi occupation. I assume that abandonment occurred at a point in the use-life of each field when declining productivity reached unacceptable levels. Given these conditions, intensification is futile (West 1798:21). Short-term field use with attendant mobility or community pattern change is more likely. Powell (1983) has demonstrated the seasonal nature of many Anasazi sites on nearby northern Black Mesa, as well as the diversity of their subsistence.

If the temporal and spatial variability of the plateau environment selects for a high degree of mobility, we would expect to find evidence in the Owl Creek record of more frequent population movement than is commonly assumed for the "sedentary farmer" of the Southwest. We would expect more impermanent settlements than those in other situations, e.g., along the Rio Grande River. In addition, we would expect population movements to reflect fluctuations in such factors as precipitation and temperature. Jennings presented
this model:

If the Pueblo can be seen as subsistence gardeners representing a culture whose limits were closely geared to some minimal rainfall line, if we can see the Pueblo as expanding and contracting territorially in almost annual response to climatic/rainfall conditions,...then perhaps we can understand its survival and better understand its details.
(Jennings 1963:12-13)

Jennings' model implies a distinction analogous to that between sensitive and complacent tree rings; Anasazi movements record Colorado Plateau resource productivity with varying fidelity. From the risk minimization view, degree of mobility reflects resource reliability. With hindsight, it seems clear that a specialized agricultural subsistence system could not be maintained over the whole of the twelfth century range, and that such an adaptation could only have had limited short-term success.

Some researchers have considered that the fluctuating nature of the plateau environment is reflected not only in settlement patterns but in the nature and structure of cultural distributions, particularly community patterns. This view is expressed in Lipe's recognition that "small size and transient quality of Klethla occupation were as expected for people who were semi-sedentary over most of their range" (Lipe 1967: 287-288). In this case, Anasazi of the Red Rock Plateau were inferred to have had a pattern of high residential mobility. Other Anasazi groups have been interpreted as evidencing high logistic mobility (e.g., Powell 1983).

If an extensive and mobile agricultural system were selected for by the environmental characteristics discussed above, we would
predict that small and dispersed groups provide the most efficient subsistence organization. Where resources are neither reliable nor abundant we would not expect to find investment in field locations or land ownership (e.g., Matson 1983:138). Investment in field locations, interpreted as "intensive land use" (e.g., Upham et al. 1981:822), reflects 1) more permanent use of fields than where there are no "improvements" and/or 2) use of different agricultural methods. Such investment may reflect more reliability than is indicated for fields where no capital improvements are made.

There are few examples of agricultural facilities investment in the Cedar Mesa area. Beaver Creek (Lindsay 1961), and Creeping Dune (Sharrock and others 1961) in the Glen Canyon project area may be examples of cooperative labor investment in water diversion and storage, and check dams are found north of Cedar Mesa on Horse Flat (Brooks 1974). There are no water or soil control structures on Cedar Mesa itself. The agricultural investment in this part of the Colorado plateau apparently took the form of labor during the growing season (including the summer rains) in temporary fields rather than capital investment in facilities and permanent fields.

**Cedar Mesa Settlement Patterns**

Matson and Lipe (1978) found that Basketmaker III (AD 400-700) sites are concentrated at the northern end of Cedar Mesa in deep soil areas. Pueblo II-III sites (AD 900-1300) show similar clustering,
but have a broader distribution over the mesa. Canyon locations are used more commonly in later Pueblo III times, but were never as important to settlers as was the mesa top. Observed pattern changes are interpreted in terms of varying agricultural practices, and the sequence of occupations and abandonments are said to reflect climatic variation (Matson and Lipe 1978).

The effective moisture gradient on Cedar Mesa runs northeast to southwest, and is reflected in vegetation. Pinyon-juniper woodland with sage parks covers the northeast mesa, and thins to the southwest where blackbrush is dominant in lower and drier areas. Anasazi movements (occupation and abandonment, reoccupation) apparently proceeded along this gradient, the southwest being occupied in wetter and occupation limited to the northeast in drier times. The mesa is so agriculturally marginal that population movements are interpreted as direct reflections of change in the maize niche (Matson and Lipe 1978). Occupation of southwestern Cedar Mesa reflects the maximal agricultural use of the mesa, and such use is ephemeral. This is evident in a comparison of Lipe and Matson's samples: in the North Road drainage on northeastern Cedar Mesa, the site density is 31 sites/km², and the southwestern-most unit (Hardscrabble) has only 12 sites/km². North Road has 15 Pueblo period sites per km² compared to 3.5 sites in Hardscrabble. Sixty-six percent of Hardscrabble sites are Basketmaker II (interpreted as non-agricultural) and 29% are Pueblo. Forty percent of North Road sites are Basketmaker II and 51%
Figure 4. Location of the Owl Creek block survey in relation to Lipe and Matson's sampled drainages.
are Pueblo (Camilli 1975). The distribution of Basketmaker II sites is not thought to be as sensitive to the effective moisture gradient as is that of Pueblo sites, since their locations are contingent on factors other than farming opportunities (Matson and Lipe 1978).

The Basketmaker II (100 BC-AD 400) settlement pattern contrasts with later patterns in that BMII site locations reflect broader niche requirements. Basketmaker III and Pueblo sites are thought to be located with respect to arable land, and occupation mimics fluctuating agricultural potential. Lipe and Matson suggest that while arable soils are more abundant on the mesa top, farming is easier on canyon bottom lands. Improvement of cultigens, farming techniques, and storage facilities are cited as responsible for opening the mesa top niche (Matson and Lipe 1978:5). Assuming the necessity of runoff watering, Lipe and Matson term the inferred strategy "small watershed floodwater farming" (Matson and Lipe 1978). Given the localization of growing season storms, this method is subject to the same risks as dry farming, and has more stringent requirements in field placement and possibly labor.

Pueblo III (AD 1100-1300) groups on Cedar Mesa farmed in the canyon bottoms and on the mesa top, employing different agricultural strategies. The distribution of canyon sites is not as sensitive to the effective moisture gradient as are mesa top sites, since canyons contain permanent water and exhibit a more stable soil-water-vegetation balance (West 1978). Although Lipe was unable to positively correlate the extent of alluvium in canyon bottoms with
intensity of occupation (Lipe and Matson 1975:70), increased use of the canyons may be an indicator of changes in environmental conditions.

Success of Adaptation

Population Curves

Population changes through time in Anasazi areas, as measured by number of sites or pueblo rooms, describe a characteristic curve—one of increasing population followed by an abrupt decline from the peak of the curve to zero (Martin and Plog 1973:320, Table 15; Dean 1969:192). The curves are smooth and monotonic at the level of resolution usually achieved. However, maximum population numbers were reached at different times in different areas. For example, the height of Chaco Canyon occupation occurred almost two centuries before that of the Mesa Verde or Kayenta regions, with the Canyon de Chelly peak midway between these extremes (AD 1200). All of the curves describe an increase of varying slope followed by abrupt population loss beginning at the height of the curve. Such a curve is reminiscent of the ecological curve describing exponential overshoot followed by a population crash. Such patterns are explained as populations exceeding an area's resource potential (e.g., Margalef 1968; Pianka 1974). Abandonment of some parts of the Southwest by prehistoric populations has been similarly explained
(e.g., Lipe 1978 and references therein).

**Health of Anasazi Populations**

Paleopathological and demographic studies have suggested that Anasazi populations suffered from a variety of problems related to poor nutrition. Brew's (1946:328) analysis of Alkali Ridge skeletons showed a high incidence of premature osteoporosis attributed to malnutrition and probable vitamin deficiencies. He also found periostitis, arthritis, violent deaths, and high incidence of a usually rare hereditary skeletal anomaly. The latter was attributed to inbreeding (Brew 1946:329).


Other pathological indicators of nutritional deficiencies include periosteal infection, Harris lines, and enamel hypoplasia in Black Mesa individuals (Huss-Ashmore et al. 1982). The Black Mesa burial population is described as subject to "chronic and constant nutritional stress that increased through time" (Powell 1983:135). Huss-Ashmore and others (1982:416-417) show how a maize-rich diet can result in these conditions.

If the health of Anasazi populations deteriorated through time, a narrowing subsistence base and increasing reliance on maize may be implicated. The extent to which this trend characterizes Anasazi groups in different areas is unknown.
Modern Pueblos

While Anasazi adaptations have been viewed as "only marginally successful" (Powell 1983:135) and as a failed experiment in drylands agriculture (F. Plog 1978), their descendants survive in the modern Pueblos. The occupation of the Colorado Plateau was a short-term range expansion which could not and did not persist; selected features of the highly variable Anasazi adaptations, such as the extensive farming strategy of the Hopi (Hack 1942; Bradfield 1971) and pueblo structures, did.
CHAPTER III

OWL CREEK, SOUTHEAST UTAH

Locational and Distributional Data

It is necessary to distinguish between locational and distributional data because their uses and interpretations differ. Locational data include specific site locations relative to environmental features; distributions include site locations relative to each other in some designated space.

Settlement patterns (site locations relative to environmental characteristics) are often inferred from regional sampling programs, using small units or low sampling intensities. Intersite patterns (distributions) and relationships between sites cannot be derived from the same kind of data. Interpolation between samples cannot provide the distributional structure required for community pattern definition.

A study of intersite spatial structure requires complete coverage of a large contiguous area containing enough redundancy for pattern recognition, and enough variability for temporal resolution.

The data requirements of the Owl Creek study thus dictate the survey of a large contiguous area within which all cultural material is recorded. The block must be large enough to contain at least one multisite community for community pattern interpretation. With such a frequency array of spatially disposed data, the Pueblo period sites
located in the Owl Creek block (Figure 3) are examined to describe community patterns, identify structural relationships, and interpret pattern changes. Contemporaneity of the 67 Pueblo sites is first established (Chapter 4), and intersite variability is examined (Chapter 5). The site configurations that provide the basis for community pattern interpretation are generated by combining the chronological and site type analyses.

Regional Surveys

The Owl Creek community pattern analysis presented here was based on a study developed from the Cedar Mesa Project (1971-1975) directed by W.D. Lipe and R.G. Matson. Like many of the Southwest regional scale settlement pattern projects of the 1970s, the Cedar Mesa Project (CMP) was designed to acquire settlement pattern data economically by means of a tightly formulated sampling scheme (Matson and Lipe 1975). Why prehistoric populations located sites where we find them was the primary research question (Matson and Lipe 1978:1). Lipe and Matson's strategy produced site locations and environmental data which permitted the inference of changes in settlement location through time, and their explanation in subsistence and land use terms. The results are consistent with those derived in other areas by the Southwestern Anthropological Research Group (SARG), addressing the same question and recording similar kinds of information (e.g., Euler and Gumerman 1978).
In addition to substantive contributions in various areas, SARG participants made contributions to method. The amount of spatial and temporal variability in just the northern Southwest was staggering, and often could not be adequately addressed through standardized recordkeeping (Dean 1978; Sullivan and Schiffer 1978), or generalized across time and space (Cordell and Plog 1979). It became clear that while probabilistic sampling schemes employing small units spread thinly over large areas were adequate predictors of site type/environmental relations, they did not provide distributional information or intersite patterning (e.g., Cowgill 1975:266).

The distinction between locational data and distributional data at a regional scale is the difference between settlement pattern interpretation (relationships between sites and the environment) and community pattern interpretation (relationships between contemporaneous settlements). Community pattern, as a spatial arrangement of sites, requires larger sampling units or sampling at a much higher intensity than does settlement pattern description (cf., Jermann and Dunnell 1979; Jermann 1981). In some parts of the Southwest, larger sampling units (blocks) have been surveyed to augment the kind of information generally produced in regional sampling programs (Plog 1976; Dean, Lindsay and Robinson 1978). Large-scale intersite patterns can be derived from such block surveys.
Cedar Mesa Survey

Lipe and Matson sampled the Cedar Mesa universe by dividing it into 20 drainages treated as clusters, and surveying 7% (randomly selected) quadrats of 400 meters/side in 25% of the clusters (Matson and Lipe 1975). This design generated locational data from which settlement patterns were inferred (Matson and Lipe 1978). For community pattern analysis, I designed the survey of a large contiguous area of Cedar Mesa. The arbitrarily bounded block was placed in the Owl Creek watershed northeast of the sampled part of the mesa (Figure 4). This location is little-disturbed, physiographically varied (although less so than the Cedar Mesa samples because it excludes deeply entrenched canyon). Because it is within the Cedar Mesa study area, Lipe and Matson's predictions can be used as hypotheses.

Owl Creek Distributions

A crew of five to eight spaced three meters apart surveyed the eight-kilometer block. All cultural material was located on aerial photographs, as were survey units and water sources. Pueblo sites, identified by the presence of ceramics other than grayware, were mapped and partially collected. Collection areas were stratified on the basis of surface remains, and sherds and lithics collected in two meter units within strata. A few very small clusters were totally
collected, but most assemblages comprise a small fraction of the surface material.

Of the 308 prehistoric sites located in the block (Figure 5), 71 are Basketmaker II, 110 are Basketmaker III, 67 are Pueblo, and 60 are Unknown. The Unknown sites have no temporal assignment, and represent a functionally distinct class. They lack ceramics, and often lack structures, precluding dating.

The coincidence of Basketmaker III and Pueblo site distributions (Figures 7, 8) indicates similar site location criteria. The Basketmaker II sites display an almost perfect complementary distribution to the later sites (Figure 6), and represent different locational factors. The Unknown class has a different distribution (Figure 9), reflecting different generative processes.

The Owl Creek block was partitioned into quadrats to compare site populations with Lipe and Matson's sample estimates (Matson and Lipe 1975a). The only departure from Lipe and Matson's predictions was the Basketmaker III class; these sites were much more numerous in the block than predicted for the mesa. Lipe and Matson had hypothesized that Basketmaker III sites should be located on the deep soil areas of the mesa top, particularly on the divides, where dry farming is most practicable. Thus Basketmaker III sites should be concentrated in the northern sector of the mesa where agricultural potential is highest (Matson and Lipe 1975b). These locational hypotheses were supported in the CMP quadrat survey results, although
Figure 5. Locations of all sites in the Owl Creek block.
Figure 6. Distribution of Basketmaker II sites in the Owl Creek block (grid size = 400 m/side).
Figure 7. Distribution of Basketmaker III sites in the Owl Creek block.
Figure 8. Distribution of Pueblo sites in the Owl Creek block.
Figure 9. Distribution of temporally unassigned ("Unknown") sites in the Owl Creek block.
the sample size of Basketmaker III sites was very low. Only 35 (13%) of 270 sites found in that survey had a Basketmaker III component.

In the Owl Creek block, 95 of 243 sites (39%) are exclusively Basketmaker III. This figure does not include Basketmaker III sites with a later Pueblo component.

Important to community pattern interpretation is the fact that the Basketmaker III sites are clustered along the western edge of the block nearest the mesa divide. They are also the largest sites in the block. The hypothesis that larger Basketmaker III sites are concentrated in the northern part of the mesa (Matson and Lipe 1975b) is supported in the Owl Creek block, however there is insufficient comparative material from other areas of the mesa.

The nature of the Owl Creek distributions, i.e., their theoretical distributional characteristics—random, clustered, regular—and the degree of clustering, regularity, and randomness were compared to aid in inferring underlying generative processes of the site population structures.

Populations of interest to archaeologists are most often randomly distributed, because cultural remains are generally patterned and structured in space. In fact, community pattern interpretation relies on this assumption. However, it is clear that pattern and structure may be adversely affected by sampling strategies, even when precision in estimation of population parameters is high.

In a variation of Wood's (1971) analysis, I fit the Owl Creek data to several discrete models in order to compare underlying
distributional differences between site populations. To find the scale at which clustering is most apparent in the site populations, I fit the theoretical models (Poisson, Neyman Type A, Dacey's Modified Poisson, Negative Binomial) to quadrat sizes from 100 meters/side to 600 m/side (Table 1). Results of these tests show that the distribution of Basketmaker II sites approximates the Poisson; these sites exhibit a random distribution in 400 m/side quadrats particularly. The other site distributions failed to fit any of the models, except that in 100 m/side quadrats all site distributions fit both the Dacey's and the Negative Binomial. The only possible interpretation is that the failure to fit a Poisson distribution is conclusive evidence of non-randomness (Harvey 1969:575).

Matson and Lipe's hypothesis that Basketmaker II sites are evenly dispersed over the mesa is generally supported by the block survey. We would expect the sample estimates for this site class to be more precise and accurate than those for the other site classes, because Basketmaker II has a random distribution and the others are non-random. More exact distributional information is desirable for the site types that depart from randomness and are thus less likely to be reliably estimated by sampling procedures.

Because community pattern interpretation requires knowledge not only of the particulate nature of the distribution, but the spatial arrangement of points (sites) relative to each other, Morrill's coefficient of contiguity (1970) was used to clarify those empirical
Table 1. Comparison of the fits of Owl Creek survey data to discrete distribution models varying quadrat size.

<table>
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<tr>
<th>Site Type</th>
<th>Quadrat Size</th>
<th>Poisson $X^2$</th>
<th>$P(X^2)$</th>
<th>Neyman Type A $X^2$</th>
<th>$P(X^2)$</th>
<th>Dacey's Poisson $X^2$</th>
<th>$P(X^2)$</th>
<th>Neg. Binomial $X^2$</th>
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<td>7.30</td>
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<td>0.97</td>
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<td></td>
<td>600</td>
<td>3.99</td>
<td>0.25</td>
<td>5.59</td>
<td>0.15</td>
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</tbody>
</table>

* Indicates circumstances having a 95% or greater possibility of fitting the model.
distributions that are clustered in a sample frame, but measured as random or dispersed with respect to each other. This measure is calculated:

\[ C = \left( \frac{d_{ij}}{x} \right) / n_c \]

where \( d_{ij} \) is the difference in numbers of points between any contiguous cells, \( x \) is the mean number of points per cell, and \( n_c \) is the number of contiguous edges within the bounded space. A value of one indicates randomness; a value less than one indicates clustering of like values; and a value greater than one the discontinuity or repelling of like values.

Recognizing that the contiguity measure is affected by a departure from randomness in the number of points per cell, Morrill gives a correction function:

\[ C^* = C / \left( n_j (x - x)^2 / (n - 1) \right)^{1/2} \]

where \( n_j \) is the number of cells with \( x \) occurrences and \( n \) is the total number of cells.

Application of this measure to the Owl Creek data resulted in a \( C^* \) of 1.4249 for the distribution of Basketmaker II sites in 400 meter/side quadrats, indicating that the sites are slightly more dispersed than predicted, assuming a random distribution. The contiguity coefficient for this site class indicates that this is true at all quadrat sizes.

The \( C \) for Basketmaker III site shows a slight tendency toward clustering, and the modified coefficient \( C^* \) indicates a high degree of clustering evident in the larger quadrat sizes. The clustered
distribution of Pueblo sites is apparent at the level of 400 m/side quadrats, and the C* value decreases toward a higher degree of clustering (contiguity) as more sites are examined in the larger quadrats (Table 2).
Table 2. Contiguity coefficients for Owl Creek survey data using Morrill's (1970) technique, varying quadrat size.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Quadrat Size (m)</th>
<th>Coefficient of Contiguity (C)</th>
<th>Modified Contiguity Coef. (C*)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASKETMAKER II</td>
<td>100</td>
<td>1.8092</td>
<td>8.1000</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>1.7761</td>
<td>3.4961</td>
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<td>300</td>
<td>1.6097</td>
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</tr>
<tr>
<td></td>
<td>400</td>
<td>1.2213</td>
<td>1.4249</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>1.1895</td>
<td>0.9639</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>1.1429</td>
<td>0.6795</td>
</tr>
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<td>BASKETMAKER III</td>
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<td>1.5899</td>
<td>4.5621</td>
</tr>
<tr>
<td></td>
<td>200</td>
<td>1.2248</td>
<td>1.5156</td>
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<td></td>
<td>300</td>
<td>0.7911</td>
<td>0.5910</td>
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<tr>
<td></td>
<td>400</td>
<td>0.8023</td>
<td>0.3719</td>
</tr>
<tr>
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<td>0.2354</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>0.8305</td>
<td>0.1881</td>
</tr>
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<td>PUEBLO</td>
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<td>200</td>
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<td>300</td>
<td>1.1086</td>
<td>1.1160</td>
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<td>400</td>
<td>0.9926</td>
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<td>500</td>
<td>0.7347</td>
<td>0.4077</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>0.8325</td>
<td>0.3372</td>
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<td>1.8166</td>
<td>7.2575</td>
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<td>300</td>
<td>1.3665</td>
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<td></td>
<td>400</td>
<td>0.8808</td>
<td>0.7762</td>
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<td></td>
<td>500</td>
<td>0.9311</td>
<td>0.5707</td>
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<tr>
<td></td>
<td>600</td>
<td>0.6863</td>
<td>0.4127</td>
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CHAPTER IV
CONTEMPORANEITY OF SITES

Community Patterns

Community pattern analysis, defined as description and interpretation of relationships between sites, requires that coexisting settlements be identified and contemporaneous sets of sites isolated. Because the Owl Creek surface remains lack the typical kinds of materials used to define coeval sites in some Southwest community pattern studies, e.g. datable beams (Dean 1969) or architecture (Wilcox 1975, 1982), ceramic variation is used to develop a local chronology and establish intersite contemporaneity.

Ceramic Variation

The ceramics in the Owl Creek block represent both Kayenta and Mesa Verde traditions. The types identified by Matson and Lipe (1977) in their survey collections on Cedar Mesa are all found in Owl Creek. Type descriptions are found in Brew 1946; Colton 1955, 1956; Lindsay 1969; and Breternitz, Rohn, and Morris 1974. Kayenta and Mesa Verde ceramics are contrastive in various dimensions: the black-on-white wares in tempering material and paint, and redwares in temper and paste.

The definitive attributes embedded in the type descriptions are
five tempering modes (sand, rock, sherd, rock and sherd, sand and sherd); three pastes (gray, red, orange); two surface textures (plain and corrugated); three paints (black mineral, black organic, red); and slipping (present/absent). This classification is shown in Figure 10. Finer type designations are made on the basis of design.

The history of analysis of northern Southwestern ceramics has contributed a record of changes in attribute occurrence and frequency through time. Temper and paint combinations on black-and-white pottery were charted by Shepard (1939:284); temporal trends identified include change from use of rock temper to sherd temper, and from mineral paint to organic paint. Plain grayware declined in frequency while corrugated grayware increased, and San Juan redware reached an earlier peak of abundance than did Tsegi orangeware. While these general trends were repeated in numerous local sequences in the Four Corners area, their timing varied widely; they do not serve to establish local chronologies, but by convention serve as culture historical markers.

Matson and Lipe (1977) examined the changing frequencies of Kayenta and Mesa Verde ceramic types on Cedar Mesa. Dividing their seriated types into regularly co-occurring complexes, they defined a sequence of Pueblo II Mesa Verde pottery followed by a Late Pueblo II Kayenta dominated assemblage (AD 1100-1300). This set was succeeded by a Late Mesa Verde dominated group (AD 1125-1300), and finally a post-AD 1200 Mesa Verde assemblage. These changes were interpreted
Figure 10. Owl Creek ceramic classification and concordance.
as reflecting shifting foci of affiliations that included ceramic exchange (Matson and Lipe 1977:55). Their interpretation assumes that most of the pottery found on Cedar Mesa was not locally made.

It now appears that pottery was exchanged over large areas of the prehistoric Southwest (e.g., Cordell and Plog 1979; Graves 1982; Upham 1982). The nature and extent of the networks are subjects of current research (e.g., differential distributions of relatively rare and nonlocal pottery have sometimes been interpreted as evidence for the existence of elite access to high status ceramics (Upham, Lightfoot and Feinman 1981:826; Cordell and Plog 1979:420)). Such interpretations should be viewed with caution because these distributions may be just as easily attributed to other kinds of interaction, or even sampling error (e.g., a type that is rare in large assemblages has a low probability of being found in small ones). Also, as expected, smaller sites contain fewer types (e.g., Matson and Lipe 1977:63,66). Data that would allow evaluation of the influence of this factor have not been published with the "elite access" interpretations.

**Tree-Ring Dated Ceramics**

Using the pottery types of the Kayenta and Mesa Verde traditions, contemporaneity of sites was established by comparing time ranges for types dated through tree-ring associations (Breternitz 1966). The method used is a variation of the overlap system commonly employed in
the northern Southwest (e.g., Dean 1969:54, 102; Schwartz, Chapman, and Kepp 1980). Recent criticisms of the uses to which tree-ring dated ceramics have been put notwithstanding (Cordell and Plog 1979), appropriate applications do exist (Dean, Lindsay and Robinson 1978). While many of the assumptions underlying Breternitz's dating of the life spans of pottery types are untenable, the accumulated associational information is usable. For example, the assumption that the site with the most sherds of a particular type is the locus of manufacture of that type is invalid on several counts (Cordell and Plog 1979:407; Deutchman 1980:130). Berternitz's implicit abundance and fall-off model (internally violated by "indigenous" and "trade" dates) is at odds with what we know of the pattern of stylistic change through time, and is innocent of the numerous sources of ceramic variation now recognized (e.g., S. Plog 1980). Still, his compilation of dated types can be used in processual studies of ceramic variation at the levels of attributes and attribute combinations.

Because Matson and Lipe's (1977) seriations display the same sequence of attribute combinations on Cedar Mesa as elsewhere in the region, Breternitz's relative order of dates is considered applicable in establishing a local chronology. It was used in conjunction with seriations of Owl Creek ceramics, Mesa Verde and Kayenta traditions being seriated both separately and together. Lest the AD dates attached to the contemporaneous sets lend a fictional aura of absolute dating (Schwartz 1965), I emphasize that the chronology is
a relative one and the sets do not display "absolute contemporaneity" (Dean 1969:198).

Contemporaneous sets were created of Owl Creek sites by plotting the spans of pottery types based on tree-ring dates for each assemblage, and isolating the overlapping temporal ranges of assemblages (Appendix A). The groups of sites in each set comprise all components with the same ceramic dates. Clusters of earliest known dates for types serve to establish the lower limits of sets (e.g., a site cannot be earlier than the oldest tree-ring dated pottery type found on it). No assumptions about rates of change are made, nor do I assume that tree-ring dates assigned to ceramic types date any particular event such as date of manufacture or height of popularity.

By these methods, 107 components in the ceramic assemblages from the surface of the sixty-seven Pueblo sites were isolated. The occupations of 33 multicomponent sites were separated by means of discontinuities in the temporal ranges of their ceramics. Nine contemporaneous sets were defined (Table 3).

The Owl Creek sets reflect neither absolute contemporaneity nor classificatory contemporaneity (Dean 1969:198). Sets 4, 7, and 9 include all sites that could possibly have been used simultaneously within the specified time frame. Set 1 reflects minimum possible contemporaneity because it includes only those Basketmaker III sites with later Pueblo components. Several additional
Table 3. Temporal sets of Owl Creek sites.

<table>
<thead>
<tr>
<th>Set</th>
<th>Time</th>
<th>Sites</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>AD 400-700</td>
<td>8, 10, 15, 17, 25, 29, 36, 37, 38, 44, 50, 51, 52, 54, 60, 66</td>
<td>Pueblo sites with earlier Basketmaker III components (other BM III sites in block not included)</td>
</tr>
<tr>
<td>2</td>
<td>AD 760-875</td>
<td>19, 24, 26, 27, 30, 39, 43, 46, 65</td>
<td>Pueblo I components</td>
</tr>
<tr>
<td>3</td>
<td>AD 575-875</td>
<td>8, 14, 16, 17, 19, 24, 25, 26, 27, 29, 30, 36, 37, 38, 39, 43, 44, 46, 50, 51, 52, 54, 60, 65, 66</td>
<td>All P &amp; B components to AD 875 (includes ceramic ranges 575-875 and 760-875)</td>
</tr>
<tr>
<td>4</td>
<td>AD 875-1075</td>
<td>7, 21, 31, 36, 41, 43, 45, 46, 54, 60, 67</td>
<td>Possible Early Pueblo II components (most tentative set—fewest types, low frequency)</td>
</tr>
<tr>
<td>5</td>
<td>AD 1075-1200</td>
<td>1, 3, 4, 10, 14, 17, 18, 19, 20, 24, 25, 29, 31, 32, 33, 37, 40, 42, 44, 46, 49, 50, 51, 52, 57, 65, 67</td>
<td>Pueblo II components (many located on earlier, and larger, Basketmaker III sites)</td>
</tr>
<tr>
<td>6</td>
<td>AD 1115-1200</td>
<td>6, 26, 35, 38, 53</td>
<td>Pueblo II starts after 1115 (includes ceramic ranges 1115-1130, 1115-1150, 1115-1200) All sites have Tsengi polychromes</td>
</tr>
<tr>
<td>7</td>
<td>Post-AD 1075</td>
<td>1, 3, 4, 6, 10, 14, 17, 18, 19, 20, 24, 25, 26, 29, 31, 32, 33, 35, 37, 38, 40, 42, 44, 46, 49, 50, 51, 52, 53, 54, 65, 67</td>
<td>Total Pueblo II components after AD 1075</td>
</tr>
<tr>
<td>8</td>
<td>AD 1200-1300</td>
<td>2, 5, 9, 11, 12, 13, 15, 16, 17, 19, 20, 22, 23, 24, 25, 29, 31, 32, 36, 39, 40, 44, 47, 48, 52, 53, 56, 58, 59, 61, 62, 63</td>
<td>Sites established after AD 1200 Pueblo III</td>
</tr>
<tr>
<td>9</td>
<td>AD 1200-1300</td>
<td>2, 5, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 19, 20, 22, 23, 24, 25, 29, 31, 32, 36, 39, 40, 44, 47, 48, 52, 53, 56, 58, 59, 61, 62, 63, 66</td>
<td>Total components persisting past AD 1200 (final maximal configuration, probable abandonment in the 1270s)</td>
</tr>
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</table>
Basketmaker III sites that may have coexisted with set 1 sites are shown in Figure 11. Sets 5, 6, and 8 indicate times of earliest possible use of the included sites, reflecting all newly established settlements within each temporal range. They thus reflect minimal (to the level of resolution given) but not maximal contemporaneity, because sites established earlier may have continued in use into later times. These possibilities are shown in the cumulative sets (3, 7, 9). Set 9 includes all sites with ceramic ranges extending into the thirteenth century. It thus reflects the last possible site configuration, since no sites were founded later. The abandonment sequence within this last configuration is detailed in Chapter 7.
CHAPTER V
INTERSITE VARIABILITY

Site Classification

Introduction

When contemporaneous sets of sites have been isolated with maximum temporal resolution, community pattern description requires the identification of morphological and (inferred) functional variability between sites within sets. Site types in Owl Creek are established by stipulating features that reflect redundancy in activities.

The site types are not based on mutually exclusive attributes, but reflect varying degrees of overlap in activities represented. The features found important in making the distinctions are storage features, kivas (ceremonial structures), structures, and grinding equipment. These attributes are used to define site types, and their utility is tested through an activity range measure (similar to a diversity index).

Intersite variability is also examined through comparison of lithics/ceramics ratios and painted/utilitarian ware ratios. Other variation is described.

Configurations of site types serve to distinguish nucleated from dispersed community patterns. Differences between patterns allow
interpretation of community pattern change and degree of mobility.

Community pattern variation is assessed by comparing the proportions of different site types, their spatial configurations, and temporal differences. Site size comparison provides data important to the interpretation of intersite relations and community organization (e.g., Upham, Lightfoot, and Feinman 1981). Because site size distributions alone do not serve to distinguish between nucleated and dispersed patterns, additional lines of evidence are used.

**Classification of Sites**

Researchers south of Cedar Mesa have classified sites with the SARG-defined categories of habitation or special use (Dean, Lindsay, and Robinson 1978:29) based on size, permanent structures, and range of maintenance activities represented. SARG investigators north of Cedar Mesa used a single room/multiroom distinction (DeBloois and Green 1978:16 ff). The commonly used habitation/special use classification, while sometimes intuitively applied, provides a relative measure of the intensity and duration of use of the contrastive site types. Most special use sites are interpreted as food collecting and processing stations or agricultural fieldhouses; but water and soil control structures, quarries, trails, isolated storage facilities, and burial and ceremonial sites are included in this category as well. The classification generally
serves to isolate sedentary and permanent settlements from temporary ones, a necessary ingredient in settlement pattern analysis.

This habitation/special use classification was insufficient for the Owl Creek community pattern study for several reasons. Aside from the effects of natural processes on unsheltered mesa top sites, the definition of habitation sites would not accommodate small diffuse sites (e.g., Lipe's "ephemeral" Klethla phase sites on the Red Rock Plateau (1970:112-122, esp. 120), which may have been part of a dispersed sedentary pattern. That dichotomy also would not distinguish sedentary from temporary sites at the level of resolution required for community pattern analysis. Klethla sites with abundant artifacts had very few structures (Lipe 1970:115), and Lipe concluded that structural remains were not, in this case, a good indicator of intensity of use, sedentariness, permanence, or "habitation." Red Rock groups apparently spent most of their time living in temporary camps that would not be classified as habitation sites by SARG criteria. Standardized classifications can obscure variability, incorporate unwarranted assumptions, and lead to inappropriate interpretations. These problems increase when a classification is extrapolated to a new area. The site classification used here is most similar to Lipe's (1967, 1970) for the Red Rock Plateau region east of Cedar Mesa. The Owl Creek and Red Rock studies address similar questions, and the archaeological contexts differ primarily in that many Red Rock sites are naturally sheltered while Owl Creek sites are open. Several Red Rock sites were
excavated in the course of the Glen Canyon Project, while Owl Creek sites are known only from their surface expression.

**Owl Creek Site Classification**

Owl Creek site types are based on combinations of the dimensions of kiva, structures, storage facilities, and grinding tools treated as presence or absence (except storage facilities which has an additional mode "distinctive"). Of the 24 possible classes, four have members in the Owl Creek block. Assignments of sites to class, and numbers of sites in each class, are shown in Table 4.

Artifact abundance and site size are not used as defining criteria, but treated as variability to be investigated.

Site class 1 is defined by the presence of structures, storage facilities, and grinding equipment. Class 2 is defined by the presence of structures, distinctive storage facilities, grinding equipment, and absence of kivas. Class 3 is defined by the absence of kivas and storage facilities, and presence of grinding equipment. Structural remains are variable. Class 4 sites lack kivas, storage facilities, and grinding equipment. Structural debris varies.

The utility of this classification in segregating sites for community pattern interpretation is assessed below by measuring intrasite activity ranges.
Table 4. Owl Creek site classification and site assignments.

<table>
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<tr>
<th>Site Class</th>
<th>Class Definition</th>
<th>Members (Owl Creek Sites)</th>
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<td>1</td>
<td>+ structures</td>
<td>1, 7, 13, 24, 26, 38, 44, 65</td>
</tr>
<tr>
<td></td>
<td>+ storage facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ grinding equipment</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>+ distinctive storage</td>
<td>17, 20, 27, 30</td>
</tr>
<tr>
<td></td>
<td>+ structures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+ grinding equipment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- kiva</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>+ grinding equipment</td>
<td>3, 6, 10, 14, 19, 22, 23, 25, 29, 31, 32, 33, 35, 36, 37, 39, 40, 46, 51, 52, 53, 57, 60, 66, 67</td>
</tr>
<tr>
<td></td>
<td>- storage facilities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>- kiva</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>- grinding equipment</td>
<td>2, 4, 5, 8, 9, 11, 12, 15, 16, 18, 21, 28, 41, 42, 43, 45, 47, 48, 49, 50, 54, 55, 56, 58, 59, 61, 62, 63, 64</td>
</tr>
<tr>
<td></td>
<td>- storage features</td>
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</tr>
<tr>
<td></td>
<td>- kiva</td>
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</tr>
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</table>
Variability

Range of Activities Measure

To assess the degree to which these site types reflect variation in the total range of activities represented, a simple diversity index was devised. This range measure does not distinguish functional inferences such as storage from habitation structures. Instead, it is designed to reflect behavioral variability based on numbers of activities, e.g. construction, represented. The index measures redundancy in total number of activities by occurrence, and demonstrates relative investment (of time and energy) in the site.

To the extent that this measure can be interpreted as reflecting intensity of use, duration of use, and activity range, it is useful in distinguishing sedentary from seasonal settlements and permanent from temporary occupations. The measure clearly distinguishes limited activity sites from those displaying the full repertoire of activities represented in Owl Creek.

Changes in the activity range measure should be apparent if community patterns changed from nucleated to dispersed or dispersed to nucleated, if localization of functions increased, if specialization or diversification increased or decreased, and perhaps if changes in scale of social integration occurred.

Application of the activity range measure requires a simple total of activities represented in each site; counts are based on
presumed material correlates of the range of behaviors represented. Like the production step measure (Feinman, Upham, and Lightfoot 1981), activity points were assigned on an occurrence basis (present/absent). The logical extension of this technique would include assigning points weighted for relative amounts of time or labor invested in the different activities. Studies that would allow confident assignment of numbers to such costs are required (e.g., McGuire 1983:129).

The occurrence scores were ranked as an ordinal index of investment and intensity of use, and compared to site class assignments. The activity correlates on which the measure is calculated include jacal, distinct trash deposit, kiva or pit structure, surface room(s) of masonry or slab construction, slab cist, hearth, grinding equipment (mano, metate), lithic manufacturing equipment (hammerstone, core), ceramics, and lithics. This list yields a possible score of ten if all activities are represented. Only artifacts and features inferred to represent activities undertaken in situ were counted in the range measure. Thus, the presence of a drilled olivella shell does not contribute to the activity score, because I could not assume that its manufacture took place where it was found, or that its presence represents any particular behavior. The presence of stone axes in seven sites was counted, assuming it represents local woodcutting activity. In addition, two unique activities were counted: petroglyphs at Site 23, and a stone sandal form at Site 26 which was assumed to reflect
sandal manufacturing. This yields a theoretically possible score of 13, but all activities are represented at no single Owl Creek site.

The highest score among Owl Creek sites was 10 at Site 26, a site without a kiva. Sites with the highest activity scores are Types 1 and 2, and those with lowest scores are Type 4 sites (Table 5). A low score could reflect behavioral features such as limited activity, special or short-term use, or seasonal use, or archaeological problems like failure to find evidence of the full range of activities due to poor observation, sampling, or post-occupational disturbance. The latter may be considered a random source of distortion in the present case because all sites in the block are subject to the same natural processes (i.e., all are open sites on erodible soils). The study area is small enough that differential disturbance is negligible, and should not bias the measure. The few vandalized sites are nearest the road (Utah 261), and are also large visible sites with high Range of Activities Measure (RAM) scores (e.g., Site 38).

Type 4 sites have fewest activities represented; RAM scores of 4–5 include sites of Types 3 and 4. Sites with 6–7 activities include Types 1, 2 and 3 sites; all are Type 3 except Sites 27 and 30 (Type 2), which are the earliest Pueblo sites, and Sites 1 and 65, which are the earliest Type 1 sites. While Sites 65 and 1 are classified as Type 1, they have fewer activities than do later Type 1 sites (6 compared to 8–10). They also lack kivas. Interpretations
Table 5. Range of Activities Measure for Owl Creek sites, with Site Type in parentheses.

<table>
<thead>
<tr>
<th>Site Type</th>
<th>Range of Activities Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>5(4)</td>
<td>4(4)</td>
</tr>
<tr>
<td>9(4)</td>
<td>8(4)</td>
</tr>
<tr>
<td>21(4)</td>
<td>12(4)</td>
</tr>
<tr>
<td>28(4)</td>
<td>15(4)</td>
</tr>
<tr>
<td>41(4)</td>
<td>16(4)</td>
</tr>
<tr>
<td>42(4)</td>
<td>34(4)</td>
</tr>
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<td>56(4)</td>
<td>43(4)</td>
</tr>
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<tr>
<td>66(3)</td>
<td></td>
</tr>
<tr>
<td>67(3)</td>
<td></td>
</tr>
</tbody>
</table>
of these differences are offered below. The sites with 8-10 activities are all Types 1 and 2; sites with scores of 9-10 are Type 1 except Site 17, a site with unusual storage facilities (Type 2).

This range of activities measure was devised to enumerate activities rather than functional types. It shows that the site types do not reflect redundant sets of activities that come in different sized packages, but sites that may serve qualitatively different functions in community and settlement patterns. Permutations of the activity range measure could be useful in preliminary assessments of the degree of functional differentiation in analyses of changing cultural complexity. Measurement of heterogeneity in the archaeological record often relies on burials and architecture (McGuire 1983:124). In cases where neither is available other measures of heterogeneity, including range of activities and indices of diversity, might be applied.

Artifact Variation

Projectile points are represented in assemblages from all site types except Type 2. Artifacts unique to the study area were found in Sites 20 and 44 (Type 2 and Type 1 respectively), both with high RAM scores. Seven site assemblages contained ceramics and no lithics; these sites and all those with less than 10 lithics had no grinding equipment. All seven are Type 4 sites, and have the lowest RAM scores.
Masonry, jacal, and slab structures occur together on sites, and their variability is not accounted for by temporal differences. Assemblages with hammerstones occur in all site types, but cores are found only in site Types 3 and 4.

Kivas

Five kivas and two depressions indicating possible kivas or pithouses were located in the Owl Creek survey. All are circular, and the best example (exposed by stream cutting) has a double masonry wall and southern recess (Site 24). Other sites with kivas are 7, 13, 38, and 44. Sites 32 and 52 have possible pit structures. All sites with kivas, save 38, had a post-AD 1200 occupation. Site 38 has Kayenta tradition ceramics with abundant orangeware; Site 44 nearby has Mesa Verde black-on-white types only, suggesting that Site 38 is earlier. The other sites have more heterogeneous assemblages. Not all large sites with high RAM scores have kivas.

Kivas have traditionally been important to community pattern interpretation because of their inferred group meeting, integrative, and redistributive functions (e.g., Dean 1969, 170; 165; Cordell and Plog 1979). Kivas may also figure in determination of seasonality since the ethnographic record suggests they did not occur at summer farming sites (Mindeleff 1891:95), and archaeological research indicates that they do not occur at seasonal sites (e.g., Hill 1971; Dean et al. 1978).
More important here than kiva function is kiva redundancy. Community pattern definition through redundancy of units is well established in the archaeology of the northern Southwest (Prudden 1903, 1914, 1918; Steward 1937, 1955; Rohn 1965, 1971; Dean 1969, 1970). On the intersite level, community boundaries have often been drawn by recognition of clustering around a "nodal" site which is redundant between clusters but unique within (e.g., Lipe 1967, 1970; Dean, Lindsay and Robinson 1978). In the Southwest, the nodal sites around which clusters are bounded are those of assumed integrative function: kivas, Great Kivas, plazas, refuges, forts, or other features not replicated at every site (e.g., "group assembly sites" of Lipe 1970:129). Such structures are not found at most Owl Creek sites, and are assumed to play a unique role in community organization.

Ceramic/Lithic Ratios

Southwestern archaeologists have found ceramic/lithic ratios to be useful indicators of site function (e.g., Cordell 1977; McAllister and Plog 1978; Dean and Lindsay 1978). Cordell (1977:453, 458) divided limited activity sites into those associated with agricultural practices (more ceramics than lithics) and plant processing or hunting (more lithics than ceramics).

Ceramic/lithic ratios of Owl Creek sites were examined for their potential in characterizing site types, especially those
with fewest activities (Types 3 and 4). Most assemblages are
dominated by ceramics (Table 5); the only sites with more lithics are
early Sites 1 and 37, and Site 63 (whose total assemblage consists of
3 flakes and 2 sherds). Two sites with ratios of one, Sites 18 and
23, are located in the northeastern corner of the study area where
there was dense Basketmaker and early Pueblo occupation. Sites with
overwhelmingly more ceramics than lithics (10, 20, 26, 35, 51, 53)
are all Pueblo II starts, none of which were in use earlier than AD
1075, and all site types are represented among them.

Site 5 has a unique assemblage of 137 sherds and no lithics. It
is a small featureless post-AD 1200 Type 4 site. Because the
ceramics are almost all painted wares (to the exclusion of "utility"
types, or graywares), it is not interpreted as a storage site. Sites
44 and 38 have similar lithic/ceramic ratios: 464/1467 and 439/1479
respectively. They are both Type 1 sites, but Site 38 dates from
before, and Site 44 after, AD 1200.

Sites with lithic assemblages larger than 100 (3,7,14,17,20,
24,26,27,30,31,38,44,52, 53,57,65) are either large or early sites;
none are post-AD 1200 new occupations.

Painted/Utilitarian Ware Ratios

Ratios of painted/utilitarian wares have also served Southwest
archaeologists as site function indicators. Anasazi utilitarian
wares include plain gray and corrugated vessels, both of which
are inferred to have had cooking and storage functions. Ratios were examined for Owl Creek sites to determine whether their contribution to functional, temporal, or spatial variation could be isolated.

Early large Type 1 sites (27,30,65) with an activity range of 6 have much more utilitarian than painted ware. Painted sherds were more abundant than utilitarian in the latest assemblages (Sites 13, 44), and painted ware significantly dominates the Site 53, 5 and 19 collections. Sites 5 and 19 are Type 4, and 53 is Type 3. Sites with kivas do not have similar painted/utilitarian ware ratios. Sites 7, 24, and 38 have more utilitarian than painted, and 13 and 44 (later sites) have more painted ware. These observations suggested that painted/utilitarian ware ratios in Owl Creek reflect temporal variation more strongly than functional or spatial variability.

Site Size

Site size distribution has played an important role in interpretation of multisite community patterns and intersite relations. Recent researchers have derived interpretations of hierarchical organization (Upham, Lightfoot, and Feinman 1981), ranking (Upham 1982), redistribution (Lightfoot 1979), and changing level of regional integration (Cordell and Plog 1979) from bimodal site size distributions.
Dispersed community patterns with bimodal site size distributions have been integral in reconstructions of settlement systems in the Hopi Buttes (Gumerman 1969), Navajo Reservoir (Eddy 1966), and Blue River (Rice 1975) areas. Bimodal site size distributions described for many Southwest regions, particularly those dating to the twelfth century AD, have been interpreted as indicators of sociopolitical systems ranked in size and organization, and discussed as "tiers," "hierarchies," and "major centers" (Upham, Lightfoot, and Feinman 1981:825). The most provocative of these analyses use variation in site size distribution to explore changing levels of integration, interactive networks, scales of exchange, and sociopolitical complexity (e.g., Upham 1982). Certainly regional organization cannot be understood without examining the articulation between smaller and larger sites (Cordell and Plog 1979:407).

Knowledge of site size distributions is a necessary prerequisite for identification of redistribution or other exchange relationships, because a redistribution center, often the focal site of a dispersed sedentary community, may be larger than surrounding sites and have dissimilar facilities and features. The possible redistributive function of kivas has been explored recently (Lightfoot 1979).

The interpretation of larger scale socioeconomic organization and changes in regional integration is dependent in part on the distinction between nucleated and dispersed community patterns. Patterns comprising a few large sites with unique features and many small redundant sites with narrow activity ranges can be interpreted
either as a dispersed sedentary system with integrative center, or as
a nucleated community with non-contiguous areas of temporary
activity. The difference is not trivial; one of these two
reconstructions is a primary ingredient of all explanations of
aggregation and abandonment episodes in the northern Southwest. For
example, the question of whether aggregation (change to a nucleated
community pattern) reflects subsistence success or resource stress
has been answered variously, but in all cases requires interpretation
of a "bimodal" (or multimodal) site size distribution.

Distinguishing between these two interpretations hinges on
defining the role of the small sites—distinguishing sedentary from
seasonal and other temporary uses. The distinction is not obvious
and often difficult; the Small Sites Conference served to demonstrate
the difficulty of the problem, and offered some solutions (Ward
1978). The resolution of the question lies in analyses of functional
redundancy and variability in activity ranges.

Site size distributions reflect behavioral factors such as
function, time, permanence, reuse, depositional processes and post-
occupational disturbance, as well as size of area investigated,
survey strategy, and recovery techniques. Even so, expected distri-
butions can be generated and their referents stipulated.

Multimodal patterns could reflect multilevel hierarchical struc-
ture (Upham and others 1981), variation within a dispersed sedentary
pattern, particularly in a colonizing process (Lipe 1970), a
nucleated pattern with differential population distribution (perhaps
contingent on "favorable" resource areas), differential reuse of sites, or variation in temporary activity sites.

A unimodal pattern could result from a mobile nucleated system, sedentary nucleation without temporary use sites, or other permutations. I would not expect to find a normal distribution often in archaeological site sizes, and the direction and magnitude of skewing can be a useful indicator of patterns.

The explanatory potential of site size distributions lies in identifying change through time. Owl Creek site sizes (based on area of artifact scatter) are compared by time sets in Figure 11. Three size classes (based on the trimodal distribution of site sizes) are used: small (less than 400 m²); medium (400-900 m²); and large (more than 900 m², largest exceeds 5000 m²). The shape of a distribution is dependent, of course, on the size classes used, and can change with different class intervals. Recognizing this, it is irritating that so many discussions in the literature of "bimodal" patterns do not provide site size measures. It is left to the reader's imagination whether site "size" means area of artifact spread, area of structural remains, number of rooms in pueblo sites, artifact abundance, or other measures. Size classes are also not specified. Because we know that sites do not come in "large" and "small" categories but are put in them by their investigators, it is necessary to specify the measures used in drawing the distributions. The distinction is critical, because the possible measures are not highly correlated and don't often allow prediction of one variable
from the other. For example, in Owl Creek there is no significant correlation between site area, number of artifacts, and number of structures (Table 6). Additionally, modality for the same set of sites will vary with the size measure used.

Based on the history of archaeological work in the Four Corners region, a Pueblo I pattern of large nucleated communities should exhibit a unimodal size distribution. Pueblo II sites are expected to form a dispersed sedentary pattern (part of the "Pueblo II expansion") and be unimodally distributed with small sites or bimodally distributed with a modal class of small sites. If the Pueblo III or post-AD 1200 communities participated in the late Pueblo aggregation pattern reported for many Anasazi areas, they should show a distribution skewed toward large sites or a bimodal pattern with modal classes near the ends of the distribution.

The earliest Pueblo patterns in Owl Creek (Sets 2 & 3) are bimodal (Figure 11). The Pueblo II sites (Sets 5, 6, 7) display a fairly even distribution; more small sites were built earlier (Set 5) and more large sites later (Set 6). Sites constructed after AD 1200 (Set 8) are mostly small, and no large sites date to this period. Set 9 shows the final distribution made up primarily of small sites.

The largest sites, those more than 2000 m², are Type 1 sites established before AD 1200. The size of new Type 1 sites decreases through time. The small site class consists of site Types 3 and 4.

The pattern of change in site size distributions in Owl Creek is
Figure 11. Owl Creek sites in three size classes showing temporal changes.
Figure 12. Locations of Pueblo sites in Owl Creek block by site number.
from a bimodal distribution to a wide range of variation in Pueblo II site sizes before AD 1200, to the dominance of small and medium sites after AD 1200 with almost all newly established sites being small. The temporal trend in site size is toward more small sites, and fewer sites at the "large" end of the distribution. The change of largest magnitude occurs between Sets 7 and 8, sites established before and after AD 1200. Implications of this change are examined in the following chapter.

**Site Plans**

Plans of Owl Creek sites depart from the "unit pueblo" plan (Prudden 1903, 1918) in irregularity of layout and non-contiguity of structures. Type 1 and 2 sites are similar to Red Rock sites east of Cedar Mesa. They are insufficiently compact to allow identification of common use areas like "courtyard complexes" (Dean, 1970:157) or "plaza groups." Owl Creek sites do not fit Chang's (1958) "planned village" model as do Prudden's unit pueblos (Figure 13), examples of which occur elsewhere on Cedar Mesa (e.g., Mule Canyon ruin). It is possible that excavation of Owl Creek sites might alter these findings. Site plans (Types 1 and 2) are shown in Figures 14-16. It is clear from these plans that the "typical" kiva/dwelling ratio of 1:6 (Prudden 1914, 1918; Steward 1937) is probably not characteristic of Owl Creek sites.
Figure 13. Frequency of Site Types 1-4 in temporal sets.
Figure 14. Plan of "Prudden unit" pueblo. (Brew 1946)
Figure 15. Plans of three Owl Creek Type 1 sites.
Figure 16. Plans of two Owl Creek Type I sites.
Figure 17. Plans of two Owl Creek Type 2 sites.
CHAPTER 6

MOBILITY

Introduction

Mobility, hypothesized to play an important role in Anasazi adaptations, is examined in the Owl Creek data in terms of two concepts: 1) sedentariness, i.e. year-round/temporary or seasonal occupation, and 2) permanence, i.e. relative or total duration of site occupation.

Archaeologists' inferences of sedentariness are discussed with particular reference to "fieldhouses" in the Southwest. Owl Creek sites are divided into sedentary and temporary categories based on range of activities represented, and temporal change in this dimension is plotted. Use of the Owl Creek upland became more temporary through time.

Owl Creek sites are compared in terms of relative durations of occupation, and sites founded before AD 1200 found more permanent than those founded after AD 1200. An analysis of the repair incidence in ceramics shows that the maintenance implied by mending holes in pottery was discontinued after AD 1200. This reflects a change to less sedentary use of the mesa, and less permanent occupation.

Sedentariness is measured by the range of activities represented. Permanence is assessed by investment in structures, storage facilities, site modification, and midden development. Type 1 sites are found to be most sedentary and permanent, and Type 4 sites least.
Sedentariness

To distinguish between dispersed and nucleated community patterns it is necessary to assign sites to sedentary and temporary classes. Such assignments are reflected in habitation/limited activity or residential/special purpose distinctions often made on the basis of artifact and structure abundance. The critical distinction is in range of activities represented, and in these terms the Owl Creek sites were divided into three classes from widest range of activities to narrowest: site Types 1 and 2; Type 3; and Type 4. Types 1 and 2 meet the criteria usually used for identifying habitation sites (e.g. Dean, Lindsay, and Robinson 1978). Type 4 sites would qualify as "non-habitation" in most classifications, but Type 3 sites fall between these extremes. Although Type 3 sites may have no substantial structures, they may have been occupied year-round (e.g. Klethla sites described by Lipe 1967, 1970).

While long duration "habitation" sites with structures are readily identified, less permanent settlements are problematic. Researchers in Long House Valley south of Cedar Mesa noted the "special use sites were easier to distinguish between AD 1000 and 1300" (Dean and Lindsay 1978:110). The distinction is particularly important in identifying patterns of small, dispersed, "ephemeral" sites like those in the Red Rock Plateau district (Lipe 1967). For studies of
regional organization it is important to distinguish between seasonal use of an area and a low-density sedentary occupation.

While the databank yields an "average site size" of six rooms for all SARG surveyed (puebloan) areas (McAllister and Plog 1978:17), only the sites with the most structural rubble in Owl Creek could be this "large." The structural criteria used in inferring permanence, e.g. number of rooms (McAllister and Plog 1978:21), are thus not easily applied to Owl Creek sites. McAllister and Plog also found that range of activity variation crosscut site size categories (1978:22). Lipe found that the presence or absence of structures may represent variables other than duration of occupation; home base settlements were not larger or more permanent than summer farmhouses, and he concluded that Red Rock Plateau groups "were living as often in temporary sites as houses" (1970:110). A dispersed community pattern of scattered single family homesteads ("rancheria") was identified.

Measuring Relative Sedentariness

Site Types 1 and 2 include the sites with the widest range of activities in Owl Creek, and probably represent sedentary (residential, habitation) settlements. The sites do not appear to have the internal redundancy that would allow their subdivision into multiple contemporaneous units. If so, Type 1 and 2 sites represent one domestic group domain (Wilcox 1982), socioeconomic group (Rohn,
1965, 1971), coresidence unit (Lipe 1970), or household unit (Dean 1970). Thus each site does not necessarily represent a community.

Site Types 3 and 4

Site Types 1 and 2 as described above are the most likely of Owl Creek sites to represent sedentary settlements, as indicated by wide range of activities, investment in construction, presence of kivas or distinctive storage facilities, and artifact abundance. The occupational character of site Types 3 and 4 remains to be determined. The range of activities evidenced in Type 3 sites is intermediate between that of Types 1 and 2 and Type 4. Type 4 sites lack grinding tools, but some have structural rubble. Type 3 sites have grinding equipment, sometimes in the form of features like mealng bins, but more often in moderately portable metates and manos. Type 3 sites reflect more transitory use than do Types 1 and 2, but their temporary or seasonal, as opposed to sedentary, occupation is not apparent.

Type 4 sites most closely resemble the limited activity or special use site criteria used elsewhere, and reflect impermanent and perhaps seasonal use. Several Type 4 sites represent a very small segment of the community activity range: one activity, one event, or a single "enactment" (e.g. Wilcox 1982:26). Taken together however, they reflect a variety of activities. Those activities and their
locations allow the determination of the role of Type 4 sites and associated changes in the community structure.

Type 3 and 4 sites might be expected to reflect resource acquisition loci and, therefore, subsistence practices more closely than do Types 1 and 2. Because fewer activities are represented in Types 3 and 4, and they lack storage features, they show none of the characteristics of "home bases" (e.g. Binford 1980; Smith 1981). The locational determinants of Types 1 and 2 sites may be more likely to include a range of factors such as shelter and storage opportunities, domestic water availability, centrality, and others. Their locations may reflect a compromise between many such considerations, the implications of which are examined in the following chapter.

Here we need only recall the change in site type frequencies between sets 7 and 8 (Figure 13). Sites established after AD 1200 are almost all Type 4, indicating a larger temporary use component in the community pattern than in the pre-AD 1200 distributions. The shift to more transitory settlements with narrower activity ranges (including no food processing as evidenced in grinding equipment) may reflect a change from sedentary to seasonal use of the mesa top (Matson and Lipe 1978), or change from a dispersed to nucleated community pattern with associated increase in spatially removed activity areas. In the first case, hypothesized sedentary sites would allow continued exploitation of the mesa from locations else-
where (presumably in the canyons); in the second case the postulated nucleated community settlements are not found in Owl Creek.

**Sedentary/Temporary Site Ratios**

Since the sedentary or temporary use of Type 3 sites is indeterminate on the evidence above, changes in site type ratios were calculated in two ways: first, by treating Types 1 and 2 as sedentary compared to Types 3 and 4 as temporary; and second, by grouping Types 1, 2, and 3 as sedentary compared to the temporary Type 4. Both comparisons show a qualitative directional change from a pre-AD 1200 pattern of more sedentary than temporary sites to a post-AD 1200 pattern of fewer sedentary and more temporary sites. Treating Type 3 as temporary results in a shift which is not as pronounced but in the same direction (Table 6).

Pueblo II sites have a ratio of 1:3, sedentary to temporary sites when Type 3 is counted as temporary. When Type 3 is included with the sedentary sites, the ratio changes to 5:1, many more sedentary than temporary sites. This may reflect the colonization process (Set 5 sites), and spread and filling (Set 6 sites) in a dispersed sedentary pattern.

After AD 1200, the ratio of newly founded sites is 1:15, sedentary to temporary, a very different pattern than that of the sites founded before AD 1200. Grouping the Type 3 sites with the sedentary sites makes the ratio 1:7, still markedly different from the earlier pattern.
Table 6. Ratios of sedentary/temporary sites in time.

<table>
<thead>
<tr>
<th>Time Set</th>
<th>sedentary: temporary 1 and 2 : 3 and 4</th>
<th>sedentary: temporary 1,2,3 : 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1.25 : 1</td>
<td>8 : 1</td>
</tr>
<tr>
<td>4</td>
<td>1 : 10</td>
<td>1.75 : 1</td>
</tr>
<tr>
<td>5 PII</td>
<td>1 : 3.5</td>
<td>4.4 : 1</td>
</tr>
<tr>
<td>6 PII</td>
<td>1 : 1.5</td>
<td>5 : 1</td>
</tr>
<tr>
<td>7 (cumul. to AD 1200)</td>
<td>1 : 3</td>
<td>5.4 : 1</td>
</tr>
<tr>
<td>AD 1200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>1 : 15</td>
<td>1 : 7</td>
</tr>
<tr>
<td>9 (cumul.)</td>
<td>1 : 5</td>
<td>1.4 : 1</td>
</tr>
</tbody>
</table>

The major component of the pre-AD 1200/post-AD 1200 shift is the drop in frequency of Type 3 sites and the increase in Type 4 sites. The activity range measure would suggest that grouping Type 3 sites with Types 1 and 2 is more appropriate than grouping them with Type 4 (Type 3 activity ranges are more similar to the sedentary sites than they are to the temporary ones).

Interpretation of Site Type Change

The increase in frequency of Type 4 sites through time is interpreted as increasingly temporary use of the study area by Pueblo populations. If Types 3 and 4 sites reflect resource acquisition locations, the change may reflect decreasing reliability or availability of resources. If Type 4 sites are associated with agricul-
tural practices, more frequent shifting of field locations may be
indicated. If short-term forays to upland collecting areas are
reflected, the increasing frequency of this activity requires explana-
tion. Changes in productivity and associated organizational respon-
ses could account for the observed variation. Important in testing
hypotheses of resource-related organizational change is the distinc-
tion between "fieldhouses" and other limited activity sites.

Fieldhouses

For more than sixty years Southwestern archaeologists have iden-
tified small, limited activity sites located near apparently arable
land as fieldhouses. However, the category is so broadly defined as
to include small dispersed sedentary settlements of the rancheria
type as well as sites occupied only during the growing season (Kidder
and Guernsey 1919:25; Moore 1978; Pilles 1978; Wilcox 1978). The
two kinds of sites have similar spatial locations by definition (near
arable land) and, considering the variability of "permanent struc-
tures," can leave superficially similar deposits. Distinguishing the
two is important in separating dispersed from nucleated community
patterns, and identifying organizational changes.

Fieldhouses are often identified by first making the habitation/
special use distinction discussed above, then separating the special
use sites by inferring associations with agricultural pursuits or
hunting and gathering. Presence of grinding equipment is one of the
criteria used in assigning sites to a fieldhouse class (Pilles 1978;
Wilcox 1978). Many investigators use the presence of masonry struc-
tures, some specifying number of structures (Cordell 1977; Moore
1978; Pilles 1978; Wilcox 1978). Dean and Lindsay (1978:115) use a
masonry structure criterion while remarking on its inability to
distinguish different kinds of special use sites.

One assumption underlying most applications is that the presence
or absence of structures serves to differentiate subsistence activi-
ties. This assumption is made even when it is recognized that other
variables including duration of use, amount of reuse, distance from
habitations, and climatic conditions affect construction of "perm-
ament structures." Often even temporary agriculture-related sites
are considered more permanent than hunting or wild plant-collection
sites, which may be an unwarranted assumption.

In general the criteria used to identify fieldhouses are negative
(no kiva, no ornaments), relative (diversity, "impermanence," mid-
den), variable (masonry rooms, storage features, grinding equipment),
and overlap with sedentary site types (location near arable land,
more ceramics than lithics). The variability incorporated in archaeo-
logical fieldhouse definitions is as great as the range of field-
house types described ethnographically (e.g. Mindeleff 1891:217).
Many Pueblo fieldhouses leave little structural debris, house no
grinding equipment, and contain only one or few pottery vessels.
They may have been used for only one season. These attributes apply to a variety of special use sites in the archaeological record.

Prehistoric field locations are identified by the presence of sites interpreted as fieldhouses more often than by stone borders, water or soil control features, or soil evidence (cf. Schaber and Gumerman 1969). Fieldhouses are recognized on the basis of location near arable land; "arable land" recognized by the presence of fieldhouses. Such identification is insufficient to distinguish temporary growing season sites from dispersed sedentary "farmsteads," a necessary distinction given the goals of fieldhouse investigators.

The study of fieldhouses as components in subsistence-settlement systems should help map territories of communities, trace the history of land use strategies, and reveal socio-political development.

(Wilcox 1978:28)

One interpretation of the history of fieldhouses in the Southwest is that they arose as a function of "urbanization" (Haury 1956:7) to provide a farming option for aggregated settlements with locational determinants other than field proximity. Fieldhouses would thus reflect a seasonal component of nucleated community patterns; "few predate AD 1000" (Haury 1956). More recently archaeologists (Moore 1978) have rejected this interpretation, but the inability to distinguish fieldhouses from settlements of dispersed communities clouds the issue. Both patterns reflect strategies for siting near growing crops, but different organizations for accomplishing that objective.
Change from a dispersed sedentary pattern to seasonal use of fieldhouses has been explained as a response to decreasing agricultural productivity (Cordell 1977). Although other opinions are available, a dispersed sedentary pattern may reflect more reliable agricultural conditions than a seasonal fieldhouse pattern in the same environment (assuming the permanence of the fields). A change from sedentary occupation near fields to temporary fieldhouse use implies the increasing impermanence of field locations—shorter duration of use, more frequent shifting, and consequent decrease in investment in particular fields (Cordell 1977; Wilcox 1978). Both propositions assume some degree of agricultural reliance reflected in site locational criteria.

In addition to being seen as the extension of agriculture due to deteriorating conditions (Cordell 1977), fieldhouses are seen as evidence for extension into new areas due to improved farming conditions (Pilles 1978). However, Utah data suggest that fieldhouses are an unlikely mechanism for colonizing newly opened niches; dispersed sedentary settlements form a more plausible and effective expansion strategy (Lipe 1970; Green and DeBloois 1978; Matheny 1971). Dispersed sedentary settlements of the "rancheria," "scattered homestead" (Jennings 1963:12), "open country house," or "ranch" (Prudden 1918:43) type constitute an efficient strategy in environments marginal for agriculture and with the characteristics of the Colorado Plateau environment (Chapter 2).
Permanence of Owl Creek Sites

Matson and Lipe (1978) hypothesized that the final episode of prehistoric occupation of Cedar Mesa was characterized by movements into the canyons with continued seasonal farming on the mesa top. Clustering of groups in canyon shelters could indicate a response to resource stress, need for secure storage, or increasing importance of canyon water sources. Arable land on the mesa top probably was used, although canyon bottom soils may have provided a larger proportion of total fields than earlier. If the late Type 4 sites in the Owl Creek study area functioned primarily as fieldhouses, this hypothesis is supported.

In any case, the proliferation of Type 4 sites after AD 1200 reflects organizational change in community patterns. Earlier land use strategies in the study area relied on sedentary settlements, while the latest use has a more transitory character. If that use is an agricultural one, in which Type 4 sites functioned as fieldhouses, reduced crop yield and/or field productivity are implicated in the organizational change.

Relative Length of Occupation

Whether Type 4 sites are interpreted as fieldhouses or simply as limited activity sites, they are the least permanent sites in Owl Creek.
Even Type 3 sites are of longer duration. Changing frequencies of site types through time reflect increasingly temporary and impermanent use of the study area. The last Type 1 site constructed in the block (Site 13) is uniquely situated in the least arable part of the study area, one of shallow soil and no previous settlement (Figure 31).

Increasing impermanence of field use is suggested by the numerous temporary sites scattered over the deep soil areas, and the lack of investment in field locations. Use of fieldhouses has been interpreted as evidence for shifting cultivation as opposed to permanent-field agriculture (Bryan 1929:444; Wilcox 1978:27), and a change from longer to shorter duration of field use. Such a change might be due to chemical or physical soil exhaustion, accelerated erosion, hydrological or rainfall changes, or other factors.

A change toward permanent field use from shifting cultivation is indicated by shorter fallow, more intensive field use, and more investment in field locations, as evidenced by water and soil control features (Woosley 1980; Vivian 1974; Wilcox 1978). No such investments were made in Owl Creek.

Repair Incidence in Ceramics

Archaeologists have suggested that items of material culture tend to have longer use-lives where they are rarer (e.g., Plog 1979:118;
Hodder 1980:153). Mending holes in ceramics, indicating repair for reuse, provide evidence of attempts to prolong the life of pottery vessels. Rarity is often related to "value" and to nonlocal manufacture.

Distributions of mending holes in Owl Creek ceramics were initially examined for their potential to inform on exchange, or at least presence of nonlocal pottery. Assuming that rarer types, perhaps due to import costs of pots or materials, should be repaired more often than more readily replaceable types. I had thus hoped to derive a relative measure of replacement costs for the ceramic types represented in the Owl Creek collections. The results of this analysis, however, provide more information on the duration of site use and the temporal changes in repair incidence than they do on exchange. Repair of ceramics is found to be a maintenance function undertaken only at Type 1-3 sites founded before AD 1200.

Pottery with drilled holes has been found in the northern Southwest for decades, but usually warrants only a brief mention at the ends of ceramics sections, often without counts of holes, or sherds with holes in them (e.g., Morris 1939; Kidder and Guernsey 1919). The Kidder and Guernsey study, for example, reports mended pots found in storage contexts, but does not provide the numbers of such examples of reuse. Kidder and Guernsey conclude that repaired pots often served functions different from their original use.

Holes drilled in vessel walls after firing are interpreted as "mending holes" where a crack was bound to allow continued use; holes
punched through walls before firing are interpreted as manufacture of a suspension device (e.g., Morris 1939:145). The typical extent of analysis of mending holes is reflected in Prudden's statement:

Many of the fragments of the red ware as well as some of the better types of the white had been drilled for purposes of repair.

(Prudden 1918:24)

In the Owl Creek collections, I considered conical holes drilled after firing (usually from the exterior) as evidence of repair, and holes pierced while the paste was malleable as part of the manufacturing process.

Assuming that repair indicates a replacement problem, i.e., it is cheaper to fix a break than to obtain or manufacture a replacement vessel, repaired pots represent more valuable items than do unrepaired pots. Alternatively, repair incidence could measure duration of site use, or a behavioral characteristic with no implications for the "value" of vessels.

Ethnographic evidence suggests that cooking pots have a higher breakage rate than pots not used in cooking (Foster 1960). If repair reflects breakage frequency, we would expect to find the highest incidence of repair in Anasazi utilitarian wares (corrugated and plain graywares). This expectation is not met in the Owl Creek ceramics. Mending holes are found most often in painted pottery, and in red and white wares. Probably a combination of cost and breakage frequency is represented.
Upham (1982:153) in an innovative analysis of nonlocal ceramics, assumed constant replacement rates at a ratio of 9:1 plain to decorated wares. The ratio of plain to decorated sherds in the Owl Creek collections is closer to 3:1, and since "plain" as well as decorated wares were likely to be nonlocal, I entertained the hypothesis of differential replacement of ceramics as opposed to a constant rate. This allows for differential repair of wares on a basis other than the plain/decorated dichotomy.

Upham (1982:157) and others have predicted the association of rare, valuable, or nonlocal ceramics with kivas (assuming kiva functions include redistribution or other exchange activity). If high repair incidence denotes more costly pottery, we might predict its association with special purpose structures like kivas. Repair incidence in Owl Creek, however, is not correlated with kiva presence at a site. Three of the five sites with the most mending holes (Table 8) lack kivas (Sites 20, 26, 35).

According to the production step measure ("value" of ceramic types as measured by ease of manufacture) (Feinman et al. 1981), the most valuable ceramics in Owl Creek are Shato black-on-white corrugated (Table 7). This type has a high repair incidence. The second most valuable are Tsegi polychromes, which have a low incidence of repair. As part of the more inclusive redware group, however, they have a high repair rate (Table 7).
Table 7. Repair Incidence and Production Step Measure of Owl Creek ceramic wares.

<table>
<thead>
<tr>
<th>Ware</th>
<th>Production Step Measure</th>
<th>Repair Incidence (Number of Drilled Holes Divided by Total Sherds in Assemblage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black-White</td>
<td>6</td>
<td>.22</td>
</tr>
<tr>
<td>Corrugated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red</td>
<td>2-4</td>
<td>.04</td>
</tr>
<tr>
<td>Black/White</td>
<td>4</td>
<td>.02</td>
</tr>
<tr>
<td>White</td>
<td>2</td>
<td>.003</td>
</tr>
<tr>
<td>Corrugated</td>
<td>3</td>
<td>.003</td>
</tr>
<tr>
<td>Gray</td>
<td>1</td>
<td>.001</td>
</tr>
</tbody>
</table>

1Feinman, Upham and Lightfoot 1981

2Repair Incidence was calculated by dividing the number of drilled holes by total sherds in the assemblage. The collections include 132 sherds with drilled holes from 32 sites (Table 8).
Table 8. Repair Incidence of Owl Creek sites with mending holes.

<table>
<thead>
<tr>
<th>Site</th>
<th>Frequency of Occurrence</th>
<th>Total Sherds</th>
<th>Repair Incidence (Number Drilled Holes/Total Sherds in Assemblage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>1</td>
<td>190</td>
<td>.005</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>1210</td>
<td>.0008</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>174</td>
<td>.006</td>
</tr>
<tr>
<td>11</td>
<td>1</td>
<td>55</td>
<td>.018</td>
</tr>
<tr>
<td>14</td>
<td>6</td>
<td>419</td>
<td>.014</td>
</tr>
<tr>
<td>17</td>
<td>4</td>
<td>493</td>
<td>.008</td>
</tr>
<tr>
<td>20</td>
<td>18</td>
<td>1636</td>
<td>.011</td>
</tr>
<tr>
<td>22</td>
<td>1</td>
<td>28</td>
<td>.036</td>
</tr>
<tr>
<td>23</td>
<td>1</td>
<td>109</td>
<td>.009</td>
</tr>
<tr>
<td>24</td>
<td>2</td>
<td>311</td>
<td>.006</td>
</tr>
<tr>
<td>25</td>
<td>3</td>
<td>97</td>
<td>.030</td>
</tr>
<tr>
<td>26</td>
<td>18</td>
<td>2074</td>
<td>.009</td>
</tr>
<tr>
<td>30</td>
<td>1</td>
<td>532</td>
<td>.002</td>
</tr>
<tr>
<td>31</td>
<td>2</td>
<td>202</td>
<td>.009</td>
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<td>32</td>
<td>3</td>
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<td>.017</td>
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<td>43</td>
<td>.023</td>
</tr>
<tr>
<td>35</td>
<td>13</td>
<td>236</td>
<td>.055</td>
</tr>
<tr>
<td>37</td>
<td>2</td>
<td>36</td>
<td>.056</td>
</tr>
</tbody>
</table>
Table 8, Continued

<table>
<thead>
<tr>
<th>Site</th>
<th>Frequency of Occurrence</th>
<th>Total Sherds</th>
<th>Repair Incidence (Number Drilled Holes/Total Sherds in Assemblage)</th>
</tr>
</thead>
<tbody>
<tr>
<td>38</td>
<td>11</td>
<td>1467</td>
<td>.007</td>
</tr>
<tr>
<td>40</td>
<td>2</td>
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<td>43</td>
<td>1</td>
<td>117</td>
<td>.008</td>
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<td>44</td>
<td>15</td>
<td>1479</td>
<td>.010</td>
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<td>46</td>
<td>4</td>
<td>107</td>
<td>.037</td>
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<td>51</td>
<td>2</td>
<td>246</td>
<td>.008</td>
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<td>52</td>
<td>2</td>
<td>358</td>
<td>.005</td>
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<tr>
<td>53</td>
<td>2</td>
<td>984</td>
<td>.002</td>
</tr>
<tr>
<td>54</td>
<td>1</td>
<td>27</td>
<td>.037</td>
</tr>
<tr>
<td>57</td>
<td>8</td>
<td>734</td>
<td>.011</td>
</tr>
<tr>
<td>60</td>
<td>1</td>
<td>42</td>
<td>.023</td>
</tr>
<tr>
<td>61</td>
<td>1</td>
<td>136</td>
<td>.007</td>
</tr>
<tr>
<td>66</td>
<td>2</td>
<td>136</td>
<td>.015</td>
</tr>
<tr>
<td>67</td>
<td>1</td>
<td>145</td>
<td>.007</td>
</tr>
<tr>
<td>Total</td>
<td>132</td>
<td>16,617</td>
<td>.008</td>
</tr>
</tbody>
</table>
Mending holes occur in all but Type 4 sites' ceramic assemblages. Sites founded in periods 5 and 6 (Pueblo sites founded before AD 1200) have the highest repair incidence. Sites founded after AD 1200 have almost no mending holes. More redware vessels were repaired than would be expected based on their frequencies in the collections. Fewer corrugated and graywares had mending holes than expected if repair were random across types. Most mended vessels were rock or sherd-tempered, which could be interpreted as evidence for the rarity or nonlocal manufacture of those wares (import of vessels or tempering materials), or more frequent breakage.

The scant references to repair in the literature suggest that mending holes are rare in Basketmaker III assemblages, but more common in later Pueblo period sites (Morris 1939:153). In Owl Creek, the large Type 1 early sites (1 and 65) have no mending holes. Repair is restricted to Owl Creek sites founded between AD 1075 and AD 1200. Repair is also restricted to settlements at the more permanent and more sedentary end of the scale of site types. No Type 4 site has more than one drilled hole, and only four Type 4 sites have one. Repair incidence is not predicted by site size, kiva presence, or activity range, but it has temporal and functional specificity. Repair appears to be an activity undertaken in sites of relatively longer duration of use.

Sites with more than ten mending holes are present in the northeast and northwest corners of the study area in the twelfth century (Figure 18). These pre-AD 1200 assemblages account for
Figure 18. Distribution of sites with highest frequencies of occurrence of mending holes. All were founded before AD 1200.
85% of all mending holes. The high repair incidence before AD 1200 could reflect the nature of Pueblo II regional interaction if the local population did not independently produce most of its own pottery, but also were not strongly enough integrated into a regional exchange network to receive regular replacements. The change to no repair in sites founded after AD 1200 is then accounted for by 1) increasingly regular and frequent replacement, 2) short duration of occupation, or 3) no participation in ceramic exchange.

The decrease in ceramic repair thus reflects either the temporary character of the post-AD 1200 occupation, or change in the exchange system. In either case, the observed change is one of discontinuing the repair activity in post-AD 1200 settlements. If ceramic repair is a maintenance activity of sedentary settlements, the change may reflect increasingly temporary use of the mesa top as demonstrated in the changing frequencies of site type. Relating this change to changes in the exchange network requires information on repair incidence in canyon sites occupied after the abandonment of the Owl Creek upland. Information on the structure and organization of the exchange networks which included Cedar Mesa awaits information on drilled holes in those collections.
Summary

Ceramic repair incidence is interpreted as reflecting relative permanence of sites. A high repair rate appears to be associated with long duration of site use. Repair incidence does not necessarily reflect sedentariness, however. It does reflect a change in maintenance activities between the sites founded before and after AD 1200. The later sites do not show ceramic repair. Most of the post-AD 1200 sites are, however, temporary sites that would not be expected to evidence many maintenance activities. Implications of these findings are explored in the community pattern interpretations of Chapter 7.
CHAPTER 7
COMMUNITY PATTERN CHANGE

Introduction

The Pueblo community pattern sequence based on previous work in the Four Corners region suggests an organizational change from contiguous settlements of several residence units (e.g. Alkali Ridge Site 13) to a pattern of spatially separated residences, to contiguous residences with summer (growing season) dispersion.

Pueblo occupation of the Owl Creek upland seems to evidence increasingly temporary use and movement of sedentary groups from the study area. In the thirteenth century there is no evidence for nucleation or increasing localization of functions (intrasite diversity). The Owl Creek record reflects change from a mobile nucleated community pattern, probably seasonal (Basketmaker II) to a sedentary nucleated (Basketmaker III - Pueblo I) pattern; this changes to the dispersed sedentary system of early Pueblo II, and finally to temporary (probably seasonal) use after AD 1200. This sequence reflects
the limited resource potential and fluctuating environment of Cedar Mesa and the mobility and organizational flexibility required for its use.

An example of organizational change in the opposite direction comes from the Red Rock Plateau east of Cedar Mesa, where sedentary/temporary site ratio shows more sedentary and fewer temporary sites in the final occupation (Lipe 1970). The interpretation of the apparent contradiction depends on the size of the study area under consideration. While both the Owl Creek upland and the Red Rock Plateau supported Pueblo II-III occupations characterized by dispersed sedentary community patterns, the Owl Creek upland continued as a component in the later Pueblo III settlement-subsistence system after its abandonment for sedentary use and the Red Rock Plateau did not. Lipe suggests that Red Rock groups migrated to the Navajo Mountain area (1970:137). This would have precluded their continued use of the plateau on a seasonal basis. An important feature of Lipe's analysis is his identification of the unit of abandonment as the family or coresidence unit and not the community (Lipe 1970:136).

Dean (1969, 1970) records evidence for movement on both scales in the Tsegi Canyon south of Cedar Mesa. The dispersed communities of southeast Utah demonstrate "decomposibility" (e.g., McGuire 1983:121) to the level of domestic groups (the minimal unit of functional redundancy). Migration, and group decision-making and corporate action associated with mobility, often were effected at that scale.
Owl Creek Community Patterns

Distributions of the four site types were mapped in temporal sets (Figures 19-26). There is no permanent surface water in the Owl Creek study area; the drainages shown on the maps are intermittent. Some are recent. The sixteen potential water sources located in the block survey include barely flowing seeps, plunge pools that retain water after washes run, and potholes holding water after rains.

Early Pueblo times (Sets 2 and 4) show fairly even numbers in all site classes, while Pueblo II times (Sets 5 and 6) contain mostly Type 1 and 3 sites. There is a dramatic difference between the pre-AD 1200 pattern (Set 7) and the post-AD 1200 newly established sites (Set 8). Fifteen of the latter are Type 4 sites, and one each of Types 1 and 3. The final distribution (Set 9) is dominated by Type 3 and 4 sites. Set 3 consists of Basketmaker III sites (Set 1) added to possible Pueblo I sites (Set 2), and is not considered in the following discussion.

Figure 13 displays the frequency of occurrence of site classes for each time set. While the modal class in all Pueblo II distributions is Type 3, the modal class of the post-AD 1200 distributions is Type 4.
Figure 19. Distribution of Basketmaker III sites with later Pueblo occupations.
Figure 20. Pattern 2. Pueblo I (AD 760-875) distribution.
Figure 21. Pattern 4. Early Pueblo II (AD 875-1075) site distribution.
Figure 22. Pattern 5. Distribution of Pueblo II sites founded as early as AD 1075.
Figure 23. Pattern 6. Distribution of Pueblo II sites founded after AD 1115.
Figure 24. Pattern 7. Distribution of all Pueblo sites AD 1075-1200.
Figure 25. Pattern 8. Distribution of Pueblo sites founded after AD 1200. Site 13 is the only Type 1 site.
Figure 26. Pattern 9. Distribution of all Pueblo sites in use after AD 1200.
Abandonment of the Owl Creek Upland

No Type 2 settlements, sites with large storage capacities, were abandoned before AD 1200. A large Type 1 site with a kiva (38) located in the northwest corner of the study area was abandoned before AD 1200. Most of the Type 3 and 4 sites on the western boundary of the study area were also abandoned before the thirteenth century. The early Type 1 sites (65 and 1) in the southwest corner of the block were abandoned, as was the site with the highest RAM score (Site 26). Most of the sites abandoned before AD 1200 are Type 3 sites.

The sites founded before AD 1200 and continuing in use into the thirteenth century include three Type 1 sites with kivas, two Type 2 sites (storage), and nineteen Type 3 sites. The Type 3 sites are located in the northeast, west central, and southern drainages of the study area.

Settlements founded after AD 1200 include only one Type 1 site, and no Type 2 sites. Site 13 is located on a previously-unoccupied ledge on the central drainage of the study area. One Type 3 site (22) was founded after AD 1200 north of Site 13, and fifteen Type 4 sites were founded south of Site 13. Most of the Type 4 sites are clustered between the southernmost drainages of the block.

Site 13 is smaller than all other sites that have kivas, which may in part reflect its shorter occupation. Granaries that are separated from the site (and apparently unprotected)
are located upstream from Site 13 under the ledge on which the site is built.

Interestingly, the last-occupied Type 1 sites in the Owl Creek block have entirely different occupational histories.

Table 9. Owl Creek sites (with Site Type) in founding and abandonment periods.

<table>
<thead>
<tr>
<th>Abandoned before AD 1200</th>
<th>Founded before 1200 and Abandoned after 1200</th>
<th>Founded after 1200</th>
</tr>
</thead>
<tbody>
<tr>
<td>38(1)</td>
<td>60(3)</td>
<td>24(1)</td>
</tr>
<tr>
<td>1(1)</td>
<td>57(3)</td>
<td>7(1)</td>
</tr>
<tr>
<td>65(1)</td>
<td>14(3)</td>
<td>44(1)</td>
</tr>
<tr>
<td>(1)</td>
<td>6(3)</td>
<td>17(2)</td>
</tr>
<tr>
<td>37(3)</td>
<td>42(3)</td>
<td>20(2)</td>
</tr>
<tr>
<td>46(3)</td>
<td>49(3)</td>
<td>23(3)</td>
</tr>
<tr>
<td>51(3)</td>
<td>50(3)</td>
<td>31(3)</td>
</tr>
<tr>
<td>67(3)</td>
<td>4(3)</td>
<td>32(3)</td>
</tr>
<tr>
<td>3(3)</td>
<td>18(3)</td>
<td>29(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>40(3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>39(3)</td>
</tr>
</tbody>
</table>
Figure 27. Distribution of sites founded before AD 1200 and continuing in use past AD 1200.
Figure 28. Frequency of occurrence of Site Types abandoned before AD 1200, founded before and abandoned after AD 1200, and founded after AD 1200.
Figure 29. Distribution of sites founded after AD 1200. Site 13 is in center of block. Most sites are Type 4.
Four Type 1 sites with kivas were occupied after AD 1200, and their internal order of abandonment was determined through seriation and the tree ring dated ceramics sequence. Site 24 in the north was abandoned first, followed by Site 7 in the south, 44 on the western border and, finally, Site 13 on the central drainage. Site 13 was founded at a time when other newly established sites represented only limited activities; Sites 24, 7, and 44 were founded earlier and are multicomponent.

Two Type 2 sites with extensive storage facilities were used into the thirteenth century. Site 17 has a honeycomb of slab cists and other storage features; Site 20 had six large corrugated jars set in the floor as well as other storage features. While these sites (which coexisted) may have served as centralized storage sites for a resource acquisition area, their proximity to each other is not explained by that hypothesis (Figure 30). Site 24 has several masonry granaries built by walling up small natural alcoves in a sandstone cliff face. A kiva is found nearby. This settlement may have served as the center of a dispersed community which included groups in the neighboring Type 3 sites with narrower activity ranges. This hypothesis may be supported by the fact that only two to four possible habitation rooms are present at Site 24.

Site 13 has two non-contiguous domestic structures, one storage area (separate), a kiva between the two habitations, and two discrete trash deposits. The other late Type 1 site (7) consists of several separate structures with a centrally located kiva and one trash
deposit. Site 44 likewise has separate structures surrounding a kiva, but has two distinct trash areas.

There is considerable variability between the last-occupied Type 1 sites. In order to estimate duration of use and the role of these sites in community patterns, it is instructive to look at Site 13. Analysis of Site 13 is easily accomplished because it is single-component and of short duration. Although Site 13 is a Type 1 site, habitation, and is interpreted as reflecting sedentary use, it is impermanent.

The temporary sites in use at the same time (relatively) as Site 13 display in part a complementary distribution: Type 3 sites are found in the northern part of the block, and Type 4 sites in the south (Figure 30). We might infer similar functions from their complementary distributions; perhaps they represent field sites, but play a different role in different community patterns. The Type 3 sites may represent small sites of the pre-AD 1200 dispersed sedentary pattern, and the Type 4 sites represent more temporary field use of the post-AD 1200 pattern.

What can be learned about the meaning of these patterns from an analysis of the agricultural potential of the mesa?
Figure 30. Distributions of all sites dating to the thirteenth century.
The use-life of a maize field on Cedar Mesa without nutrient renewal has been estimated at four years (Olsen, Wilson, Metcalf, and Hutchings 1962). If the Site 13 community used four fields represented by Type 4 Sites 11, 12, 34, and 15 (based on contemporaneity and proximity), the maximum duration of use is 4-16 years depending on whether fields were used concurrently or consecutively. Assuming some degree of agricultural reliance, the occupation of Site 13 covered four to sixteen years (allowing for fallow) between AD 1200 and AD 1250.

Abandonment of sedentary settlements on the mesa top is probably contingent on reduced crop yields and decreasing field use-life with increasingly frequent turnover in field locations (e.g., West 1978; Pilles 1978). The increasing mobility that this would have entailed probably culminated in movement out of the area.

That mesa top groups first moved into the canyons of Cedar Mesa (Figure 31) is hypothesized on both environmental and archaeological grounds. If soil loss were a problem on the mesa top, related deposition in the canyons could have improved agricultural opportunities enough to encourage movement (Schumm 1961; Olsen et al. 1962). Archaeological evidence for construction in the canyons in the AD 1260s is abundant (Matson and Lipe 1978). Because it is clear that the amount of arable alluvium in the canyons was insufficient to support late populations, mesa top fields would probably have continued in use (Agenbroad 1975; Lipe 1975).
Anasazi Mobility

Population mobility is increasingly recognized as an adaptive strategy used throughout their history by the "sedentary" Anasazi (Dean 1969:199; Powell 1983). The use of more marginal lands and increasing subsistence instability is thought to characterize the prehistoric occupation of the Colorado Plateau (F. Plog 1979:129), reflected in organizational variability in local adaptations. Environmental characteristics (Chapter 2) combined with Anasazi technology suggest that crop failure was common. Even with shifting cultivation, soil nutrients were rapidly depleted, especially in marginal areas (F. Plog 1979:129). Decline of the productive capability of the soil was inevitable (Athens 1977:372); the length of occupation of particular sites has been correlated with quality of soil and water resources (Cordell 1975). Mobility was probably more pronounced in marginal zones like Cedar Mesa than elsewhere on the plateau. Cedar Mesa history has been described:

The abandonment and reoccupation of individual drainages is a major characteristic; in virtually every drainage that has been described in detail, very short phases separated by occupational hiatuses are evident.

(F. Plog 1979:127)

Local conditions affecting Owl Creek upland settlement include the lack of ground and surface water, topography unsuited to known Anasazi water-control techniques, soils susceptible to accelerated erosion with vegetational removal (Olsen et al. 1962), long regeneration time of the pinyon-juniper woodland (West 1978), and sensiti-
vity to both physical and chemical soil depletion with disturbance of the microfloral surface crust (Kleiner and Harper 1977).

Strategies for coping with these conditions include water control technology, time-dependent redistribution, planting multiple fields in diverse situations, storage expansion (Athens 1977:374), and residential mobility. All these options were attempted in various parts of the northern Southwest (e.g. Hack 1942; Ford 1972; Jorde 1977). Owl Creek groups apparently relied on dispersion and shifting of field location, investment in storage facilities, and population mobility.

The prehistoric attempts to intensify agricultural systems in the western Anasazi area are seen as futile due to annual rainfall variation alone (F. Plog 1979:129); some researchers have speculated that without Spanish intervention, Pueblo groups would eventually have recolonized the plateau region using an extensive farming strategy like that of the Hopi (F. Plog 1979:130; Mindeleff 1891).

Although Darwin didn't write about the Anasazi, their adaptation couldn't be better described:

Having become fitted, in a manner highly useful to them, for short and frequent migrations, liability to wide dispersal would follow from this capacity as an almost necessary consequence.

(C. Darwin 1859:374)
CHAPTER 8

ORGANIZATIONAL CHANGE

Social Organization and Social Structure

Social organization and social structure are inferred from different kinds of archaeological evidence. They are subject to different kinds of verification, and are useful in different kinds of explanation. Certain problems in explaining southwestern social change can be attributed to failures to distinguish between the two concepts.

The proposition that aspects of social organization are reflected in spatial distributions of artifacts is well established in the Southwest (e.g. Martin and Plog 1973:268; Glassow 1977:213). Chang's (1958) interpretations of social groups from community patterns, although based on an outdated theoretical framework and too generalized to be locally applicable, demonstrated the utility of community pattern analysis, its relation to social organization, and in particular, the flexibility of lineage organization. Since Chang, archaeologists have found social organizational referents in both inter- and intrasite patterns. Although the specificity or organizational interpretations is debatable (e.g. Allen and Richardson 1971; Stanislawski 1973; S. Plog 1978), determinations of group size and boundaries can often be made and composition inferred (e.g. Wilcox 1975; Hayden and Cannon 1982).
General aspects of social organization are reflected in
distributional patterns; social structure is inferred from other
kinds of evidence. On the basis of archaeological usage, these
definitions have been derived: social organization is the size,
scale, and nature (including composition when obtainable) of
groups; social structure is the relationship between groups.
Therefore concepts such as lineage, clan, descent group,
sodality, and moiety describe organization; stratified, rank,
egalitarian, high-status, elite, and "tribal" (in the sense
of Braun and Plog 1982) describe structure. The "horizontal"
and "vertical" elements of structure (e.g., Dalton 1977:195)
denote nonhierarchic and hierarchic relationships respectively,
and can be interpreted as describing connections between
equal (in some sense) and unequal units. In functional terms,
these are the relationships between redundant and nonredundant
units, respectively. The distinction made here between social
organization and social structure is not the same as McGuire's
(1983:93) analytic division of cultural complexity into hetero-
geneity and inequality. Heterogeneity is a property of the arch-
aeological record from which elements of social organization can
be inferred. Inequality appears to be a higher level inference
about social structure (relationships between groups). Hetero-
geneity as variability, without the connotation of a graded or
hierarchic relationship between units, is a measurable character-
istic of artifact distributions; inequality is inferred from the
same or other observations about the nature of the relationships.
measured variously (range of variation, functional redundancy, etc.) and about which observations are argued to reflect differentiation, specialization, or other cultural properties (e.g. Plog 1974). Inequality is not amenable to the same treatment. It is based on empirical observations whose relevance to the variable of interest must be established. In addition, inequality describes a relationship between groups in the functioning cultural system, whose material consequences in the archaeological record remain to be specified. This synchronic feature renders analyses of inequality and similar concepts of graded or ranked relationships more appropriate to functional explanations than to evolutionary ones (cf. McGuire 1983).

Interpretations of Social Organization and Structure

Social structure is inferred from buildings and burials (Rathje and McGuire 1982), from differential distributions of exotic artifacts and nonlocal goods (e.g. Upham, Lightfoot, and Feinman 1981; Lightfoot and Feinman, 1982, and secondarily from inferred differential access to resources (e.g. Grebinger 1973). Two cases are instructive.

Grebinger (1973, 1978) has interpreted Chaco Canyon settlement and community patterns as social structural change from egalitarian to status-differentiated society based on access to agricultural resources. This interpretation uses the same evidence from which Vivian (1970) inferred social organizational differences:
observed variation like the bimodal distribution of site sizes, different site plans, and differential distribution of exotic artifacts (including their concentration in "towns", the large planned sites). Variation in contemporaneous settlements, interpreted by Vivian as organizational variability, appeared to Grebinger to reflect socioeconomic heterogeneity and thus a stratified society. If the referents for social organization are the same as those for social structure, neither of these hypotheses can be eliminated. Chaco Canyon is generally thought to be one of the most likely candidates in the Anasazi area for demonstrating the development of nonegalitarian structure because of the existence of a road system and other features apparently unique to Chaco. The developmental mechanism for Grebinger's elite stratum differs from that of the second case considered here, Lightfoot and Feinman 1982. The Chaco elite are thought by Grebinger to have acquired their status fortuitously: founders took the best land. Although in some ways an evolutionarily satisfying explanation, it is subject to the ambiguous inference of "differential access", identification of material referents for structural relations, and attendant equifinality problems (see Sullivan 1978:191).

In the second case, Lightfoot and Feinman (1982) tested hypotheses of differentiation and leadership development in explaining increasing sociopolitical complexity in the Mogollon region of the Southwest. Lightfoot and Feinman's data
were settlement patterns and intrasite distributions of Mogollon pithouse villages. On the basis of bimodal settlement distributions, concentration of nonresidential architecture in larger settlements, intrasite pithouse size differences, distribution of nonlocal goods, and association between evidence of agriculture and large houses, Lightfoot and Feinman found support for their thesis of the development of social differentiation and specialized decision-making. Variability in the spatial organization of pithouse villages probably does reflect social organizational variation, but its relation to the structural characteristics inferred by Lightfoot and Feinman remains ambiguous. In addition to problems in specifying the material correlates of the social structural concepts and systemic relationships used, this study is subject to the "fallacy of affirming the consequent" as well as problems of equifinality. Worse, Lightfoot and Feinman introduce causal processes such as "competition between aspiring leaders" and "political maximizing strategies." "Aspirations" are notoriously elusive in the archaeological record, as are other motivations including maximization, perhaps especially of the political sort. As Sahlins has astutely observed in another context:

The problem is that there is no necessary relation between the phenomenal form of a human social institution and the individual motivations that may be realized or satisfied therein.

(Sahlins 1976:7)

In any case, it is unlikely that we can reasonably attribute maximizing behavior to anyone (Christenson 1982; Martín 1983), and certainly such attribution has no role in an evolutionary explanation.
of change (e.g. Coombs 1980). The result is a plausible functional account, with no empirical means of weighing it against other plausible (and ideally more parsimonious) explanations. In spite of Lightfoot and Feinman's plea for evaluation of their "alternatives" along with more traditional hypotheses, their study suggests no compelling reasons for applying vitalistic causation to the explanation of prehistoric change, sociopolitical or otherwise. Even if one allows the reasonableness of their many assumptions, propositions, and hypotheses derived from them, the material associations employed do not necessarily follow. For example, the expected correlation between house size and high status, leadership role, or wealth is ethnocentric as well as empirically false (e.g. Wilk 1983). Although the assumed relationships between material remains and social structure are drawn from ethnography and our own history, recent ethnoarchaeological studies expand the range of variability in possible relationships and thus emphasize the unreliability of common assumptions about material referents. For example, Wilk (1983) found in a Mayan context that relative wealth was not reflected in either the quantity or quality of goods owned, and that social differentiation and ranking were not apparent in material possessions (Wilk 1983:108). House size did not show wealth but total number of kin that could be assembled to build it: organizational information of the sort I have suggested is most readily accessible to archaeologists.
Other common assumptions questioned by recent ethno-archaeological findings include the correlations between size of domestic structure and size of household (e.g., Lightfoot and Feinman 1982:71), individual wealth and luxury items (Hayden and Cannon 1982:138), the size of a structure and its permanence (Wilk 1983), and the size of a structure and household wealth (Hayden and Cannon 1982:139). The assumption that sociopolitical leaders were also most active in long-distance exchange, and the consequences of this assumption for the expected distributions of nonlocal goods, are unwarranted on the basis of ethnographic and historical records.

Exchange in Social Structure Interpretation

Recognition of the existence of large-scale exchange networks in the prehistoric Southwest has led to reconstructions of social structural change such as "incipient urbanization" (Martin and Plog 1973:269). Southwest social structure has been described as stratified pristine ranked society (Grebinger 1973), religious bureaucracy and high-ranking priesthood (Eddy 1966:378), elite-controlled (Cordell and Plog 1979), and as a managerial elite residing at developing central places with control of exchange (Upham, Lightfoot, and Feinman 1981).
That regional exchange is interpreted as prima facie evidence for social structural change is a typological error with severe consequences for understanding the evolution of complex societies. If it is considered that evidence for localized centers of ceramic production with widespread distribution of pottery is sufficient demonstration of elite-managed and controlled exchange, we forego evaluation of alternative models of increasing specialization and differentiation. Also obscured is the change from social organization of redundant (probably kin-based) groups to non-redundant groups (homogeneous to heterogeneous composition in the sense of McGuire 1983). In addition, spurious causal links between elements of increasing complexity are established—e.g. interregional exchange networks determine the degree of organizational complexity (Lightfoot and Feinman 1982:81). The relations between exchange, its scale and character, specialization, and social structure, remain to be demonstrated (e.g. Plog 1977:139). Our uncertainty about these relationships and their material correlates allows contradictory inferences from the same distributions. For example, Braun and Plog's (1982) model of exchange generates identical distributional expectations for opposite social organizational changes. A decrease in the frequency of valuable goods exchange could indicate either increasing social isolation, or conversely, decreasing social distance (Braun and Plog 1982:517). There is no apparent means of choosing between these alternatives except investigator preference. In addition, it has been shown that changes in the content of exchange networks over time
may reflect changes other than those proposed in regional sociability (Saitta 1983; Graves et al. 1982).

The interpretive leap required to infer managerial hierarchical structure from nonlocal exchange is analogous to the discovery in the Southwest of differential distributions of ceramic design elements (e.g., Longacre 1970) which was interpreted as evidence for matrilineal residence and descent rules. The equifinality error is similar in the case of inferring nonegalitarian social structure from exchange. Differential ceramic distributions do not necessarily and invariably reflect residence and descent (Allen and Richardson 1971). They may reflect a variety of other things such as strength and coherence of corporate groups (Hayden and Cannon 1982:148). They may even reflect nothing about social interaction (Plog 1980). Similarly, widespread trade in ceramics does not imply status-based or elite-controlled systems (Braun and Plog 1982; Graves et al. 1982). In fact, the opposite relationship probably obtains. Widespread exchange is unlikely to reflect increasing social integration (e.g., Sahlins 1968:95).

The interpretation of kivas, particularly Great Kivas, as redistribution centers has a long history (e.g., Plog 1974; Lightfoot 1979; Upham 1982), but the relationship remains speculative. When the inferred redistributive function is used as evidence for the existence of a managerial "big man," the tautological potential of functional explanation is fully realized. Even if a correlation between food storage, sharing, and kivas were demonstrated, the
nature of that activity and its structural consequences remain unspecified.

Archaeological Potential for Social Organization and Social Structure Interpretation

That we can identify units of minimal functional redundancy (i.e., socioeconomic groups [Rohn 1965] and coresidence groups [Lipe 1970]) facilitates interpretation of social organization from the archaeological record. Thus the importance of analysis at the scale of household (Ciolek-Torrello and Reid 1974; Flannery and Winter 1976; Rathje and McGuire 1982; but see Hayden and Cannon 1982). On the contrary, social structure has no unambiguous referents in the archaeological record for several reasons: 1) its analysis requires establishment of relationships and not just units or variables; 2) relationships between elements of social structure are not unambiguous in living societies; and 3) structural units are analytic categories of social scientists and not isomorphic with corporate groups at any scale (Partridge 1983:408; Sahlin 1968), and thus have unspecified or widely varying material correlates. Such social concepts, even if well-defined, generate no specific expectations for the archaeological record.

Until material consequences of social structure are specified, social structural interpretations of the archaeological record are insecure and plausible at best. These inductive inferences depend on
the strength of their arguments of association and relevance (Sulli-
ván 1978:185). At the present stage of analysis, graded, ranked, stratified, or non-equalitarian societies are distinguished from non-hierarchical, "tribal," nonstratified, or "egalitarian" ones on the basis of differential artifact distributions and subsequent inferences of wealth, status, access, leadership, management, elite control. Such distributions may well reflect generative processes other than hierarchical structural relationships. They may even reflect entirely non-cultural properties of the data. For example, the observation that smaller sites have less intrasettlement variation than large sites, and fewer or no rare artifacts (Lightfoot and Feinman 1982:81), meets our statistical expectations based on assemblage size alone, and may imply nothing cultural at all. The same distributions can be accounted for by formation processes (Schiffer 1983:694-696) or sampling design.

Explaining Organizational Change

Interpretations of social organization and social structure have played an important role in explaining change, particularly aggregation and abandonment, in the Southwest. Organizational flexibility is an important feature of Pueblo societies, whose history is de-
scribed as
recurrant, cyclic responses to local social and natural environmental conditions by a mobile population of autonomous ceremonial-domestic groups.

(Reid and Shimada 1982:16)

Flexibility of (segmentary) lineage organization and descent groups among small-scale agriculturalists has been widely investigated (e.g., Steward 1955; Service 1962; Sahlins 1968; P. Plog 1978). The prominent feature of this kind of organization is its potential for rapid change in group size (Sahlins 1961; Kottack 1982:128), important where mobility is maintained. It is an opportunistic organization that responds readily to fluctuating conditions. The dispersive and aggregative processes characterizing Anasazi occupation of the Colorado Plateau are compatible with this kind of organizational flexibility. The classes of aggregation explanations—response to resource stress (e.g., Dean 1970:169; Zubrow 1975; Reid 1978), increased productivity of favorable locales (e.g., Rice 1975; Dean and Robinson 1982:59), increased sedentariness (Plog 1979), population growth (Glassow 1977), defense (e.g., Mindeleff 1891; Martin and Plog 1973:268), increased size of production group and labor requirements (Cloleq-Torrello and Reid 1974), and centripetal force (Kidder 1924:341)—are all cases of organizational flexibility. These explanations can be combined in a diachronic view of adaptive responses to social and environmental variations, as suggested by Reid and Shimada (1982:16). Organizational changes need not be seen as slavish responses to climatic change (cf. Shoewetter and Dittert 1968), but as opportunistic advantage-taking of the
expansion and contraction of local niches in a fine-grained environment with respect agricultural conditions.

The social organization of aggregated communities is expected to differ from that of dispersed communities in predictable ways (F. Plog 1978: Cordell and Plog 1979:422-423). Specifically, descent groups display more flexible membership when relationships to particular plots of land are less permanent. This effect may be operating in episodes of aggregation like that resulting in the settlement of Kiet Siel in the Kayenta area (Dean 1969, 1970).

Evidence for mobility at the level of the household, domestic group, or smallest socioeconomic unit is inferred from the scale of abandonment at Kiet Siel (Dean 1970:159), the Red Rock Plateau (Lipe 1970), and from architectural units in Kayenta sites (Plog 1979:120). Such changes in group size (as reflected in dispersion and aggregation episodes) and reduction to minimal socioeconomic units are accommodated within a flexible kin-based (descent) organization, and do not entail changes in social structure.

Organizational flexibility persists because of the selective pressures of the Colorado Plateau environment (lack of surface water, rainfall unpredictability, dependence on runoff), and Anasazi technology (e.g. no means of pumping groundwater). A less flexible organization or a hierarchical structure with nonredundant functional components (more differentiated, specialized, and thus interdependent) would not persist under the same conditions. In fact, in the cases in which systemic collapse is attributed to "hyper-coherence"
or over-interdependence (Upham 1982; Graves et al. 1982) we may be seeing examples of just such structural failure. Upham attributes the collapse of a Little Colorado system to management failure in a hierarchical society; Graves sees a similar collapse as due to a lack of structural change in a nonhierarchical Mogollon system. In both cases collapse was preceded by the increased aggregation of communities, and inferred interdependence. Upham's model is one of formal alliances based on centralized trade networks. Graves' network is interpreted as a loosely integrated, nonhierarchically structured exchange system. Since it is not clear how centralization could develop within constraints like those of the Colorado Plateau environment (e.g. Befu and Plotnikov 1962; Sahlins 1968), the evolution of the Little Colorado system is of great interest. We would expect to find evidence of less mobility and less fluctuation in group size before the development of the large fourteenth century centers like Nuvoquotaka (Chavez Pass Ruin) than obtains elsewhere on the plateau.

If Anasazi social organization is seen as an adaptation to environmental unpredictability, rigid interlocking structures, which lack the capacity for rapid dissolution into redundant constituent elements, would be at a disadvantage (e.g. Braun and Plog 1982:505-506). Given the Colorado Plateau environment, populations with fixed parameters are uncompetitive relative to groups that can change quickly. The social structure permitting such rapid change in group size is "tribal" and nonhierarchical (Braun and Plog 1982:504). Functional
redundancy is maintained at the scale of household or domestic group to facilitate movement. Tribal social networks then have the effect of defining the fission and fusion lines for dispersion and aggregation (Braun and Plog 1982:507). Inequality (McGuire 1983) is unlikely to develop in these circumstances (e.g. Sahlin 1968:76).

In Mesoamerica, different pressures selected for differentiation and specialization at community, corporate group, and perhaps even household levels (Flannery and Winter 1976; Rathje and McGuire 1982) and attendant higher levels of integration. Organizational changes of dispersion and aggregation, however, do not imply or necessitate structural changes (Fuller 1981; Graves et al. 1982:117; Jennings 1966). While larger scale organization, such as might be inferred for large aggregated settlements, may precede structural change (e.g., Naroll 1956), it does not necessarily result in it (e.g., Graves et al. 1982). In the Anasazi region, selective factors favored small redundant groups with flexible organization.

Social organization, as determined by the scale of functional redundancy and group boundaries, is readily accessible archaeologically. Social structure, relationships between groups inferred from distributions, is less accessible. We can almost distinguish "tribal" egalitarian societies from nonegalitarian hierarchical ones. But even if we could accomplish this gross typological distinction, it would contribute little to our understanding of social change. A more productive approach, one recognizing the potential for variability in the past unknown in ethnographic examples, requires analy-
sis of individual variables (e.g., community patterns), relations between them, and their changing frequencies in local sequences; i.e., treating the archaeological record as one composed of continuous variables (e.g., Plog and Upham 1983:200).

The Owl Creek sequence illustrates these propositions. Anasazi groups occupied the Owl Creek upland intermittently from about AD 200 to AD 1300. During this time community patterns changed from nucleated to dispersed forms, and use of settlements from sedentary to temporary (Chapter 6). These patterns reflect organizational changes in the size of residence groups and duration of use of sites and, perhaps, fields. The Owl Creek record does not display evidence for the structural changes inferred for many other areas of the northern Southwest (e.g., Martin and Plog 1973; Grebinger 1973; Lightfoot and Feinman 1982; Upham 1982). There is no evidence for subsistence intensification, formal exchange, or population aggregation. Models of increasing social complexity applied in the Southwest (e.g., McGregor 1965; Longacre 1970; Martin and Plog 1973; Plog 1974; Glassow 1977; Upham 1982; McGuire 1983) are inapplicable to Owl Creek. Although some recent analysts recognize greater variability than allowed by unilinear models of development, and assert that political change fluctuates through time (Lightfoot and Feinman 1982:79) (and presumably varies in space), the assumed causal relationships between elements of changing complexity render the schemes directional.
If southeastern Utah prehistory is to be understood as anything more than the poor relation or laggard version of developments taking place elsewhere in the northern Southwest, a new explanatory framework is required. Apart from the poor empirical fit of the Owl Creek sequence to extant explanatory models, a fundamental theoretical problem inhibits explanation. A different view of the nature of change is required to explain the prehistory of Owl Creek and other marginal or peripheral areas whose history does not mirror directly and cannot even be loosely correlated with other Anasazi sequences. In addition, many of the assumed relationships between elements of social change require rethinking—e.g. the correlation of increased population and increased complexity (when complexity means changes in structure, as in McGuire 1983).

There is no evidence for social structural change in the Owl Creek study area, or in other parts of southern Utah (e.g. Lipe 1967, 1970). There is evidence for great organizational variability and rapid organizational change. This record is amenable to explanation with a selectionist view of change.

Corporate groups larger than households do not persist under conditions of temporary field use like those inferred for Owl Creek. Mobility at the scale of household or minimal unit of functional redundancy, is adaptive in this unstable and unpredictable environment. The nature and distribution of resources, i.e. low diversity and low productivity, dictates a household level or domestic mode of production (Sahlins 1968). Stratification, consisting by definition
of non-redundant units, could not become fixed in populations under these circumstances, unless the society were very small scale—a condition not usually associated with stratification for other reasons—and empirically is usually associated with corporate groups at a larger scale than households (e.g., Hayden and Cannon 1982). Such groups have no selective advantage in dispersed communities (Befu and Plotnikov 1962:323; Sahlins 1968).

Resource control functions of corporate groups become more important when resources include permanent fields, as in modern Pueblo societies (e.g., F. Plog 1978; Smith 1983). The amount of investment in land is reflected in access rights: the more investment, the more restricted the control (e.g., Wilk and Rathje 1982:627). Since no field investment is evidenced in Owl Creek (Chapter 6), and since land use becomes increasingly temporary, structural changes associated with property (e.g., Martin and Plog 1973:267; Sahlins 1968) did not occur. This suggests that differential access to resources, accumulation of wealth, and other elements of inequality (in the sense of McGuire 1983) have little chance of becoming fixed (e.g., Matson 1983).

Although the Owl Creek community pattern is dispersed in the Pueblo periods, it does not approximate the "fissioning" model applied elsewhere to explain dispersion dynamics (Lightfoot 1978). This mother-daughter model does not account for the sequence of abandonment of the Owl Creek upland, where the last abandoned
settlement was also the last founded, and no more permanent than others of the same period (after AD 1200).

Storage facilities in the Owl Creek study area provide no evidence for restricted access to stored goods, or individual accumulation of resources. We would not expect to find such accumulation with household level production and segmentary lineage organization (though these are not necessary correlates). Corn cobs left in the isolated granaries of Cedar Mesa canyons are simply by-products of the abandonment of particular locales or fields, and not evidence of surplus production (of either individual or group ownership). Such remains would be interpreted as the de facto refuse of abandonment if the stored maize in isolated structures were planting corn, as suggested by Glassow (1977:210) for another Anasazi area. Such a feature would mark the final planting of a specific field, and thus inform on group mobility, not social structure.

While Owl Creek inhabitants participated in regional exchange systems (Chapter 3), these are tribal social networks in the sense of Braun and Plog (1982), probably of a balanced exchange sort (e.g., Kottak 1982), and do not approximate the world system model used by Upham (1982) to described fourteenth-century exchange in the Little Colorado area. Southeast Utah trade more closely resembles the "horizontal" reciprocal system inferred for fourteenth century communities south of the Mogollon Rim (Graves et al. 1982; Graves 1983).

There is no evidence for redistribution such as Great Kivas, storage facilities associated with kivas, or concentrations of non-
local goods. There is also no evidence in Owl Creek for differential access to nonlocal ceramics; their distributional variation is temporal, and cannot be attributed to contemporaneous structural difference.

Apparently, low-level functional homogeneity and domestic mode of production were selected for in the Owl Creek uplands; strong pressures favoring small redundant groups with organizational flexibility and mobility precluded the development of differentiation, specialization, economic inequality, and other characters of structural change and increasing "complexity."

What can be learned from a local sequence like the Owl Creek record? There are contrasting views about the value of local or regional perspectives in the explanation of change. To some archaeologists the organizational diversity of the northern Southwest appears so great that the explanation of local adaptations is seen as the most productive goal (e.g., Cordell and Plog 1979:406). To others, explanation of change through analysis of local factors is a "crucial mistake" (Lightfoot and Feinman 1982:81). The latter is only true to the extent that a unilinear model of developmental change is espoused. Since such a model is constructed of empirical generalizations loaded on a transformational framework, it is an inappropriate vehicle for conveying a scientific explanation of change (see Dunnell 1980). It is the selectionist evolutionary analysis of local histories that offers the greatest potential for scientific explanation of social organizational and social structural change and persistence.
CHAPTER 9
THE EVOLUTION OF SOCIAL COMPLEXITY

Introduction

The recent emphasis on explaining cultural change has required archaeologists to identify the material correlates of social organization and social structure. Although a variety of evolutionary explanations of increasing social complexity have been proposed, the traces of social organization and structure in the archaeological record remain ambiguous, and vary with the explanation.

While it is considered important for some purposes to be able to rank cultural systems on a scale of simple to complex, we lack the theory to link our ideas about social change to the archaeological record. Three critical aspects of the necessary explanatory system are the focus of this chapter:

1. Identification of material correlates, i.e. standardization required for comparison, and creation of analytic units useful in interpreting organization and structure.

2. The framework of evolutionary explanation, i.e. appropriateness of a transformational or selectionist view of change to archaeological data;

3. The nature of organizational change, and the utility and necess-
sity of common assumptions in an archaeological view of the development of complex societies.

In my consideration of these issues, I first outline a theoretical approach that has specific consequences in the archaeological record, one that enables us not only to compare societies in terms of complexity, but also to explain organizational change and stasis within systems. The results of applying this approach to the analysis of Anasazi organizational change, as inferred from community patterns, are summarized here in illustration of the theoretical argument.

**Differentiation and Redundancy**

It has been recognized for at least a decade (e.g., Plog 1974) that differentiation is a primary component in the development of social complexity. Differentiation is recognized in the archaeological record as functional specialization, diversity, and nonredundancy of elements. The difference between simple and complex societies can be viewed as the distinction between systems composed of functionally redundant individuals and groups, or one composed of functionally nonredundant individuals and groups. The latter are differentiated.

By functional redundancy I mean interchangeability; i.e., redundant individuals or groups are assumed able to perform the same tasks. Individuals have knowledge of, and can carry out, the same range of behaviors. The interchangeability criterion can also be
applied to institutions; for example, theocracies are efficient in that they eliminate redundancies of political and religious institutions while consolidating control of labor and power.

It follows that simple and complex societies can be distinguished by the size of group required to replicate the cultural system. An individual or small group meets the case in a simple society; a large group is required in a complex one. This is a measure of relative functional differentiation. I suggest that among the northern Anasazi a domestic group, or even an individual, could control the information necessary for survival because the system was not functionally differentiated. Small groups could easily "bud off" and survive. When the quantity of information necessary for survival is so large that it cannot be passed on by an individual or domestic group, functional differentiation arises (Dunnell and Wenke 1979). In a differentiated system, which is characterized by non-overlapping groups of producers and consumers, hierarchies based on information-access develop, and there are large numbers of functionally dependent individuals. The development of writing, and of computers, are examples of such grounds for differentiation. On the contrary, I see no opportunities in Anasazi technology for the development of hierarchies based on access to knowledge (contra Upham 1982).
In a high-mobility system that is continually fragmenting and fissioning, functional redundancy is selected for at the scale of the fissioning groups. Among the northern Anasazi, migration was often effected at the level of the household (e.g., Lipe 1967, 1970; Dean 1969, 1970). The constant dispersion and aggregation of small groups insures that redundancy is maintained at that scale, i.e., individuals or small groups replicate the behaviors necessary for survival.

Functional differentiation is not adaptive in these circumstances, and will be eliminated (to the extent that functional differentiation affects Darwinian fitness). Functional dependence thus does not develop (or persist). The explanations of system collapse based on “over-interdependence” (e.g., Graves et al. 1982; Upham 1982) are demonstrations of this point.

Mobility and Social Complexity

Anasazi mobility played such an important adaptive role that few stable groups developed at larger scales than the household. Aggregation episodes resulted in cooperating groups of varying size and composition on different occasions (Dean 1969). In this context there is little potential for the development of stable leadership, or other than transitory authority (Lamphere 1970:43). There is little opportunity for leadership more permanent than that of tem-
porary task groups. Labor control cannot develop if producers can move away at will. There is no means by which permanent decision-making offices or roles could become fixed.

If the success of hierarchical institutions is measured by population concentration (Sahlins 1972:131), the northern Anasazi fail the test. Aggregated settlements are unstable and short-lived in the prehistoric northern Southwest. Large sites represent temporary amalgamations of groups that did not become integrated or unified organizations (e.g., Graves et al. 1982; Upham 1982).

If the Hohokam of the Arizona desert developed greater social complexity (see Doyel and Plog 1980; Doyel 1981; Martin and Plog 1973) than did Colorado Plateau cultures, mobility may have been a critical factor. Without a highly mobile population, the pressures favoring low-level redundancy would not apply, and more functional differentiation could develop.

The Nature of Organizational Change

The distinction between corporate residence groups and institutions is an important component in recent analyses of the development of cultural complexity (e.g., McGuire 1983:124-125). By treating kivas (inferred ceremonial function) as institutions, McGuire assumes that the nature of social change is one of corporate group to institutional organization. This is a common assumption that has consequences for our understanding of social complexity.
It is unnecessarily restrictive to view all social change as change from residence or kin-based corporate groups to institution-based structures (as in Western industrial society). There is a qualitative difference between an organization of small behavioral units (decision-making and action-taking groups) and a functionally differentiated society organized along institutional lines. The difference is not simply one of size of the population or its constituent groups.

Entertaining the possibility of other kinds of organizational change, the kind of variation to look for is in the size and nature of residence or corporate groups, their boundaries, and levels of autonomy. I use "autonomy" not in the sense of isolation or total independence (cf. Plog 1980), but functional redundancy. What community pattern change (e.g., dispersed to nucleated patterns) reflects of organizational change is, for example, the varying scale of group boundaries. In the Anasazi case, the fluctuation of group boundaries is interpretable in terms of Colorado Plateau environmental characteristics, revealing the adaptive component of organizational change. The view that change in corporate group organization takes the form of institution-based structures ignores a wide range of organizational variability, and limits our understanding of social change to one kind of transformation.
While Sahlins (1972:80) views technological change as a shift from human mastery of tools to tool mastery of humans, the more evolutionarily important feature of technological change is the changing percentage of a population composed of tool users and makers. This is the record of increasing specialization, functional differentiation, and consequent interdependence of societies. Our past reflects the change from functional redundancy of individuals and groups, to nonredundancy. Our history also reflects an increase in the scale of functional redundancy, i.e., it takes an increasingly large group to replicate the range of behaviors necessary for survival of the society.

Consideration of the percentage of tool users and makers in a population is related to questions of the control of the means of production. Significant control, that is, economic power, could not become important until the majority of a population is not made up of tool users and makers. The majority acts as consumers only, i.e., functional dependents. Such a situation implies a functionally differentiated society with a majority of individuals who cannot replicate the system. This condition, often considered pathological, has been termed "hypercoherence" (Flannery 1972).
Specialization

The inferred existence of part-time craft specialists in the prehistoric northern Southwest (e.g., turquoise or shell workers) does not indicate significant nonredundancy in the system. Anasazi turquoise carvers could no doubt farm if necessary for survival, and Anasazi farmers could apparently survive without carving turquoise. An individual's survival potential, or Darwinian fitness, was not affected by the ability to carve turquoise. While carving could have been an alternative way of maximizing fitness, we have inadequate demonstration of standardization or specialization in the archaeological record of the Anasazi to find it developmentally significant.

There is no evidence in Anasazi populations for a large body of consumers who were not also producers. No control of others' labor is possible on a large scale until there is a significant differential in the producer to consumer ratio, i.e., until there is a high functional nonredundancy (differentiation) in the population. Until that point, when redundancy is high and domestic groups can survive on their own production (e.g., Sahlins 1972), they can move, rather than become dependent, when production is low. Such groups carry with them a range of behaviors adequate to ensure their survival by replicating known resource acquisition techniques. In such a redundant system, everyone is (structurally) equally fit. I would, however, expect to find groups on the margins of such populations
with a wider range of behavioral variability, more "experimentation," and consequent divergence from a "central tendency".

In a population where most domestic groups are unable to move and survive on their own production, but instead rely on relationships with other producers, not only has the mode of production changed, but the scale at which significant selection operates has shifted (Dunnell and Wenke 1979). This occurs as a consequence of functional differentiation and resulting interdependence of the population.

Power

How does power (control of resources, means of production, or other measure) become concentrated in a minority of a society's individuals or groups? The answer lies in the changing ratio of functional redundancy to nonredundancy, and the degree of overlap between producers and consumers (cf. Sahlins 1972:82). If control stems from access to knowledge, it depends on the system holding more significant information (that information necessary for system replication) than can be controlled by an individual or small group.

Knowledge

Upham (1982) has suggested that power in Pueblo society was based on control of "esoteric knowledge" of primarily religious nature.
The survival value that such knowledge might confer on its holders and deny others (a basis for coercion), and the circumstances in which such behavior as a basis for control might become fixed in the population, are difficult to imagine. Crop yields presumably do not respond to incantations (cf. Dozier 1970:133). It is doubtful that Pueblo society was ever sufficiently differentiated, or had a sufficiently high ratio of consumers to producers to make the possession of esoteric knowledge evolutionarily important. If differential access to knowledge carries economic implications with consequences for survival, it is clear how power could develop from control of knowledge.

Labor

Equally important in the development of social complexity is the control of others' labor. The difference between cooperative labor and co-opted labor is a critical feature in distinguishing nonhierarchical from hierarchically structured societies. How can this distinction be made archaeologically? The importance of labor control in the development of complex societies has been recognized by cultural evolutionists, in whose trait lists "monumental architecture" figures prominently. More recent analysts of cultural complexity have also considered large-scale constructions as important information sources (e.g., McGuire 1983:110-114).
In an archaeological analysis of labor, some of the theoretical questions that might be asked about structures include: 1) Could an individual or small group build it?, 2) How many people are required to build it?, 3) How much time is represented?, 4) How could workers be supported? (i.e., Is a large population of non-producing consumers implied?), and 5) Who benefits? Benefit is viewed in a materialist sense so that referents in the archaeological record can be identified.

In the American Southwest, kivas have been interpreted variously as evidence for social integration, hierarchical social structure, the presence of "institutions," existence of a central authority, social complexity, among others. Such interpretations are warranted on the basis of labor requirements. Kivas cannot be construed as reflecting controlled labor if the workers all benefit (by inference). Further, an individual or small group could certainly build a kiva while supporting itself. When the same questions are asked about Great Kivas, different answers are obtained, and different interpretations of complexity are derived.

In its implications for social complexity, a Great Kiva is more similar to a Mississippian mound than to a small kiva. A Mississippian mound may provide evidence of labor control, because it can be argued that 1) a large labor force is required in construction, 2) a minority of the population benefits from the labor of others, and 3) an individual or domestic group could probably not build it and support themselves at the same time. This line of reasoning applies
to pyramids as well. If such labor control is evidenced, a hierarchically structured society can be inferred. The hierarchy is based on nonredundancy of elements in the population, and unequal control.

On the contrary, the fact that a large structure like the Big House at Casa Grande, Arizona reflects a single building episode, requires a large number of workers, and evidences long distance materials procurement, does not imply the existence of a hierarchically structured society with centralized authority. Cooperative labor could as easily be represented.

Irrigation

The presence of irrigation systems has been cited as evidence for hierarchical structure, centralized authority, and social complexity. Counter-arguments have noted that many irrigation systems have no such entailments. The issue is easily resolved by asking the labor requirements questions listed above about each case; the answer is that some irrigation projects reflect social complexity and others do not, depending on scale and technology.

Northern Anasazi irrigation features are generally small scale, benefited their architects directly (i.e., were built by producers, who were also consumers), and could have been constructed and maintained by an individual or small group. Rio Grande pueblos irrigation, on the other hand, has been interpreted (Dozier 1970) as causing a change from kin-based to non-kin group organization (pre-
sumably through different labor requirements). Non-kin organization would then permit the development of centralized authority (Dozier 1970:150). An analysis of labor requirements, scale, and technology is required to test this proposition.

It is clear that in many societies, including western North America in 1984, some irrigation systems are associated with institutions that represent centralized authority, and others are not. The theoretical questions about labor given above provide a starting point for differentiating the two, and inferring social complexity from "public works."

**Evolutionary Explanation of Organizational Change**

In explaining organizational change in general, and the development of social complexity in particular, it is more productive to examine the range of variation, possible selective pressures, and persistence and loss of behaviors rather than attempting to distinguish dependent and independent variables and arrange them in a causal chain. More insight into processes of change is gained by "breaking down" the system into variables whose changing frequencies can be monitored archaeologically (e.g., McGuire 1983). Variables with such distributions in the archaeological record include: changes in group size, community patterns and settlement patterns; the scale of functional redundancy, and production and consumption units;
subsistence and burial practices; nonlocal goods; and labor investment in structures and locations.

A selectionist view of change, rather than a transformational one, is necessary to the evolutionary explanation of change. This perspective requires analysis of changing frequencies of individual variables through time; their setness at any point in time is not assumed, but observed in the archaeological record. Therefore, evolutionary explanations will be more complex than those incorporating a transformational view of change; they will also be less facile and more productive. Consider this cultural evolutionary explanation:

Southwestern cultures reached the threshold of cultural complexity, but stalled there because their physical environment lacked the agricultural or economic productivity to support further development, given the available technology.

(Wenke 1980:686-687)

This is a simple and negative explanation suggesting failure on some cultural evolutionary scale. A more informative approach is the analysis of organizational change and variability, rather than assuming that some structural change is desirable and should occur. It is surely of great interest how and why organizational flexibility persisted among the Anasazi, precluding structural change. The primary components of such an analysis, as illustrated in Owl Creek, are population distributions, mobility, and ecological factors.
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Witkamp, M.  

Wolman, M. G. and J. P. Miller  

Womack, W. R. and S. A. Schumm  
Wood, J. J.

Wood, J. J. and R. G. Matson

Wood, J. S.

Woodbury, R. B.


Woosley, A. I.

Wright, H. E., A. M. Bent, B. S. Hansen, and J. Maher

Wyckoff, D. C.

Wylie, H. G.

Yarnell, R. A.

Yellen, J.

Yellen, J. E. and H. Harpending
Zubrow, E. B.

Zubrow, E. B.

APPENDIX A

Composite Ceramic Profiles of Owl Creek Sites
Composite Ceramic Profiles of Owl Creek Sites

Composite profiles of Owl Creek sites were derived by 1.) plotting the tree-ring ranges of types represented at each site, 2.) identifying the areas of overlap in the ranges for each site, and 3.) charting the overlapping temporal ranges as the occupation spans of each site. The profiles are conservative in reflecting not the total temporal ranges of ceramic types present, but the area of overlap in the ranges of all types present on a site. These smaller ranges are assumed to represent a setness that is interpreted as the probable occupation spans of the sites.

A fifty-year break between occupation spans is considered sufficient demonstration of a break in occupation, and such a profile was recorded as multi-component.

Contemporaneous sets of sites were established (Chapter 3) by grouping together those sites whose occupation spans co-occur. The sets are not composed of sites whose total occupational histories are similar, but those that have ceramics indicating occupation in the same time ranges.

Site profiles can be compared on the basis of number of components, and total duration of site use. For example, Site 7 has a long duration of use (AD 950-1300), but a continuous record of occupation. Site 8 has an early component (pre-AD 875), an eleventh century occupation, and a post-AD 1200 deposit, each separated by discontinuities.
The profiles taken as a whole reflect a major discontinuity between AD 900 and AD 1075, the early Pueblo hiatus hypothesized by Matson and Lipe (1978).

Similarities and differences in site profiles are apparent. For example, Sites 41 and 45 share an unusual (for Owl Creek) pattern: they were first occupied in the tenth century, and show continuous use past AD 1200.

The AD 1200 line is useful in providing a temporal boundary for many tree ring-dated ceramic types (see Breternitz 1966), allowing the sites abandoned before or established after that date to be distinguished. Of course the boundary is not so abrupt as the specific year designator would suggest. This general line, however, serves as a marker for the community pattern changes identified in Owl Creek (Chapters 6 and 7).
Owl Creek Sites  Composite Ceramic Profiles

year A.D.  1 Site Number 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16  17  18  19  20

1  575
2  600
3  625
4  650
5  675
6  700
7  725
8  750
9  775
10  800
11  825
12  850
13  875
14  900
15  925
16  950
17  975
18  1000
19  1025
20  1050

1  Based on tree ring-dated ceramic types (Breternitz 1966)
2  Bar shows occupations ending before A.D. 1200, and new sites established after A.D. 1200
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1. Based on tree ring-dated ceramic types (Breternitz 1966)
2. Bar shows occupations ending before A.D. 1200, and new sites established after A.D. 1200
Owl Creek Sites Composite Ceramic Profiles

Based on tree ring-dated ceramic types (Breternitz 1966)

Bar shows occupations ending before A.D. 1200, and new sites established after A.D. 1200
Owl Creek Sites Composite Ceramic Profiles

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1 Based on tree ring-dated ceramic types (Breternitz 1966)

2 Bar shows occupations ending before A.D. 1200, and new sites established after A.D. 1200
APPENDIX B

Occupation Histories of Owl Creek Sites
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1 Multiple = at least 50 years between occupations. Most multiple component sites have two occupations; one ending by AD 875, and one after AD 1075.

2 Long duration indicates a maximal occupation span over 225 years.

Long and short duration apply to single component sites only.
APPENDIX C

Owl Creek Site Data
Owl Creek Site Data

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¹ Area of artifact scatter. Dispersion has resulted from downslope movement added to original noncompact character of sites.
APPENDIX D

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1 Other includes Black on White-Corrugated, Incised, and unidentified.
VITA

Charlotte Louise Benson was born in Plentywood, Montana to Jean L. Porter and Robert O. Benson. She was graduated Magna cum laude from the University of Washington in 1972, and received a Masters degree from the same institution in 1975.